CCEH Hydro VI LLC

Project on the Construction and Operation of 10.9 MW Run-of-River Power Plant "Bakhvi 1 HPP" on Bakhvitskali River

Environmental Impact Assessment Report

Executor

Gamma Consulting Ltd

Director Z. Mgaloblishvili

2021

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1 Introduction

This document is an Environmental Impact Assessment Report for the project on the construction and operation of the 10.9 MW Bakhvi 1 HPP planned in the Chokhatauri and Ozurgeti municipalities in the Guria region.

According to the project, hydropower potential of the Bakhvitskali River will be utilized on the section between 1735 m and 1383 m above sea level. The project envisages arrangement of run-of-river hydropower plant on Bakhvistskali River, which will include:

- Headworks - intake, spillway and fish pass;
- Penstock;
- Powerhouse;
- Substation.

The construction works include the construction of access roads to the proposed HPP, mobilization of temporary construction infrastructure, arrangement of the main and auxiliary infrastructure of the HPP, management of construction waste generated during the construction process, and more.

According to Paragraph 22 of the first Annex of the Law of Georgia on "Environmental Assessment Code" ("Construction and / or operation of a hydroelectric power plant with a capacity of 5 MW or more") belongs to the activities subject to the EIA procedure and it can be carried out only on the basis of an environmental decision.

This report has been prepared on the basis of the scoping conclusion N29 issued by the Order N2-939 of the Minister of Environment Protection and Agriculture of Georgia on June 25, 2021.

It should be noted that in line with the comments made by stakeholders during the scoping phase, the Company has optimized the project and changed the layout of the HPP infrastructure, namely: According to the new scheme, the headworks will be arranged 300 m downstream of the alignment defined by the original project and, consequently, the head of the HPP will be reduced (by ≈14 m), resulting in a reduction of the installed capacity, which will be 10.9 MW instead of the 12 MW considered in the scoping phase. In addition, based on the results of the engineering-geological survey conducted in the project corridor, the scheme of the right bank location of the penstock and power unit was changed to the scheme of the left bank.

The project is implemented by CCEH Hydro VI LLC, and the EIA report is prepared by Gamma Consulting Ltd. Contact information of the operating company and the consulting company is given in Table 1.1.

Table 1.1. Contact Information

Operating company	CCEH Hydro VI LLC
Legal Address of the Company	Georgia, Tbilisi, Mtatsminda District, Giorgi Leonidze Street N 2a, Floor 3, Area N5
Address of the area of activity	Chokhatauri and Ozurgeti municipalities
Type of activity	Construction and operation of run-of-river power plant "Bakhvi 1 HPP"
CCEH Hydro VI LLC	
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Contact number	+995 599 411 033
Consulting company: Gamma Consulting Ltd	
Director of “Gamma	Z. Mgaloblishvili
Contact number	2 61 44 34; 2 60 15 27

1.1 List of Specialists Involved in the Process of Preparing the EIA Report

№	გვარი, სახელი	სამუშაო ადგილი	პოზიცია	ხელმოწერა
1	ზურაბ მგალობლიშვილი	შპს „გამა კონსალტინგი	კომპანიის დირექტორი	
2	ჯულული ახვლედიანი	შპს „გამა კონსალტინგი	ეკოლოგი	
3	ელენე მგალობლიშვილი	შპს „გამა კონსალტინგი	სოციოლოგი	
4	სალომე მეფარიშვილი	შპს „გამა კონსალტინგი	ეკოლოგი	
5	ნიკოლოზ დვალი	შპს „გამა კონსალტინგი	ზოოლოგი	
6	ლია გოგალაძე	შპს „გამა კონსალტინგი	ზოოლოგი-ორნითოლოგი	
7	თამთა კაპანაძე	შპს „გამა კონსალტინგი	ბოტანიკოსი	
8	თამაზ ბუდაღაშვილი	შპს „გამა კონსალტინგი	ატმოსფერული ჰაერის სპეციალისტი	
9	გიორგი ზაალიშვილი	შპს „გამა კონსალტინგი	იქთიოლოგი	
10	ავსტრიული კომპანია AFRY Austria GmbH		გეოლოგიური ანგარიში	

2 Legal Aspect

The environmental law of Georgia consists of the Constitution, environmental laws, international treaties, sub laws, presidential decrees, ministerial orders, instructions, regulations, etc. Georgia is signatory to the international, including environmental conventions.

2.1 Environmental Legislation of Georgia

This EIA report has been prepared in accordance with the requirements of the Law of Georgia on Environmental Assessment Code. In addition, other environmental laws of Georgia were taken into account in the EIA process. The list of environmental laws of Georgia is given in Table 2.1.1.

Table 2.1.1. List of environmental laws of Georgia

Year of adoption	Name of the Law	Registration code	Final Version
1994	Law of Georgia on Soil Protection	370.010.000.05.001.000.080	16/07/2015
1994	Law of Georgia on Roads	310.090.000.05.001.000.089	24/12/2013
1995	Constitution of Georgia	010.010.000.01.001.000.116	04/10/2013
1996	Law of Georgia on Environmental Protection	360.000.000.05.001.000.184	11/11/2015
1997	Law of Georgia on Wildlife	410.000.000.05.001.000.186	26/12/2014
1997	Law of Georgia on Water	400.000.000.05.001.000.253	26/12/2014
1997	Marine Code of Georgia	400.010.020.05.001.000.212	11/12/2015
1999	Law of Georgia on Protection of Atmospheric Air	420.000.000.05.001.000.595	05/02/2014
1999	Forest Code of Georgia	390.000.000.05.001.000.599	06/09/2013
1999	Law of Georgia on Compensation for Harm Caused by Hazardous Substances	040.160.050.05.001.000.671	06/06/2003
2003	Law of Georgia on Red List and Red Book of Georgia	360.060.000.05.001.001.297	06/09/2013
2003	Law of Georgia on the Conservation of Soils and Restoration and Improvement of their Fertility	370.010.000.05.001.001.274	19/04/2013
2005	Law of Georgia on Licenses and Permits	300.310.000.05.001.001.914	11/11/2015
2006	Law of Georgia on Regulation and Engineering Protection of the Seashores, Reservoirs and River Banks	400010010.05.001.016296	13/05/2011

2007	Law of Georgia on Public Health	470.000.000.05.001.002.920	11/12/2015
2007	Law of Georgia on Cultural heritage	450.030.000.05.001.002.815	26/12/2014
2014	Law of Georgia on Law of Georgia on Public Safety	140070000.05.001.017468	16/12/2015
2014	Waste Management Code	360160000.05.001.017608	19/02/2015
2017	Law of Georgia – Environmental Assessment Code	360160000.05.001.018492	07/12/2017

2.2 Environmental Standards of Georgia

In the process of development of the present report, following environmental standards will be used for assessment of the quality of environmental objects (soil, water, air) (see Table 2.2.1.):

Table 2.2.1. List of Environmental Standards

Date of adoption	Name of Regulatory Document	Registration code
31/12/2013	Considering amendments to the Technical Regulation – “Protection of Surface Water Contamination”, approved by the decree №425 of the Government of Georgia.	300160070.10.003.017650
31/12/2013	Technical Regulation – “Methods of calculation of maximum permissible emission of hazardous substances into ambient air”, approved by the order №408 of the Government of Georgia	300160070.10.003.017622
31/12/2013	Technical Regulation – on "water protection zones”, approved by the decree №440 of the Government of Georgia.	300160070.10.003.017640
31/12/2013	Technical Regulation – “Methods of calculating the actual amount of emissions according to instrumental methods for determining the actual amount of emissions in ambient air from stationary sources of pollution, list of special measuring and controlling equipment for determining the actual amount of emissions in ambient air from stationary sources of pollution and technological processes from stationary pollution sources,” approved by the order №435 of the Government of Georgia	300160070.10.003.017660
31/12/2013	Considering amendments to the Technical Regulation - provisions on "Determining Levels of Soil Fertility" and "Soil Conservation and Fertility Monitoring", approved by the decree №415 of the Government of Georgia.	300160070.10.003.017618
31/12/2013	Considering amendments to the Technical Regulation - "Topsoil Removal, Storage, Use and Cultivation", approved by the decree №424 of the Government of Georgia.	300160070.10.003.017647
03/01/2014	Considering amendments to the Technical Regulation - “The unfavourable weather conditions for Protection of Environment", approved by the decree №8 of the Government of Georgia.	300160070.10.003.017603
06/01/2014	Considering amendments to the Technical Regulation - "Method for inventory of Stationary Sources of Air Pollution", approved by the decree №42 of the Government of Georgia	300160070.10.003.017588
03/01/2014	Considering amendments to the Technical Environmental Regulation approved by the decree №17 of the Government of Georgia.	300160070.10.003.017608
14/01/2014	Technical Regulation - "Environmental Damage Determination (calculation) Method", approved by the decree №54 of the Government of Georgia.	300160070.10.003.017673
15/01/2014	Technical Regulation – “Maximum Allowed Concentrations of harmful substances at work places”, approved by the order №70 of the Government of Georgia.	300160070.10.003.017688

15/01/2014	Technical Regulation on ”Drinking Water”, approved by the decree №58 of the Government of Georgia.	300160070.10.003.017676
17/02/2015	Considering amendments to the "Rule of Implementation of State Control by the State Subdivision of the Ministry of Environment and Natural Resources Protection of Georgia - Environmental Supervision Department", approved by the Resolution No. 61 of the Government of Georgia.	040030000.10.003.018446
04/08/2015	Rules of reviewing and coordinating the company's waste management plan". Approved by the decree №211 of the Minister of Environment and Natural Resources Protection of Georgia.	360160000.22.023.016334
17/08/2015	Considering amendments to the Technical Regulation on “Determination and classification of the list of waste according to their types and characteristics”. Approved by the decree №426 of the Minister of Environment and Natural Resources Protection of Georgia.	300230000.10.003.018812
11/08/2015	“Waste recording, reporting ways and content”, approved by the decree N 422 of the Government of Georgia, dated as August 11, 2015.	360100000.10.003.018808
29/03/2016	Technical regulation on “Waste Transportation Rule” approved by #143 of the of the Government of Georgia (March 29, 2016, Tbilisi)	300160070.10.003.019208
29/03/2016	Decree #144 of the Government of Georgia (March 29, 2016 Tbilisi) on “Rules and conditions for Waste Transportation, Pre-treatment and Temporary Storage Registration”	360160000.10.003.019209
29/03/2016	Considering amendments to the Technical Regulation on “Special Requirements for Hazardous Waste Collection and Treatment”, approved by the decree #145 of the Government of Georgia	360160000.10.003.019209
1/04/2016	Decree #159 of the Government of Georgia (April 1, 2016 Tbilisi) on “Rules for Municipal Waste Collection and Treatment”	300160070.10.003.019224
15/08/2017	Technical Regulation on Standards for Acoustic Noise in Residential houses and Public Buildings approved by decree №398 of the Government of Georgia.	300160070.10.003.020107

2.3 International Agreements

Georgia has acceded to many international conventions and agreements, of which the following are important in the environmental impact assessment process of this project:

- **Nature and biodiversity protection:**
  - Rio Convention on Biological Diversity 1992;
  - Convention on Wetlands of International Importance especially as Waterfowl Habitat 1971. Ramsar;
  - Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES). 1973;
  - Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) (CMS) 1983.
- **Pollution and environmental threats:**
  - European and Mediterranean Major Hazards Agreement, 1987.
- **Public Information:**
  - Aarhus Convention on Access to Environmental Information, public participation in decision-making and access to justice in this area. (Convention 1998).

3 Project Alternatives

At the preliminary stage of Bakhvi 1 HPP project, alternatives to headwork structure and powerhouse locations and penstock corridor were discussed. Alternative routes for access roads to headwork and powerhouse were also discussed; considering aforementioned, the present EIA report presents following alternatives:

- Alternatives to headwork structure location and type;
- Alternatives to HPP type;
- Alternatives to HPP pressure system corridor and powerhouse;
- Alternatives to access roads;
- Alternatives to HPP construction infrastructure location;
- No-action alternative.

3.1 Alternatives to the Location of Headwork Structure

Following alternatives are discussed for Bakhvi 1 HPP headwork designing:

- Alternative I – arrangement of headwork structure at 1730 m elevation of Bakhvistskali riverbed;
- Alternative II – arrangement of two headwork structures on Bakhvistskali river and on its left tributary Baisurastskali river.
- Alternative III - arrangement of two headwork structures on Bakhvistskali river and on its left tributary Baisurastskali river, with hourly regulation reservoir at their confluence.
- Alternative IV - arrangement of headwork structure at 1730 m elevation of Bakhvistskali riverbed with low-threshold weir.

Brief review of each alternative is given below, following criteria are used for comparison of alternatives:

- Possibility of maximum and rational utilization of the river hydrpotential within the project section;
- Hydrological modes;
- Geological conditions;
- Terrain conditions;
- Access roads;
- Biological conditions;
- Local climate;
- Social environment.

3.1.1 Alternative I to Headwork Location

According to the Alternative I, a headwork structure with low-pressure, combined type spillway section and flush gates, lateral shore intake, fish-way and settling will be arranged on the section of Bakhvistskali river between elevations of 1730-1735 m. An hourly regulation reservoir will be installed upstream of headwork structure, the surface area of which according to preliminary data, will be 56346 m^2. Normal operating water level in the reservoir will be 1745 m, and maximum controllable water level - 1747 m asl.

The confluence of Bakhvistskali and Baisurastskali rivers will be flooded, as well as part of valley in the upper reaches of it ≈ 580 m long section.

The valley is V-shaped in the section, selected for headwork arrangement; Slopes are represented by rocky sediments. Within the headwork alignment and reservoir basin area, vegetation cover is represented only by unit specimen, with alder domination.

In case of this alternative, given the relatively large area to be covered with water, the risks on local climate should be studied in details. Besides, the reservoir is going to be of hourly regulation and frequent changing of water level can cause activation of geodynamic processes. The risk of hazardous geodynamic process activation is relatively high on the right bank slopes of Bakhvistskali river. Accordingly, detailed engineering-geological survey of the right bank slope should be carried out.

The existing access road to headwork site starts from Bakhmaro resort and runs along Bakhvistskali river valley. The road crosses the river at several places and it will be needed to arrange bridges. Technical condition of the existing road is not satisfactory and significant reconstruction works will be required. As during flooding it will be complicated to use these roads, it is feasible to arrange an alternative road.

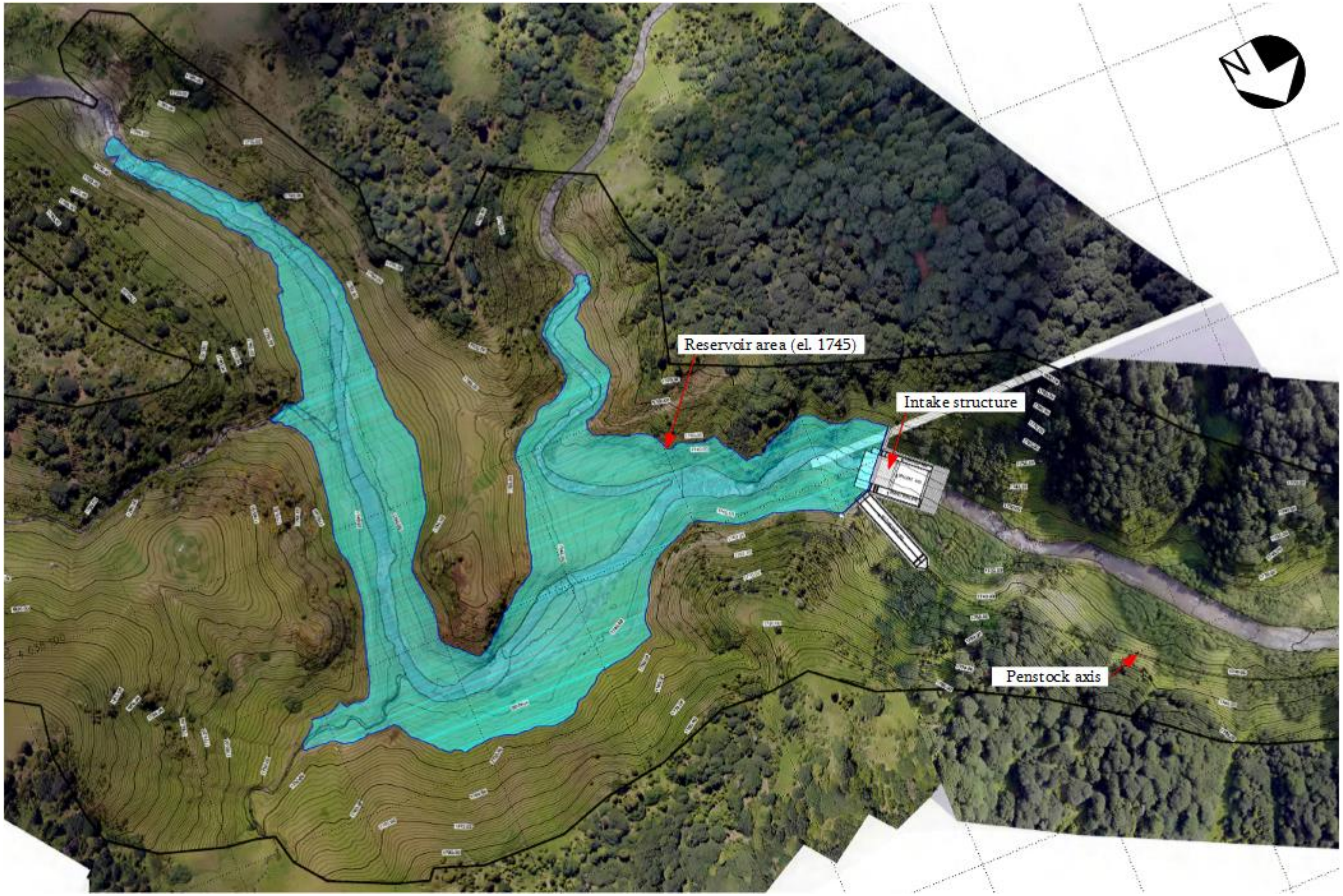
Alternative I scheme is given on Figure 3.1.1.2.

Figure 3.1.1.1 Views of the project areas according to Alternative I.

Headwork Alignment View

One of the sections of the reservoir basin

Figure 3.1.1.2. The scheme of Alternative I to headwork Structure



3.1.2 Alternative II of Headwork Location

According to the Alternative II, two low-threshold weirs are going to be arranged on Bakhvistskali river and its left tributary, which will include settling and fish-way as well. Similar to the Alternative I, normal operating water level in the reservoirs, arranged upstream of project weirs, will be at 1745 m, and maximum controllable water level in the reservoir - 1747m asl. The scheme of Alternative II is given on Figure 3.1.2.2.

From Bakhistskali river headwork structure the penstock will be arranged on the first terrace of the right bank. It will cross Bakhvistskali river by aqueduct and joins the penstock, planned on the right bank of Bakhvistskali river. From joint point to the power house the penstock will be arranged on the right bank.

As it was mentioned, alternative II considers arrangement of low-threshold weirs and accordingly, upstream of them, impoundments with small capacity and surface area will be created. Thus, according to Alternative II Bakhvi 1 HPP will be run-of-river diversion type HPP.

Due to the fact that Bakhvistskali riverbed is slightly inclined on the project section, the surface area of the impoundment, created upstream of the weir will be relatively larger than the impoundment located upstream of the tributary. It should be mentioned that the reservoir surface areas of both weirs will be significantly less than reservoir surface area of the Alternative I, namely: the surface area of both reservoirs will be 33 587 $∂^2$, including the surface area of intake planned on Bakhvistskali river is 31047 m^2, and that of intake on Baisurastskali river - 2540 m^2.

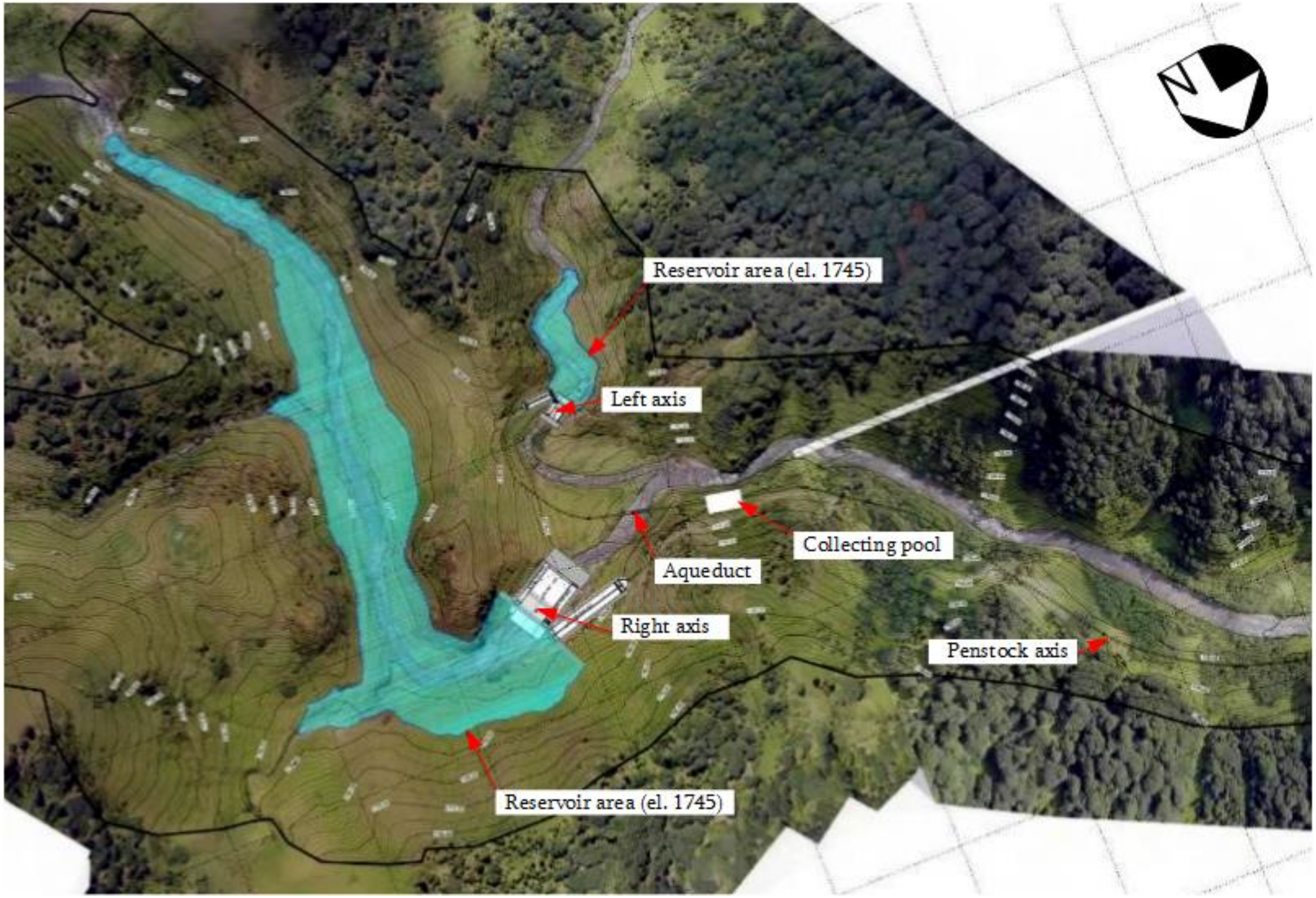
The areas to be flooded on weir locations and upstream, are free from vegetation cover and accordingly, the negative impact risks are less on animal habitats. Considering small area and depth of the reservoir, the risks of impacts on geological environment and local climate is at minimum.

Figure 3.1.2.1. Locations of weirs according to Alternative II

Location of weir planned on Bakhvistskali river

Location of weir planned on Baisurastskali river

Figure 3.1.2.2. The scheme of Alternative II



3.1.3 Alternative III

In case of alternative III, similar to alternative II, it is considered to arrange two headworks on Bakhvistskali and Baisurastskali rivers. Like in case of alternative II, weirs will be low-threshold and they will have upstream impoundments.

According to the Alternative III, unlike to alternative II, it is planned to arrange a reinforced concrete storage reservoir between project rivers, in interfluve, where the water supplied from the headwork, will be collected and used for hourly regulation. The reservoir water will be supplied to the power house through penstock. In the vicinity of the storage reservoir, a penstock will cross Bakhvistskali river. It is planned to arrange an aqueduct for river crossing.

The total surface area of impoundments upstream of intake and the storage reservoir will be 34561 m^2, including, the area of Bakhvistskali river intake impoundment will be 27667 m^2, that of Baisurastskali river intake - 2540 m^2 and storage area - 4374 m^2.

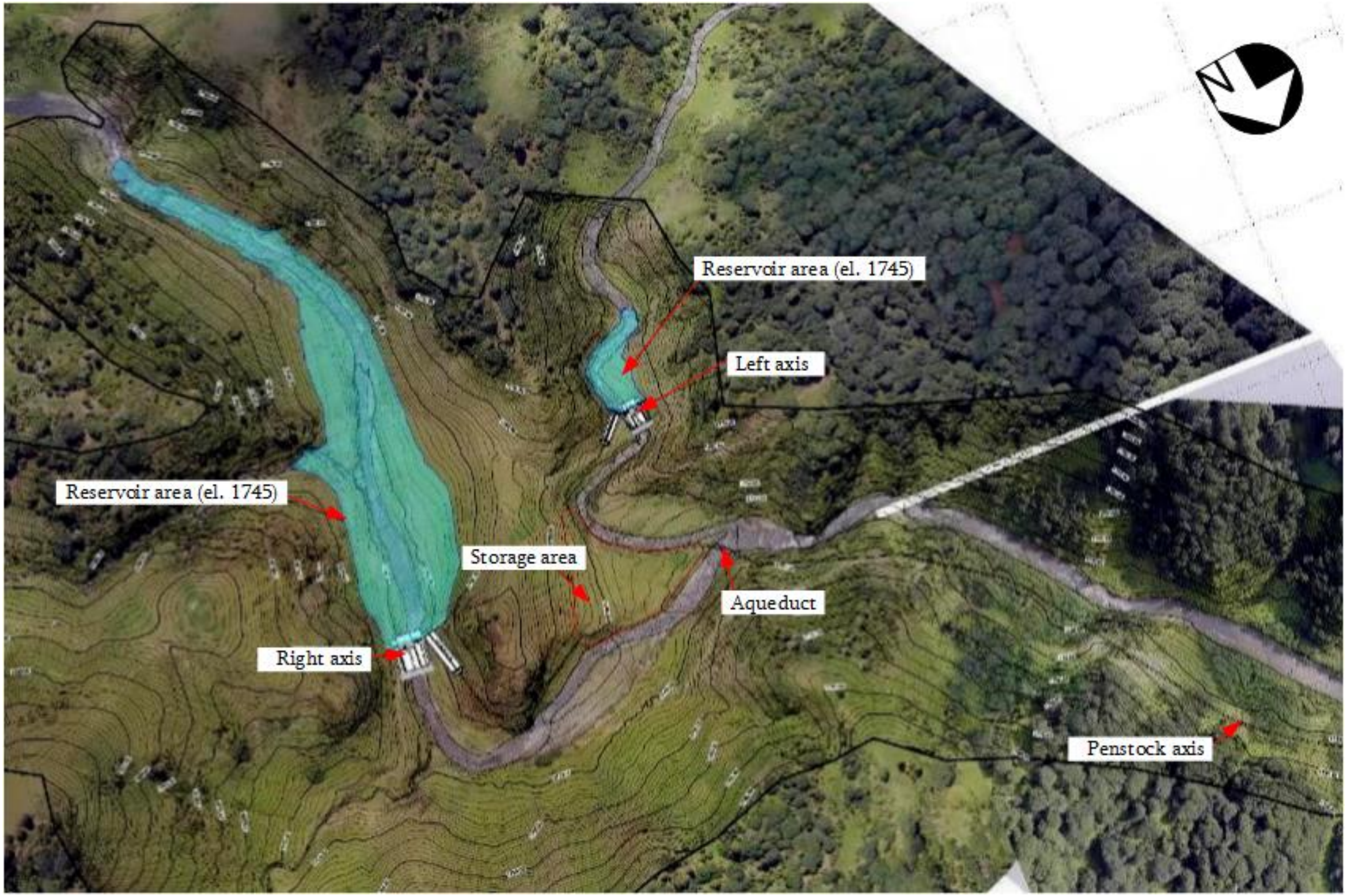
As it was mentioned, Alternative III mostly is identical to Alternative II, with only difference – in this case, similar to Alternative I, Bakhvi 1 HPP will be of hourly regulation, and water regulation will be provided using reinforced concrete storage reservoir. The area is inclined to the west and accordingly, it will be required to cut the east slope. It is noteworthy that the slope is built with solid rocks and so risks of hazardous geodynamic process activation is at minimum.

Figure 3.1.3.1. Area for arrangement of the storage reservoir

View from the East

View from the West

Figure 3.1.3.2. Scheme of Alternative III



3.1.4 Alternative IV

Alternative IV of the headworks is proposed taking into account the comments and suggestions made during the detailed design and public review of the scoping report. According to this option, the headworks will be arranged on the section between 1735 and 1383 m elevation. According to the project, it is planned to arrange a low-threshold (height 4.4 m) concrete weir with lateral water intake.

Due to the height of the dam, a reservoir will not be created upstream. In order to divert the river water towards intake, a small pond with a surface area of 2400 m^2 will be created, which will not exceed the existing riverbed and, accordingly, there are practically no risks of impact on the local climate.

The area selected for the headworks is acceptable from an engineering-geological point of view, namely: Both banks of the river are built of rocky outcrops and no high-risk areas for hazardous geodynamic processes are recorded (see section 5.2.2.7). According to the results of the research, the plant species included in the Red List of Georgia are not represented in the project area. Generally vegetation cover is poor and mainly Alder is found there. It should be noted that compared to other alternatives, the area under the influence of the headworks is significantly reduced (by about 90%), which has a positive impact in terms of reducing the risk of impact on the biological environment.

At present, there is a n earth road to the project area, which needs to be rehabilitated and widened prior to the construction works.

According to Alternative IV, the headworks will be located about 2 km away from the resort zone of Bakhmaro, and 250-300 m from the border of the recreation zone. The headworks will not be visible from any point of the resort Bakhmaro and its surroundings. Therefore, on impacts related to visual-landscape changes are expected.

In the case of Alternative IV, the HPP will operate only on the natural runoff of the river and there will be no regulation of water flow.

The view of the location of Alternative IV is given in Figure 3.1.4.1., and the layout scheme of the headworks is shown in Figure 3.1.4.2.

Figure 3.1.4.1. View of headworks location

Figure 3.1.4.2. Layout scheme of headworks

3.1.5 Comparison and Analysis of Headwork Location Alternatives

As it is mentioned in Paragraph 3.1., following criteria are used for comparison of alternatives:

- Hydrological modes;
- Geological conditions;
- Terrain conditions;
- Access roads;
- Biological conditions;
- Local climate;
- Possibility of maximum and rational utilization of the river hydrpotential within the project section;
- Social environment.

Possibility of utilization of the river hydrpotential - in terms of rational utilization of the river hydropower potential, Alternative I should be deemed as the best alternative, as in case of all alternatives, in equal pressure conditions, an hourly regulation reservoir with relatively larger capacity will ensure regulation of the river flow and opportunity of its usage during the peak hours, which is the best option from energetic point of view.

According to this criterion, Alternative III is distinguished with the better characteristics than Alternative II, according to which water regulation will be carried out by the reinforced concrete storage reservoir. Although the reservoir capacity is less compared to Alternative I, it will bring certain energetic and economic effect.

From the hydropower point of view, Alternative IV is of the lowest efficiency, because in this case, head of the HPP is reduced by 13-14 m, thus reducing the energy efficiency of the HPP. In addition, in the case of this option, there will be no regulation of water flow and, therefore, it will not be possible to increase power generation during peak hours of electricity demand.

<u>According to the possibility of river hydropower potential utilization, the preference should be given to the Alternative I.</u>

Hydrological mode – In terms of impact risks on hydrological mode of Bakhvistskali river, all four alternatives are almost identical, as the environmental flow to be passed downstream of the headwork in all options will be 0.29 m^3/s.

The main disadvantage of alternative I can be the fact that certain amount of solid sediments will be accumulated in the reservoir, created upstream of the headwork, and accordingly, sediment transportation conditions will be worthened. In case of Alternatives II, III and IV, solid sediments will be released from planned low-threshold weirs and completely passed downstream, so the impact will lower compared to Alternative I. It should also be noted that in the case of Alternative IV, the headworks will be located on relatively lower elevations and sections in the upper reaches of the River Bakhvitskali and River Basurasghele confluence will not fall within the project impact zone.

Considering aforementioned, lower impact on hydrological mode of the river will be expected in case of Alternative IV.

Geological conditions - as it is given in Paragraph 3.1.1. according to Alternative I, during operation of the planned headwork structure and the reservoir, there are risks of hazardous geodynamic process activation on the slopes within the reservoir shoreline. In this regard, Bakhvistskali river right bank slopes should be highlighted. Geodynamic process activation risks will be related to frequent change of water level in the reservoir due to hourly regulation.

Alternative II and Alternative III are characterized with relatively lower risks of geodynamic process activation, as small capacity reservoirs are going to be arranged upstream of low-threshold weirs and water level will not be changed. According to Alternative III, river water will be regulated by reinforced concrete reservoir and accordingly, there are actually no risks of impact on geological conditions on operation phase. However, compared to Alternative IV, a large amount of construction works will be implemented, which creates certain risks during the construction phase.

In terms of risks to the geological environment, Alternative IV is characterized by the lowest risks and this option should be preferred.

Terrain conditions - in case of Alternatives I and IV, headwork arrangement is planned in the narrow V-shaped valley and accordingly, construction work implementation will be related to large-scaled earth works and accordingly, there are relatively higher risks of negative impacts on geological conditions.

In case of Alternatives II and III, the headwork arrangement is planned on the section with relatively more quite terrain conditions and accordingly, these two alternatives should be preferred.

Access road - Given that in the case of all alternatives, arrangement of the headwork is planned on about 300-350 m long section of Bakhvistskali river valley, there is no significant difference between the alternatives in terms of access roads. The project envisages the arrangement of an access road to the headworks, as well as to the penstock corridor. In the case of Alternative II and III, an access road will be required for the construction of the headworks on Basura river, which will be associated with additional impacts.

Based on the above, preference should be given to the Alternatives I and IV.

Biological environment - Alternative I is characterized with relatively higher impact risks on biological environment, which will be related to the relatively larger area to be flooded by the reservoir water. Although no plant and animal species, protected under Georgian Red List or international treaties were identified within the borders of reservoir basin, but compared to other alternatives, loss of large areas should be considered as the significant environmental impact.

Compared to the Alternative I, the area of the project impact zone is less in case of all other Alternatives, however, Alternative IV should be considered as the best option, because in this case it is planned to arrange one low threshold weir and the pond created upstream will not exceed the riverbed.

Alternative IV is acceptable in terms of impact on fish fauna, as in this case one low-threshold weir will be constructed, which will be equipped with fish pass.

Given the low risks to the biological environment, Alternative IV was considered the best option.

Local Climate - climate impact risks are mainly related to the reservoir surface area and accordingly, higher risks are expected in case of the Alternative I. Alternatives II and III are almost identical, but Alternatives II is characterized by a slight advantage, as the Alternatives III provides for the arrangement of a storage reservoir and will have a relatively larger water surface area.

In the case of a low-threshold weir planned under Alternative IV, a small pond with a surface area of 2340 m2 will be created upstream, the perimeter of which will not extend beyond the existing riverbed and therefore there is practically no risk of negative impact on the local climate.

Although, in the case of all alternatives, the surface areas of the ponds created upstream of the headworks are very small and the risks of impact on the local climate are minimal, Alternative IV is preferred, as in this case, the pond created upstreamof a low-threshold weir will be small and no impact is expected on local climate.

Social Environment - it is noteworthy that physical and economic resettlement risks will not take place in case of any headwork alternatives. Due to large distances to residential zones, risks related to harmful substance emissions into ambient air and noise propagation will be at minimum. It should be noted that, except for Alternative IV, headworks of all other options cover areas in the immediate vicinity of the Bakhmaro Resort Recreation Area. According to the general plan of the resort, no infrastructure is planned in this area of the recreation zone, however, Alternatve IV should be prefered, which will be approximately 250-300 m away from the border of the recreation zone of the resort.

According to positive impact risks on socio-economic environment such as creation of temporary and permanent job places, employment of local population, central and local budget revenues, etc., alternatives are actually identical. Regarding energetic-economic profit, Alternative I should be considered as the best, as in this case HPP will be hourly regulated and power will be supplied to energy system during peak hours. Alternative III will also be of hourly regulation, but in this case, the amount of regulated water will be significantly smaller.

Brief summary: Due to the relatively low risk of physical and biological impacts, Alternative IV was considered to be the best option.

3.2 Alternatives to Penstock Location

Two alternatives for penstock corridor have been discussed during the scoping phase, namely: arrangement of the penstock on lower elevations of of the right or left bank slopes of the river. Two additional alternatives were considered during the EIA phase. Accordingly, this section discusses 4 alternative options for the installation of a pressure system (see Figure 3.2.1.), Namely:

- Alternative 1 – Arrangement of the penstock and the powerhouse on the lower elevations of the right bank slope of Bakhvistskali river;
- Alternative 2 - Arrangement of the penstock and the powerhouse on the lower elevations of the left bank slope of Bakhvistskali river;
- Alternative 3 - Arrangement of the penstock and the powerhouse on the upper elevations of the right bank slope of Bakhvistskali river;
- Alternative 4 - Arrangement of the penstock and the powerhouse on the upper elevations of the left bank slope of Bakhvistskali river.

At the scoping phase, preference was given to the right bank scheme and the alternative option of arranging the penstock on the lower elevations of the right bank slope of the river. According to the results of engineering-geological research conducted in the project area during the preparation of the EIA, the first alternative was not considered acceptable, namely:

As it is stated in Paragraph 5.2.2.5. (Geological and geomorphological assessment of geo-hazards), on the project section of Bakhvistskali River, the risks of activating dangerous geodynamic processes (erosion, rockfall) are relatively high on the lower elevations of the valley. In the case of the left bank scheme, the penstock corridor crosses relatively smaller tributaries and there is no significant risk of rockfall within the study area. According to the right scheme, the penstock crosses the right tributary where a landslide occurred in the 1970s. Although the slopes of the right tributary contain rocky outcrops and the area is currently stable, a recurrence of such an event should not be excluded.

If arranged on the slope of the right bank, the penstock will pass through a corridor built of rocks, however in this case the pipeline crosses three rocky ridges of lava rocks where steep (vertical) slopes are represented and there are very high risks of rockfall.

In addition to the above, in the case of the first alternative, the pipeline corridor is very close to the riverbed, where it may become more vulnerable to landslides, with high risks of potential hazards (especially rockfall).

In view of all the above, due to the relatively low risks of impact on the geological environment, alternative 4 was preferred.

There is no significant difference between the alternatives according to the risks of impact on the biological environment. However, it should be noted that when the penstock is arranged on the lower elevations of the valley, the risks of impact on water-related animal species (especially Otter) are relatively high, which is significantly reduced when tthe penstock is arranged on upper elevationsof the valley.

In the case of Alternative 4, the left bank slope of the river is steep along the initial section of approximately 1 km length, after which the pipeline corridor will pass through an area with a relatively flat surface at the upper elevations of the valley, where the slopes will not need to be cut and therefore the risk of impact on vegetation is relatively low. It should also be noted that according to the results of the detailed vegetation survey (taxation), in the case of alternative 4, the plant species included in the Red List of Georgia are not presented in the project impact zone.

According to the results of the study, due to the relatively low risks of impact on the biological environment, preference should be given to the alternative 4.

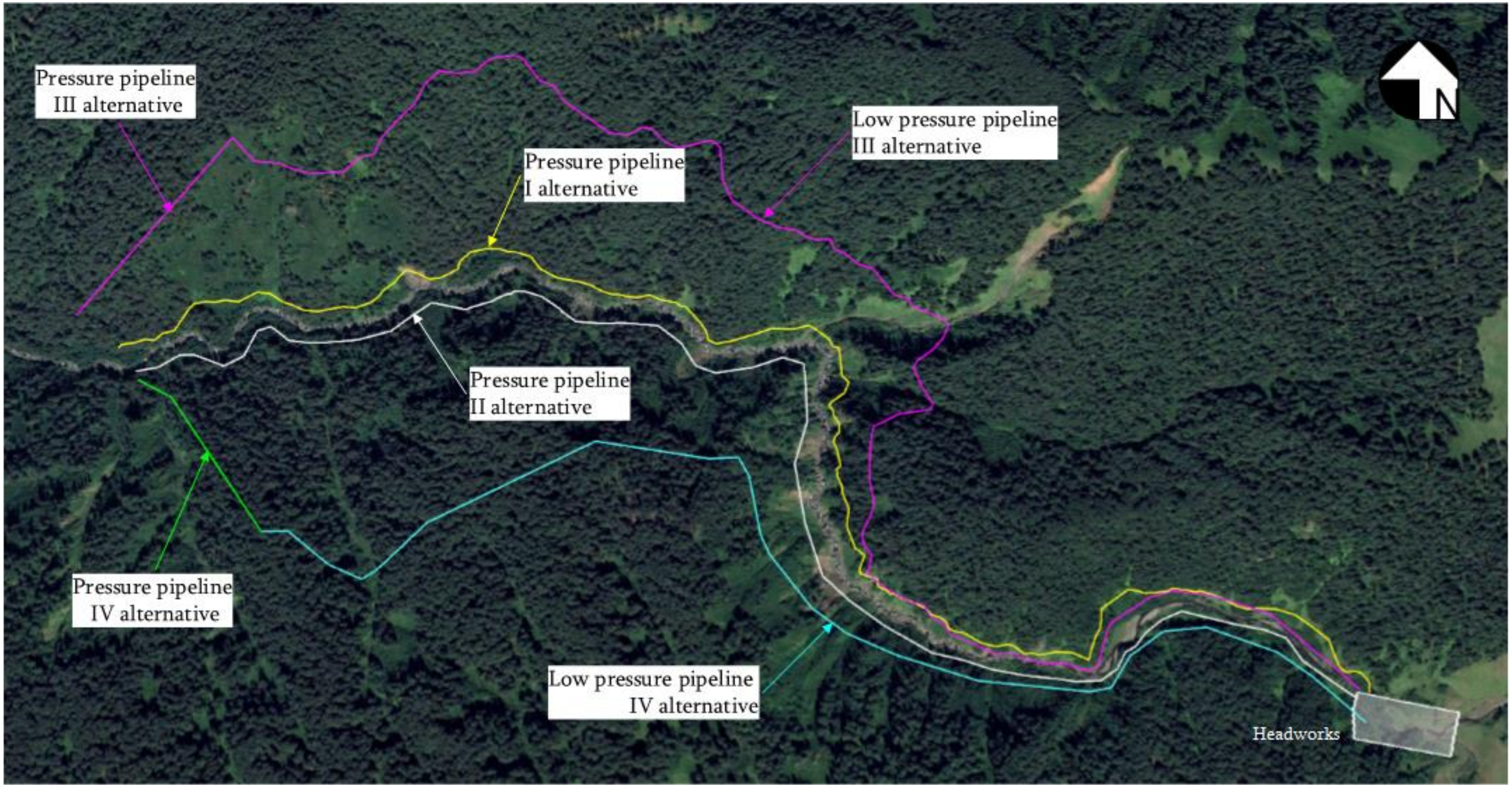
There is no significant difference between the alternatives in terms of impact on the hydrological regime of Bakhvistskali River and its aquatic environment, as in all cases the water flow and the ecological flow will be unchanged. According to the Alternative 1 and Alternative 2, the penstock is planned to be located near the river bank and therefore there is a risk of negative impact on water quality during the construction phase, which will not occur if the penstock will be located at the upper elevations (Alternatives 3 and 4). Given that in the case of Alternative 3, relatively large mudslide valleys will be crossed by the pipeline, Alternative 4 would be preferred.

The difference between the alternative options is minimal according to the impact on the socio-economic environment, namely:

- The project corridor is significantly far away from the residential areas and the resort area of Bakhmaro. Consequently, there is practically no risk of impact on the air quality and acoustic background of the residential areas;
- Areas within the project impact zone are state property and therefore no physical or economic resettlement will take place.

In view of all the above, Alternative 4 was preferred.

Figure 3.2.1. Scheme of alternative options for penstock



3.3 HPP Type Alternatives

The HPP type was selected based on local topographic, hydrological, geological, seismic and other data. Traditional schemes for the exploitation of small rivers under mountain conditions were discussed and derivative HPP with an hourly regulation has been selected, which envisages arrangement of two headwork structures, a storage reservoir, a penstock and a power house.

At the project section of Bakhvistskali river, taking into account the preliminary water calculation and other conditions, above-mentioned scheme of HPP arrangement was selected, in which head is created using the difference of heights.

The adopted design solution is the best alternative in terms of environmental impact, as it is not characterized by high environmental risks.

3.4 Alternative Types of the Diversion System

As a rule, for water transportation from the headwork structure to the power house, a tunnel, an open channel or a pipeline is used. In case of the given HPP, considering local terrain conditions, arrangement of pressure tunnel is feasible neither from technical nor from environmental point of view. In addition, the conditions for the disposal of a large volume of waste rocks on the project section do not exist in the case of tunnel arrangement. Accordingly, at the design stage, alternatives of open channel or penstock arrangement were discussed.

In case of arranging a diversion channel, it will be necessary to arrange a wide platform (at least 10-15 m wide), on which the channel, as well as the construction and operating roads should be arranged. This requires a large volume of earthwork. Accordingly, the arrangement of the channel will be associated with high risks of negative impacts on the physical and biological environment, namely: there will be risks of activating geodynamic processes and damage to vegetation, which will also lead to damage to animal habitats and permanent fragmentation of habitats.

Besides, considering complex terrain conditions of the valley, the channel actually cannot be arranged.

Taking into account all above-mentioned, implementation of the alternative of diversion channel arrangement is not deemed feasible and accordingly, the preference was given to alternative of penstock arrangement.

Three different options were discussed for selection of materials for the penstock:

- Metal pipeline;
- Fiberglass-reinforced pipeline;
- Reinforced concrete pipeline.

During selection of the best alternative, local terrain and geological conditions, issues related to arrangement of the road and penstock corridor were considered and preference was given to the alternative option of arranging reinforced fiber and steel pipeline. Reinforced fiber pipeline will be installed on the low pressure section (length 3 217 m), while the steel pipeline will be arranged on the high pressure section (length 598 m). Such a design solution is also acceptable from an environmental point of view, as the steel pipeline is characterized by high strength, which will minimize the risks of damage.

3.5 Alternatives of Access Roads

According to the feasibility study, on Bakhvi 1 HPP project areas, arrangement of access roads is planned both from up and downstream. The road planned between the headwork and the powerhouse will be used for arrangement of the penstock and additional utilization of the corridor will not be required. Alternatives of upstream and downstream access roads are given below.

Two main alternatives are discussed for access roads to HPP upstream section (see Figure 3.5.1.), including:

1. According to Alternative I, the road will start from access road to Bakhmaro resort, in its north and accordingly, roads running through the resort areas will not be needed. From Bakhmaro resort asphalted access road, the existing unpaved road will be used, which will undergone expansion/rehabilitation works. The existing road continues to the first construction camp of the project, after which it is planned to arrange a new road with a length of 1236 m. It should be noted that according to the first option, the planned road will pass outside the recreational zone of the resort Bakhmaro, which excludes the possibility of impact on the resort infrastructure or its development prospects. In addition to the above, it is important that the vegetation in the corridor of the project road is present only in the area adjacent to the headworks and therefore the impact will not be high.
2. According to Alternative 2, it is planned to arrange a road using the road leading to the territory of the resort Bakhmaro, from where the road will continue to the corridor of the earth road leading to the slope of the left bank of Bakhvitskali River. The length of the existing earth road is about 2 km and ends at the left bank of the river from where the newly constructed road will start. The newly constructed road crosses the Bakhvitskali river several times and finally connects to the area of the headworks from the right bank. The length of the newly constructed road will be about 1500 m.

The main disadvantage of the alternative 2 is the movement of vehicles required for the project purposes in the resort area, which will affect the air quality, acoustic background and traffic safety risks. In addition, the road will cross the Bakhvitskali riverbed several times and it will be necessary to arrange bridge crossings, which will be associated with additional risks of impact on the river water quality and the biological environment of the water. It is noteworthy that in the case of alternative 2, a large part of the proposed road corridor is located within the recreational zone of the resort Bakhmaro.

In terms of impact on the geological environment, there is no significant difference between the alternatives, but in the case of the first option, there is a relatively difficult slope on one section of the new road, where engineering arrangements will need to be made for slope reinforcement. With this in mind, Alternative 2 is characterized by a slight advantage.

In view of all the above, preference was given to the alternative 1, as in this case the existing and newly constructed roads are located outside the Bakhmaro resort recreation area, and there will be no movement of equipment and vehicles in the resort area and therefore impact is not expected.

Arrangement of the access road to the power unit of the HPP is planned using the existing forest road. It should be noted that the existing forest road needs rehabilitation / reconstruction works due to the difficult terrain of the corridor and unsatisfactory technical condition.

Two alternative routes are considered to access Bakhvi 1 HPP from the existing road (see Figure 3.5.2.).

In terms of impact on the geological environment, preference should be given to the alternative 1, as the selected corridor will pass within relatively flat terrain and the risks of developing dangerous geodynamic processes will not be high.

In terms of impact on the biological environment, the alternatives are approximately identical, as both routes will run on the same section of the right slope of Bakhvitskali and therefore will not differ much in terms of biodiversity. In the case of alternative 2, the length of the newly constructed road is relatively less, but a large amount of earth works will be performed and the number of trees to be cut is approximately identical.

Given the relatively low risks to the geological environment and traffic safety, preference should be given to the Alternative 1.

Figure 3.5.1. Scheme of access roads alternatives

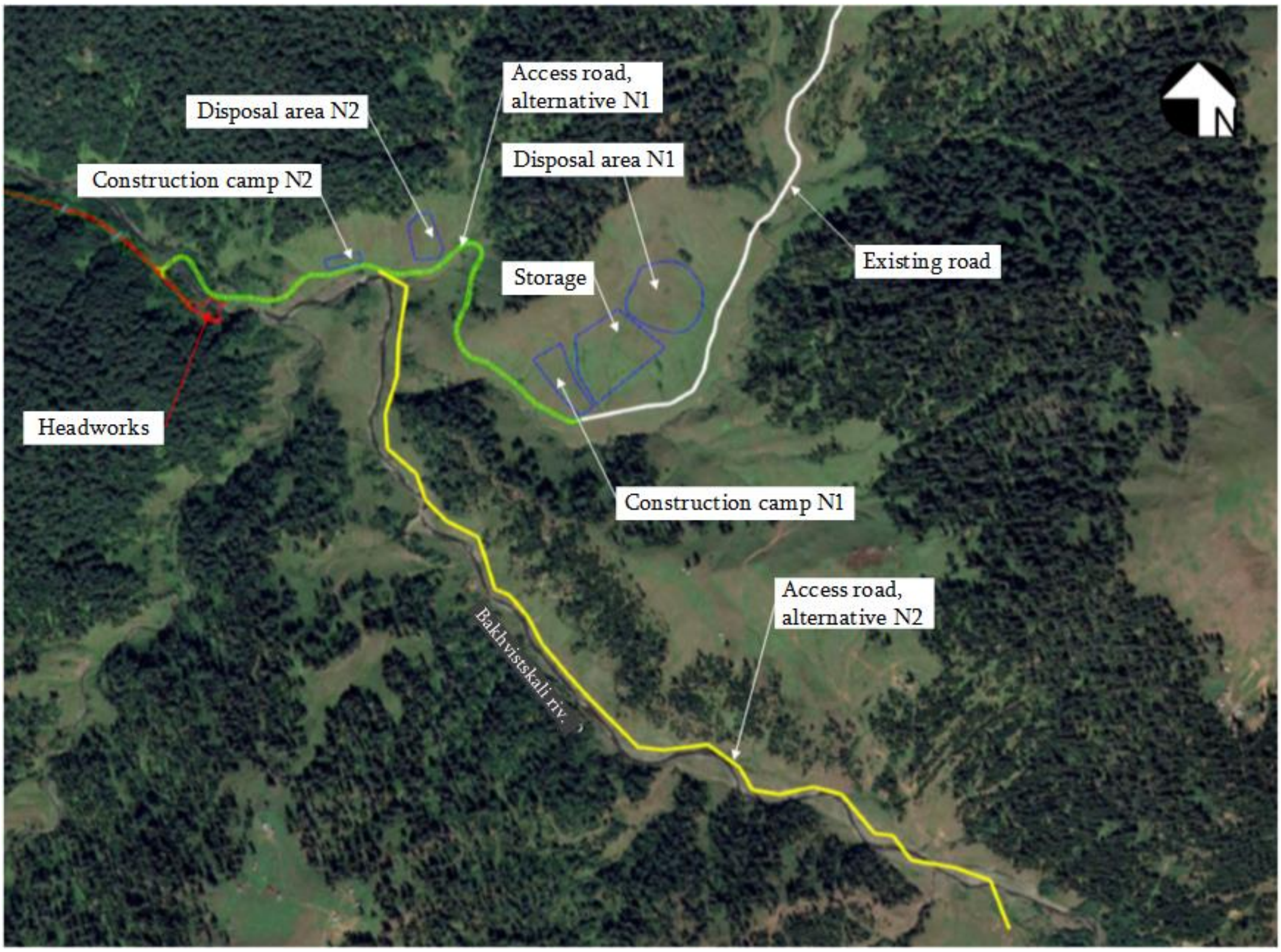
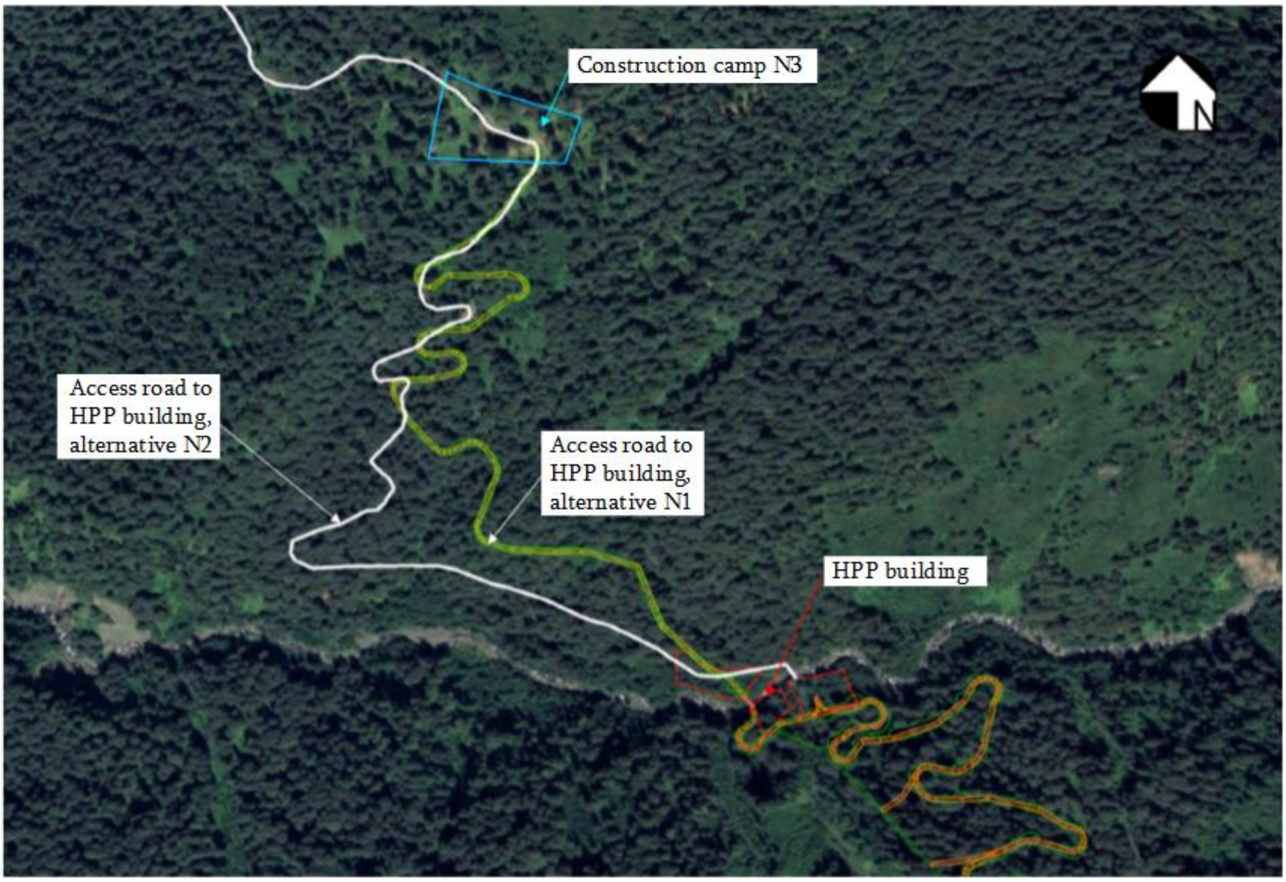


Figure 3.5.2. Alternatives for access to the HPP power unit



3.6 Alternatives for Construction Infrastructure Deployment

During the scoping phase of Bakhvi 1 HPP, the arrangement of one main construction camp in the vicinity of the project area of the headworks was considered, while the storage area of the construction materials was planned near the power unit. During the preparation of the detailed design of the HPP, a decision was made to increase the number of construction camps, namely: Due to the difficult terrain of Bakhvitskali River gorge and the distance between the headworks and the power unit area, it was decided to arrange construction infrastructure in the vicinity of both the headworks and the power unit area. It is planned to arrange 2 construction camps in the vicinity of the headworks, including one main and the other a small camp, where the workers' housing and the construction contractor's administrative buildings will be arranged.

Three alternative areas were considered for the N1 construction camp adjacent to the headworks. The geographical coordinates of the alternate areas are given in Table 3.6.1., while the layout schemes are given in the figures 3.6.1. and 3.6.2.

In the case of all three alternatives, there is no vegetation cover presented there, nor are high-risk areas in terms of geodynamic processes. Consequently, in the case of all three alternatives, the impact on the geological environment and biodiversity will not be high.

Due to the fact that the first alternative area is located within the recreational zone of the resort Bakhmaro, the use of this area was not considered appropriate.

As for the second and third alternatives, preference was given to the third alternative option. In the process of designing the construction infrastructure of the HPP, the area of the second alternative option was considered favorable for arranging the spoil ground, and the third alternative area - for the construction camp.

The thrid alternative area is located outside the recreational zone of the resort Bakhmaro. As mentioned, the vegetation in the area is not present and at the same time it is stable in terms of geodynamic risks. The selected area is at least 60 m away from the nearest surface water body, a natural ravine, and is located in the immediate vicinity of the access road to the headworks structure. The project envisages the arrangement of a warehouse area for construction materials (mainly penstock pipes) next to the construction camp.

In case of arrangement of a construction camp in the selected area, electricity will be available from the resort Bakhmaro substation, while water will be supplied using local sources.

In view of all the above, the use of the thrid alternative area was considered favorable for the arrangement of the construction camp.

Two alternative areas were considered for the arrangement of the construction camp N2. According to the first option, the camp is planned on the right bank of Bakhvitskali River, in the upper reaches of the Baisurasghele River confluence, and according to the second option, on the right bank of Bakhvistskali River, in the immediate vicinity of the project area of the headworks structure (see Figure 3.6.2). As a result of the assessment of alternative areas, preference was given to the first alternative option, which is mainly due to the lack of area in the vicinity of the headworks and relatively high risk of impact on biological environment, namely: In the case of the second alternative option, the camp will be located in a forested area (mainly alder is present) and it will be necessary to cut the vegetation.

In the case of the first option, the area is free of vegetation cover, the risk of developing dangerous geodynamic processes is minimal and it is also located outside the resort area of Bakhmaro Resort and the State Forest Fund. The camp will be supplied with electricity from the Bakhmaro substation, while the water will be supplied from the existing local sources.

Therefore, the first alternative area was considered an acceptable option.

The geographical coordinates of the alternatives are given in Table 3.6.2.

Due to the difficult terrain conditions of the power unit area, two alternative areas were considered for the arrangement of the construction camp. Biological and geological environmental risks were taken as the main criteria when selecting the areas. The first alternative area is located on the upper reaches of the right bank of the Bakhvitskali River, in an area with relatively flat terrain, and the second alternative area is located on the right bank of the river, in the immediate vicinity of the power unit.

Due to the proximity to the construction site of the power unit, it is advantageous to arrange a construction camp in the second alternative area, but due to the small area, it is not possible to accommodate the full infrastructure of the camp. With this in mind, a decision was made to use both areas, namely: the first alternative area will be used for the main infrastructure of the camp (workers' housing, equipment parking, fuel tank, canteen and small workshops), while the second alternativ area will be used for the arrangement of concrete unit, inert material crushing-sorting plant and a material storage area.

Table 3.6.1. Geographical coordinates of alternative areas of Construction Camp N1

First alternative			Scond alternative			Third alternative		
Point N	Geographical coordinates		Point N	Geographical coordinates		Point N	Geographical coordinates	
	X	Y		X	Y		X	Y
1	276514	4637659	1	276080	4637931	1	275978	4638094
2	276237	4637610	2	276222	4637980	2	276006	4638021
3	276319	4637501	3	276307	4638194	3	276040	4637970
4	276466	4637445	4	276246	4638216	4	276015	4637951
5	276435	4637511	5	276078	4638008	5	275976	4637992
6	276449	4637554;				6	275923	4638065

7	276544	4637607							

Table 3.6.2. Geographical coordinates of alternative areas for Construction Camp N2

First alternative			Scond alternative		
Point N	Geographical coordinates		Point N	Geographical coordinates	
	X	Y		X	Y
1	275580	4638292	1	275191	4638352
2	275585	4638274	2	275151	4638410
3	275515	4638261	3	275109	4638396
4	275510	4638281	4	275166	4638336

Figure 3.6.1. Layout Scheme of Alternative Areas of Construction Camp N1

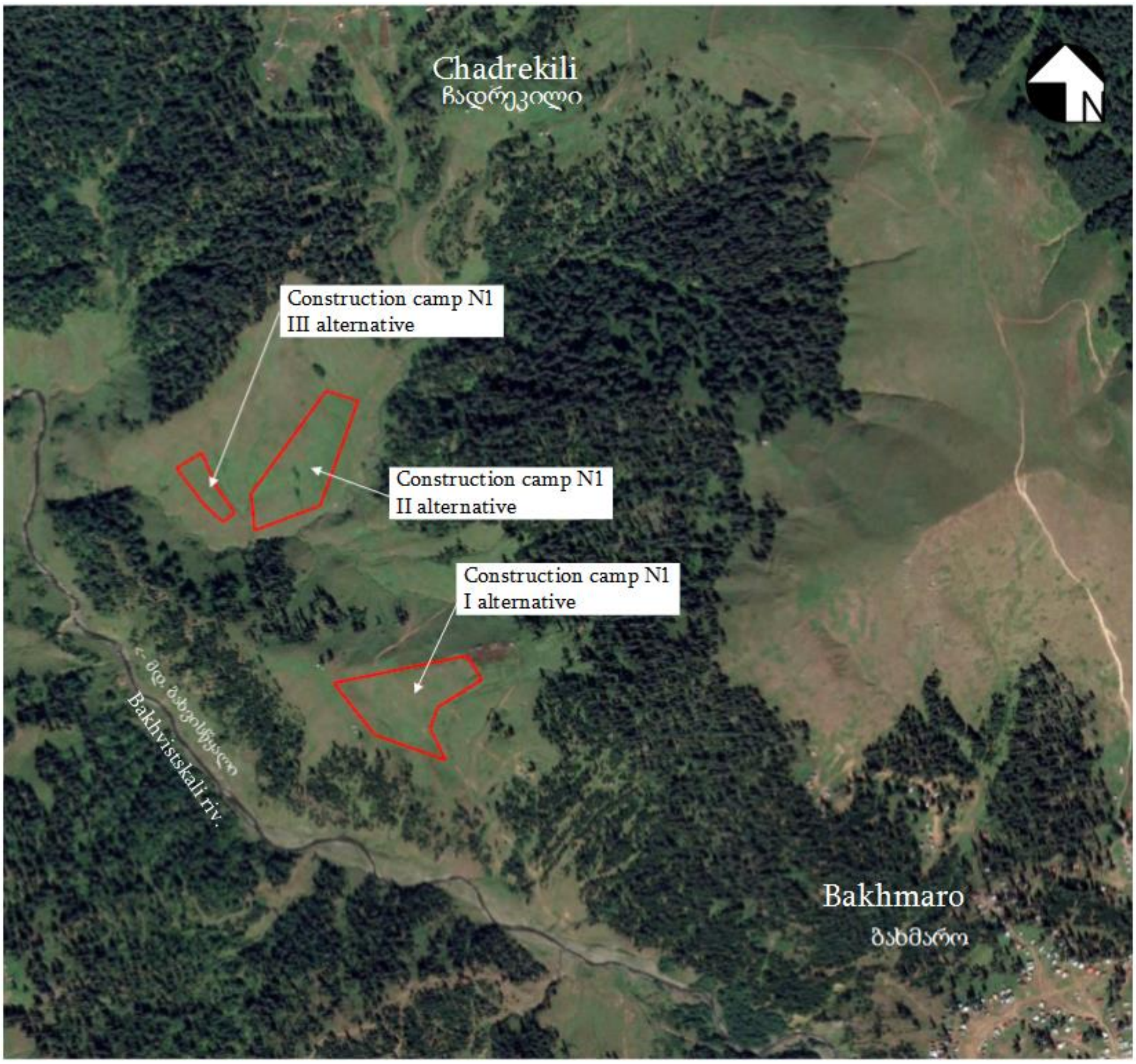


Figure 3.6.2. Layout Scheme of Alternative Areas of Construction Camp N2

3.7 No-Action Alternative

No-Action Alternative implies refusal to implement the project, which excludes the expected negative impacts on the natural and social environment with the construction and operation of the HPP.

In case of refusal to implement the project, the biological environment in the area selected for the main and auxiliary infrastructure of the HPP in Bakhvitskali gorge will remain intact, there will be no cutting of trees and plants; In addition, if the project will not be implemented, there will be no need to carry out earthworks, which in turn excludes the risks of development-activation of dangerous geological processes under the influence of anthropogenic factors in the project area. Risks of negative impacts on the population and wildlife as a result of emissions of harmful substances into ambient air, noise propagation are also excluded; No waste will be generation and as a result, the negative impact expected from their improper management will not occur, as well as the hydromorphological changes of the river will not be expected.

Natural runoff of the river will be maintained at the project section, the biological environment of the water will not be affected by the project, etc.

It is clear that refusing to implement the project is the best alternative from an ecological point of view. However, it should be taken into account that in case of not implementinng the project, there will be no benefits that the implementation of the HPP construction and operation project will bring to the population.

As a rule, in each case, the area and capacity of the HPP are determined by the Government of Georgia, through the relevant agency, and only after that the relevant memorandum is drawn up with the investor (company). Given the above and also in the interests of the country's energy independence policy and economic development, refusing to engage in activities is an unacceptable alternative. At the same time, the economic benefits of the project are no less significant, which in itself has a positive impact on the socio-economic environment of the region.

As for the need to build hydropower plants, at present the electricity produced in the country is not enough. In order to meet the local demands for energy, energy imports become necessary every year. If a few years ago electricity was imported only during the winter, today the country consumes imported energy for 10 months. Electricity research has shown that the peak summer load has increased dramatically in recent years. Without an increase in existing energy capacity, the share of imported energy carriers will increase in parallel with the increase in energy demand. At this time, the country's rich energy resources, especially hydro resources - are largely unutilezed. The total annual potential capacity of the most rivers (approximately 300 rivers) is 15 thousand MW, the average annual energy is equivalent to 50 billion kWh and currently 80% of their potential is unutilezed. In terms of the use of hydro resources, effective management of water resources is of great importance.

It should also be noted that electricity is an important part of the economy, which has the greatest impact on the social sphere and the population of the country. Therefore, the development of electricity infrastructure is a task of strategic importance for the country.

The planned Bakhvi 1 HPP project is considered as part of this strategy and as mentioned above, the project is planned to be implemented on the basis of a memorandum signed with the Government of Georgia.

The project will make a significant contribution to Georgia's long-term policy goal in the energy sector, which will meet the country's demand for hydropower in stages: first by import, then by replacing thermal generation, as well as by exporting surplus electricity generated by newly built and existing hydropower plants.

Based on the above, it can be concluded that the expected economic impact of the project will be high, which will have a positive impact on the social environment, and the expected negative impact on the natural environment can be reduced by planning mitigation measures by maintaining balance between the environmental, social and economic interests of the state and society.

CCEH Hydro VI LLC is obliged to ensure proper management of the risks expected during the implementation of the project in accordance with the principles of sustainable development, to take appropriate mitigation and compensatory measures and to establish strict control over the implementation of these measures. Under such conditions, it will be possible to minimize the scale and area of expected negative impacts on the natural environment, which in turn will increase the effectiveness of the expected positive outcomes.

It should also be noted that the project envisages the construction and operation of a non-regulated (without reservoir), diversion run-of-river type hydropower plant, which is characterized by low environmental impacts compared to regulated hydropower plants.

All permanent and temporary infrastructure of the HPP will be located at a great distance from the recreation area of the resort Bakhmaro. In addition, the project does not envisage the creation of a reservoir, which virtually eliminates the risks of impacts on the local climate. Access roads to the construction site will be arranged outside the recreation area and therefore the risk of impacts on traffic flows and traffic safety in the resort area is minimal.

In view of all the above, the project can be considered as a harmonious part of the long-term policy of the Government of Georgia in the energy sector, which can bring high economic benefits to the country. In addition, the project has the potential for employment of local people, which should be positively assessed given the current social situation.

Given the expected socio-economic benefits of the project and the fact that the expected impact on the environment can be mitigated under appropriate mitigation and compensation measures, no-action alternative is not the best alternative.

3.8 Project Cost and Benefit Analysis

Within the framework of the feasibility study of the project, alternative options of the project (territory; technical details; technology, etc.) are discussed, the relevant costs of the alternatives are calculated and the optimal scenario is selected. This is followed by a detailed calculation of the costs of the selected (optimal) option of the project and the determination of the rate of economic return and the time of return, ie the period of time during which the investor will be able to recover his expenses. Feasibility studies include a complete financial plan, capital and operating cost structure and schedule, and a profit and economic return plan. The cost structure, together with the engineering-technical component of the capital expenditure, should take into account the compensatory value of natural and social impact mitigation measures and damage (residual impacts that could not be mitigated through mitigation measures). The investor is obliged to implement the project in such a way as to minimize the negative impact on the natural and social environment and to fully compensate for the impact (damage, loss), which can not be prevented or mitigated. This obligation is defined by the existing legislation and the conditions of the permit issued for the activity, as well as by the memorandums and agreements concluded between the state and the investor, which usually specify the applied environmental and technical standards and principles. Often, statutory obligations are compounded by the policies of international financial institutions and the requirements of the investor's own standards of performance.

Feasibility study includes the obligations that the investor has made to the state in terms of protection of the natural and social environment. The feasibility document must prove that there is a real economic basis for achieving the economic goals of the project, as well as for fulfilling the commitments made in relation to the protection of the natural and social environment.

In the cost-benefit analysis, we should compare, on the one hand, the full benefits of the project for the country (state, society) and, on the other hand, the share of socio-environmental damage associated with the project, which is not subject to compensation by the investor.

No property is transferred to the company from the state free of charge and therefore no compensated loss is expected.

In the case of Bakhvi 1 HPP, the estimated investment is 61,031 GEL million. Significant amounts (property tax, which is 1% of the book value of the HPP) will be included in the budget in the form of local taxes. In 25 years, about 10 million GEL will be included in the state budget in the form of property taxes by the company. To this will be added the corporate tax in the amount of 10.5 million GEL. In addition, the budget will include a certain amount in the form of income tax, from the salary of the staff hired by the company during both the construction and operation phases.

As for the indirect benefits, the monetary depiction of strengthening energy independence and energy security is extremely difficult. On the one hand, the benefits of the country are probabilistic and reflect the hypothetical situation of limiting the possibility of filling the country's energy deficit with imported energy, when the supply of energy at the market price is artificially restricted by monopolists. On the other hand, the results of the implementation of such a hypothetical scenario will have a multifaceted and complex negative impact on the sustainable functioning of the country's economic system. In addition to direct losses (increase in the price of energy consumed or limitation of energy), indirect consequences will be significant. It will be inevitable to increase the cost of all types of products and services produced using electricity. Even worse (but difficult to predict) consequences will be the deterioration of the investment climate. A significant increase in the volume of investments is unimaginable in the conditions of low level of energy security. Given the current geopolitical situation, we can assume that in the context of dependence on electricity-exporting countries, the probability of using energy levers to the detriment of our country's sovereignty is high.

Among the significant positive results of the project implementation are the expected socio-economic benefits in the region during the construction and operation of the HPP. As the study of the background of the environment showed, the industrial infrastructure in the region is less, almost not developed. Agriculture is the main source of income for the population. In terms of tourism, growth of local revenues at a proper pace in the region cannot be ensured. The migration rate of the population (especially young people) is high, the main reason for which is the insufficient opportunities of employment.

The creation of high-paying temporary and permanent jobs and employment opportunities for the local population are noteworthy. As the practice of implementing similar projects shows, the unskilled labor required for the construction works will be recruited from the local population. In addition, auxiliary infrastructure and business activities will be developed (including: small workshops producing construction materials, transport services, food supply, household services, etc.), which in turn will create additional sources of income and jobs;

During the construction of the HPP a total of 200 people will be employed, of which a significant number will be local workers, and 10-15 people will be employed during the operation phase.

The irreversible impact on the biological environment as a result of the project implementation and the losses caused by this impact is also expected, which is reflected in the removal of vegetation cover on the areas permanently used by the project and reduction of natural water consumption, as well as in negative impact on ichthyofauna.

Regarding vegetation, it should be noted that none of the red list species are affected by the project.

The operation phase of the HPP will be mainly related to the reduction of water levels downstream of the headworks structure and the creation of a weir as a barrier for fish.

The project envisages arranging a pool fish pass, which will compensate for the expected impact to some extent.

In addition, the mitigation measures planned to reduce the negative impact on ichthyofauna will be important in the process of environmental damage and impact assessment:

- Providing the hydropower plant with an efficient fish excluder and ensuring its efficient operation - is a mitigation measure aimed at preventing the destruction of fish due to entry into the hydropower plant pressure system. Fish excluder shall be arranged during the construction process.
- Monitoring of ichthyofauna (quantitative-qualitative), as a result of which it will be possible to assess the condition of the trout in the basin, evaluate the effectiveness of fish excluder and fish pass, etc. Monitoring should be carried out annually for 5 years.

Based on the above information, it is possible to assess the socio-economic viability of the project, namely: under the agreement with the Government of Georgia and the investor, the direct and indirect socio-economic benefits that the country will receive (Revenues in the form of property and profit taxes in the state budget are sufficient to justify the implementation of the project and to allow for possible impacts on the social and natural environment (obviously given that all appropriate measures will be taken to mitigate the impacts and mitigate the residual impacts)).

4 Project Description

Bakhvi 1 HPP project is planned to be implemented in Guria region, in particular: on the territories of Chokhatauri and Ozurgeti municipalities. HPP will be arranged on the river Bakhvitskali, downstream of the resort Bakhmaro.

Project envisages the construction of the run-off-river type HPP on Bakhvistskali River, which will include headworks, penstock and above ground powerhouse. The installed capacity of the HPP will be 10.9 MW, gross head - 342.40 m, and design flow - 4 m³/s. The headworks are located approximately 200 m downstream of the confluence point of the Bakhvistskali and the Baisuras Ghele river, the full supply level is 1731.70 m asl. The tailwater level of the powerhouse is 1383.0 m asl. The approximate geographical coordinates of the location of the headworks are X=275290; Y=4638195, and geographical coordinates of the powerhouse are X=272279; Y=4639129.

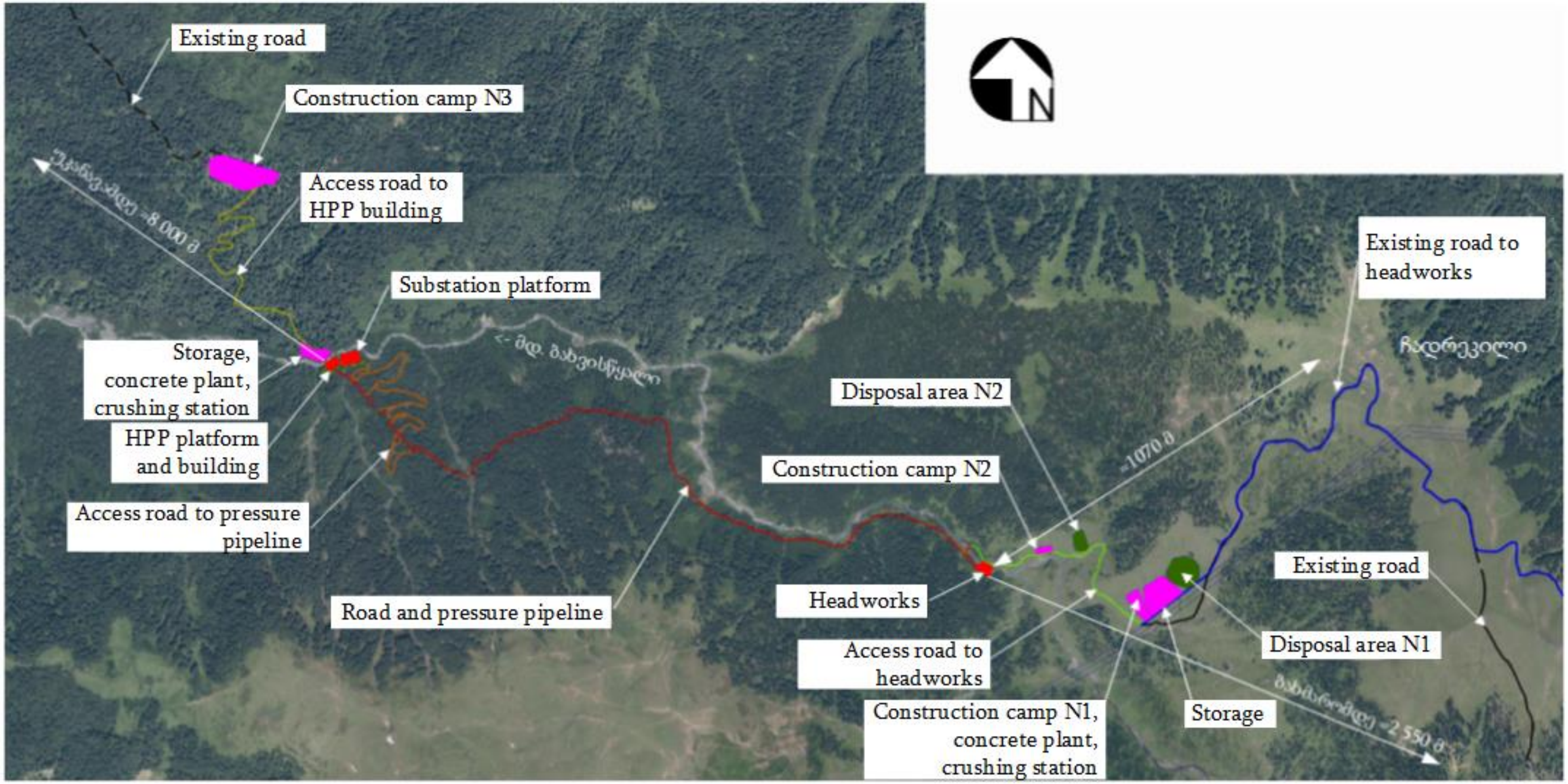
The main technical characteristics of the HPP are given in Table 4.1., and the layout scheme of the HPP infrastructure is given in Figure 4.1

Table 4.1. Main technical characteristics of Bakhvi 1 HPP

Name	Unit	Design parameters
New road		
Type		Gravel topped road
Width	m	5.50
1.1. Access road to headworks		
Length	m	1236
1.2 Access road to powerhouse		
Length	m	1747
1.3 Penstock access road (From powerhouse to GRP penstock alignment)		
Length	m	2152
1.4 GRP Penstock (GRP pipe) road		
Length	m	3209
Headworks		
Type		Diversion scheme; concrete weir structure with lateral intake
Crsst elevation	m a.s.l.	1731.95
Full supply level	m a.s.l.	1731.70
Max. height above foundation	m	8.50
Height above riverbed	m	4.40
Spillway type:		Free overflow (Ogee crest)
Design flood	m³/s	112 (HQ 100)
Safety check flood	m³/s	180 (HQ 300)
Dissipation structure type:	m	18.55
Flushing channel		
Number of flushing sluice	Unit	1
Flushing gate	m	2.00 m (width) x 4.10 (height)
Flushing sluice design flow	m³/s	37
Intake		
Type:	-	Lateral with flushing channel
Number of opennings	Unit	2
Dimensions of opennings	m	2.5 x 1.2
Spacing between the bars of trash-rack	mm	15
Trash-rack cleaning	-	Horizontal cleaning device
Desander		

Type:	-	Reinforced concrete
Length	m	67.10
Width	m	10.70
Maximum height	m	6.80
Number of chambers	Unit	3
Design flow	m^3/s	4
Diameter of sediment particles	mm	0.2
Pressure system		
Section 1 – GRP penstock		
Type		Buried glass fibre reinforced pipe (GRP)
Inner diameter	mm	1300
Axis elevation start point	m a.s.l.	1728.70
Axis elevation end point	m a.s.l.	1648.03
Length	m	3217
Section 2 – steel penstock		
Type	-	Buried steel pipe
Inner diameter	mm	1100
Axis elevation start point	m a.s.l.	1648,03
Axis elevation end point	m a.s.l.	1389.30
Total length of steel penstock	m	598
Number of anchor blocks:	Unit	8
One pipe bridge free span	m	25
Powerhouse		
Type		Surface structure
Dimensions	L × B × H,	40 x16.2x15.8
Rooftop elevation	m a.s.l.	1402.90
Foundation elevation	m a.s.l.	1386.10
Tail water elevation	m a.s.l.	1383.00
Turbine type		Vertical Pelton
Number of turbines	Unit	2
Turbine centre line	m a.s.l.	1389.30
Gross head	m	342.40
Installed capacity per unit	MW	5.44
Switchyard		
Type:	-	Air insulated switch yard
Location:		Orographic left bank of the river, upstream of powerhouse
Width	m	50
Length	m	80
Platform elevation	m a.s.l.	1400
Voltage level	kV	110/35/10

Figure 4.1. Layout scheme of Bakhvi 1 HPP infrastructural facilities



4.1 General Overview of HPP Infrastructure

4.1.1 Headwork

Construction of Bakhvi 1 HPP is planned 250 m downstream of confluence of Bakhvitskali and Baisura Ghele rivers, at an altitude of 1727 m of Bakhvistskali river. According to the project, it is planned to arrange a concrete weir with a lateral intake. The height of the weir from the level of the foundation will be 8.50 m, and from the level of the river bed 4.40 m. The crest elevation of the weir will be 1731.95 m, while the maximum flood level will be 1731.70 m a.s.l.

The headwork will include the spillway weir, intake, flushing sluice, fish pass and desander. The general plan of the headwork structure is given in Figure 4.1.1.1., 3-D image of the headwork structure is given in Figure 4.1.1.2., while the plan of the headwork structure is given in Figure 4.1.1.3.

The project envisages the arrangement of a free spillway, the maximum designe flow of which is 112 m^3/s (HQ 100), and the maximum check flow is 180 m^3/s (300-year recurrence). In order to dissipate energy of water overflowing from spillway, 18.55 m long reinforced concrete stilling basin will be arranged downstream of the weir. The section and 3-D image of spillway is given in Figure 4.1.1.4.

In order to wash out the sediment accumulated upstream of the weir, it is planned to arrange a flushing sluice equipped with 2 m wide and 4.10 m high flushing gate. According to the project, capacity of flushing sluice is 37 m^3/s (HQ 10).

The weir will be equipped with a lateral intake desinged to receive 4.0 m^3/s water flow. The intake will be arranged along the left bank of the river. It is planned to arrange two openings of the water intake with dimensions 2.5X1.2 m. The intake openings will be equipped with thin horizontal bars. A horizontal cleaning device will be installed in front of the bars to clean the water intake from the sediment.

Arranagement of the reinforced concrete desander is planned on the left bank of the river, the length of which will be 67.10 m, the width - 10.70 m, and the maximum height - 6.80 m. The desander will consist of three chambers. The design flow is 4 m^3/s. Desander is desinged for settlement of 0.2 mm diameter sediment particles. The section of desander is given in Figure 4.1.1.5.

Figure 4.1.1.1. General plan of the headworks

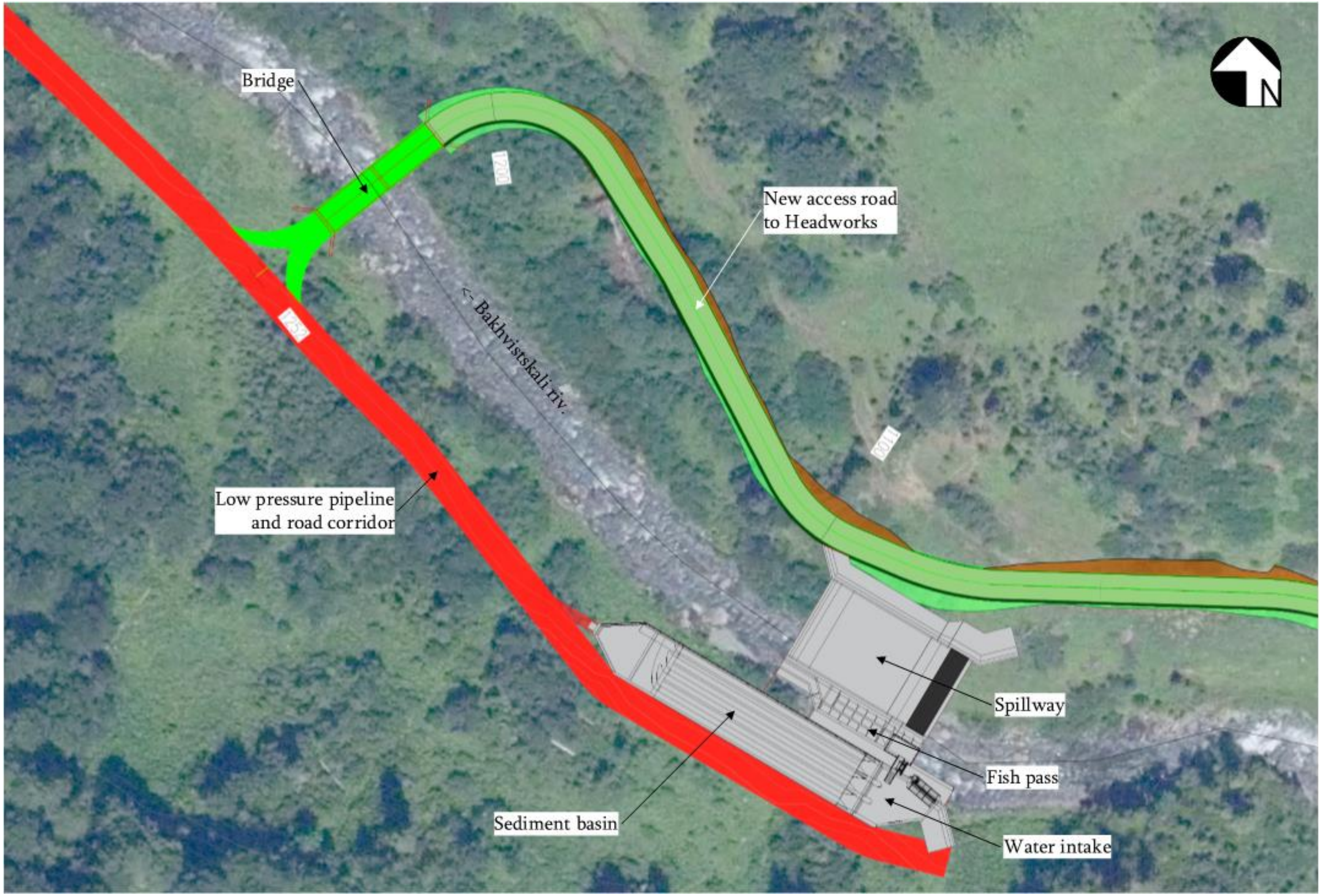


Figure 4.1.1.2. 3-D image of headworks

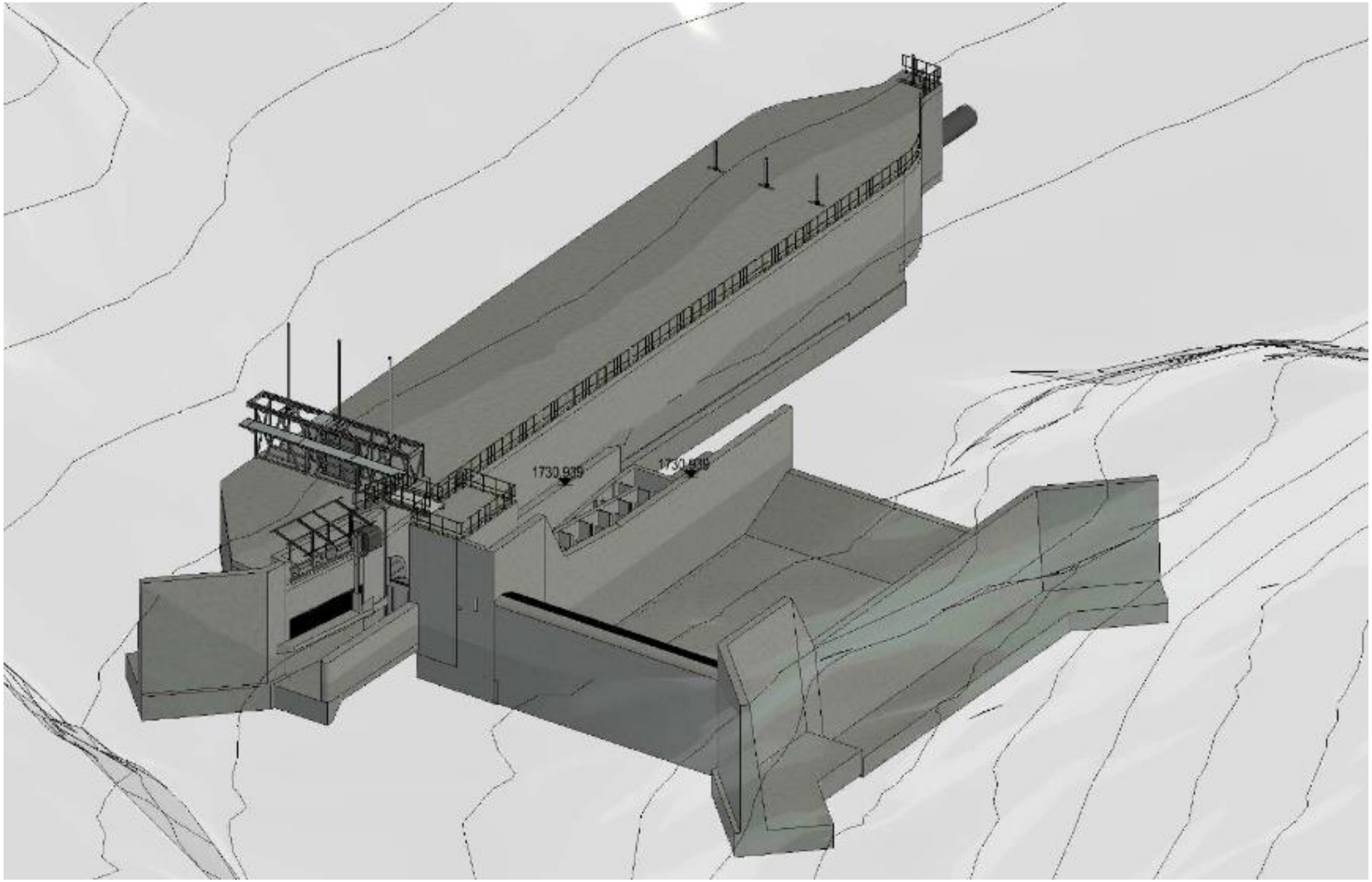


Figure 4.1.1.3. Plan of the headworks

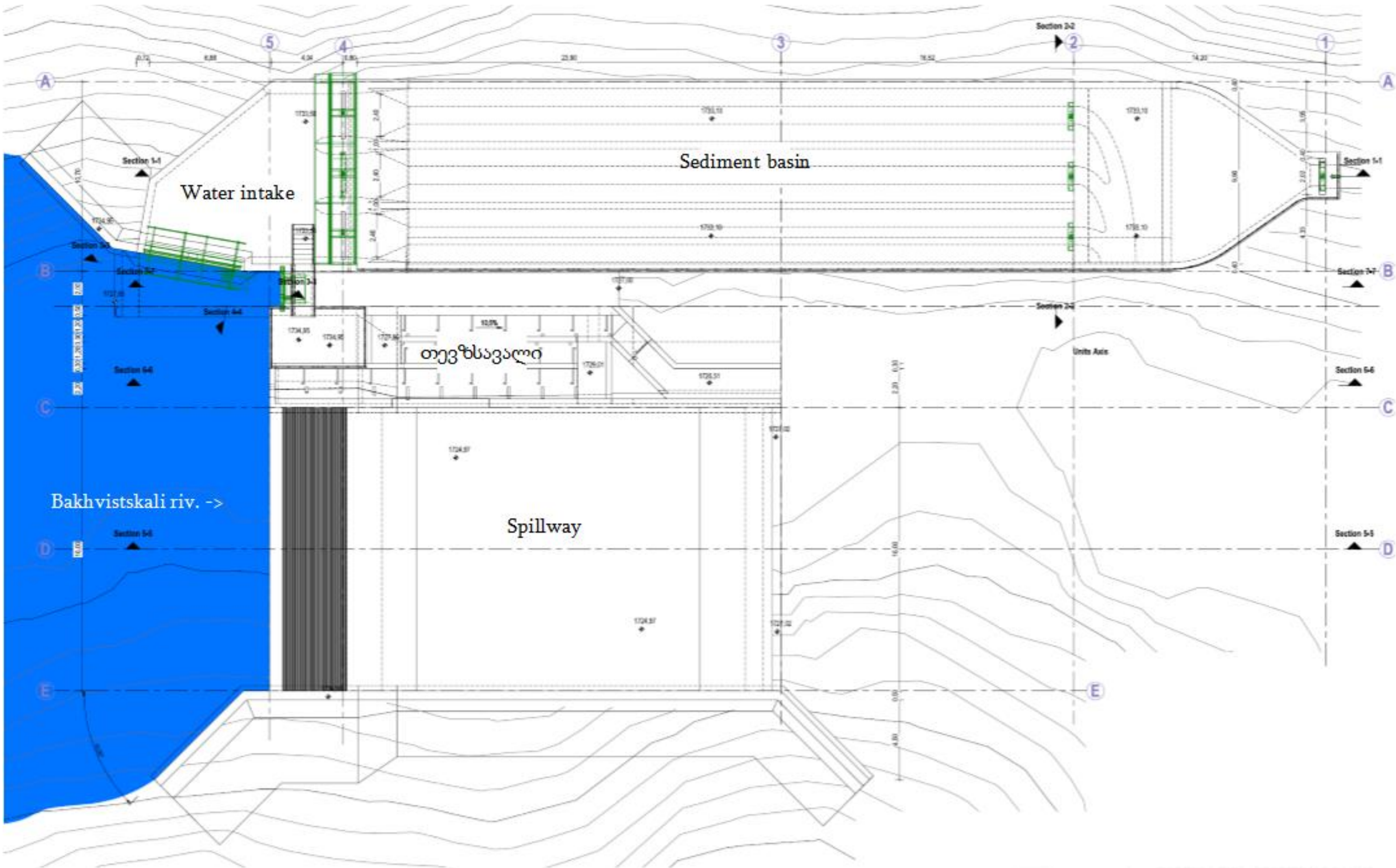
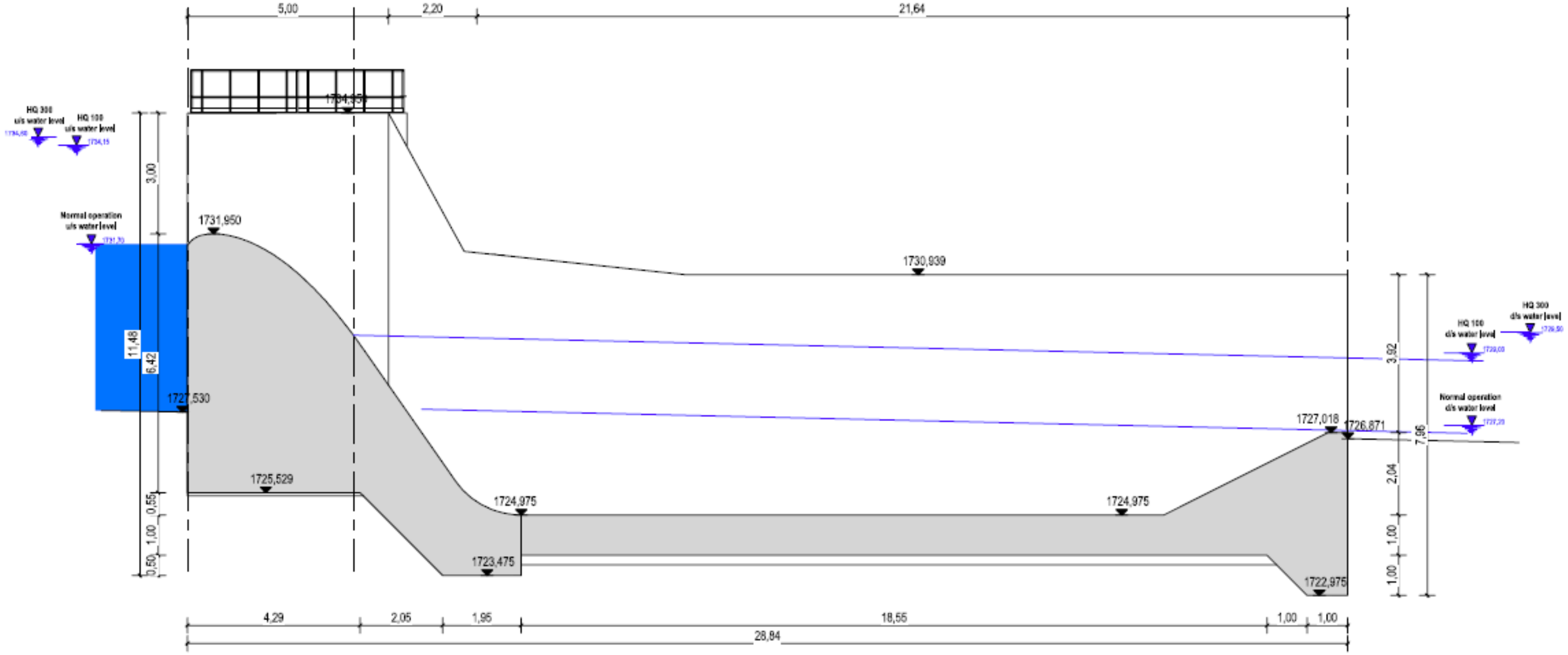


Figure 4.1.1.4. Section and 3-D image of spillway and dissipation basin



Section 5-5
1:75

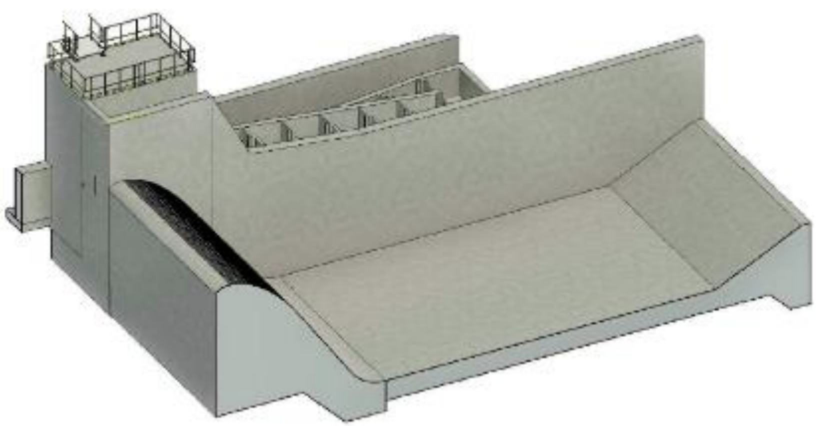
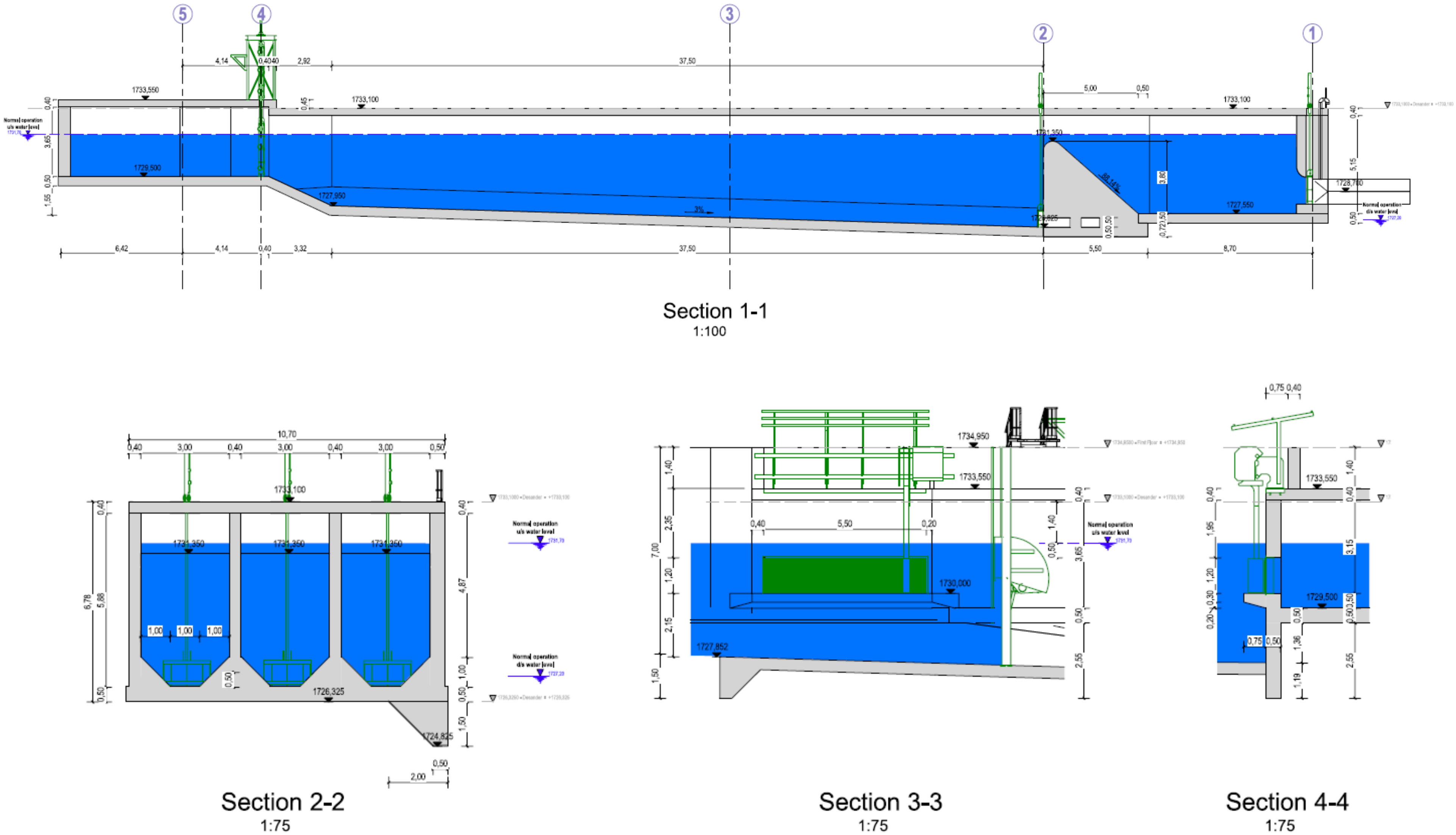


Figure 4.1.1.5. Sections of intake and sections



4.1.1.1 Fish Pass

Due to the low height of the dam, it was planned to arrange a natural fish pass, but as there is not sufficient space available for a natural type fish pass, the decision was made to arrange a a vertical-slot type fish pass. The fish pass has been designed in accordance with the DVWK Guidelines (Fish passes – Design, dimensions and monitoring, 2002).

The relevant fish type has been given as brown trout and the main dimensions for the individual pools are given in the Table 4.1.1.1.1. (DVWK guidline):

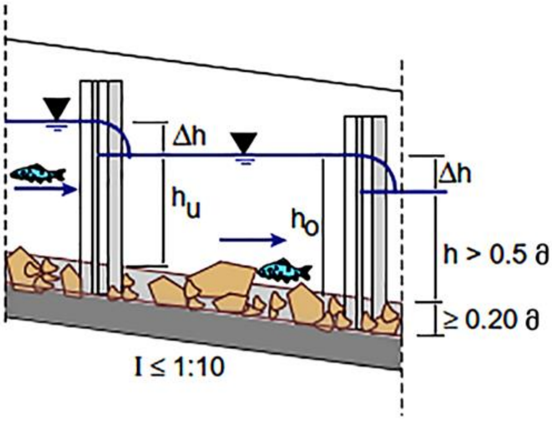
Table 4.1.1.1.1. Minimum dimensions of fish pass (dimensions are in m)

Table 5.2: Minimum dimensions for slot passes with one slot only (dimensions in m)
(According to GEBLER, 1991, and LARINIER, 1992a)

Fish fauna to be considered		Grayling, bream, chub, others		Sturgeon
		Brown trout	Salmon, sea trout, huchen	
Slot width	s	0.15 – 0.17	0.30	0.60
Pool width	b	1.20	1.80	3.00
Pool length	l_b	1.90	2.75 – 3.00	5.00
Length of projection	c	0.16	0.18	0.40
Stagger distance	a	0.06 – 0.10	0.14	0.30
Width of deflecting block	f	0.16	0.40	0.84
Water level difference	h	0.20	0.20	0.20
Min. depth of water	h_{min}	0.50	0.75	1.30
Required discharge[1]	Q in m^3/s	0.14 – 0.16	0.41	1.40

[1] calculated for $\Delta h = 0.20$ m and h_{min}

Figure 4.1.1.1.1. Schematic longitudinal section pof fish pass



The total environmental flow has been defined as 0.29 m³/s (= 10% of mean annual flow) which is above the required discharge of 0.14 – 0.16 m³/s within the fish pass. The additional flow will be provided via a bypass pipe, which will discharge in close vicinity of the downstream entrance of the fish pass.

The total head difference for the fish pass is given by the u/s normal operating water level and the minimum water level (at low flow) in the riverbed at the entrance:

- Upstream normal operating water level = 1731.70 masl
- Downstream min. river water level = 1727.10 masl
- Head difference = 4.60 m
- Water level difference per pool = 0.20 m
- Number of required pools = 23

The pools provide the required water depth of min. 0.5 m and in addition 0.2 m of bottom substrate.

4.1.1.2 Fish Excluder

The intake is equipped with a horizontal bar screen which also acts as a fish excluder. The bar screen has a spacing width of 15 mm. In addition, the approach flow velocity to the intake (v = 0.67 m/s) and the nett velocity through the bar screen (v = 0.83 m/s) is relatively low to protect fish in the vicinity of the intake.

Figure 4.1.1.2.1. Typical intake with horizontal thin bar screens (opennings15 mm)

In addition, an airlift method-based fish excluder will be arranged on the intake.

When operating this type of fish excluder, air bubbles, as they rise to the surface of the water, can bring to the surface fairly solid particles and objects. First, solid particles are brought to the surface as a result of sticking (flotation effect) of air micro-bubbles on the subject.

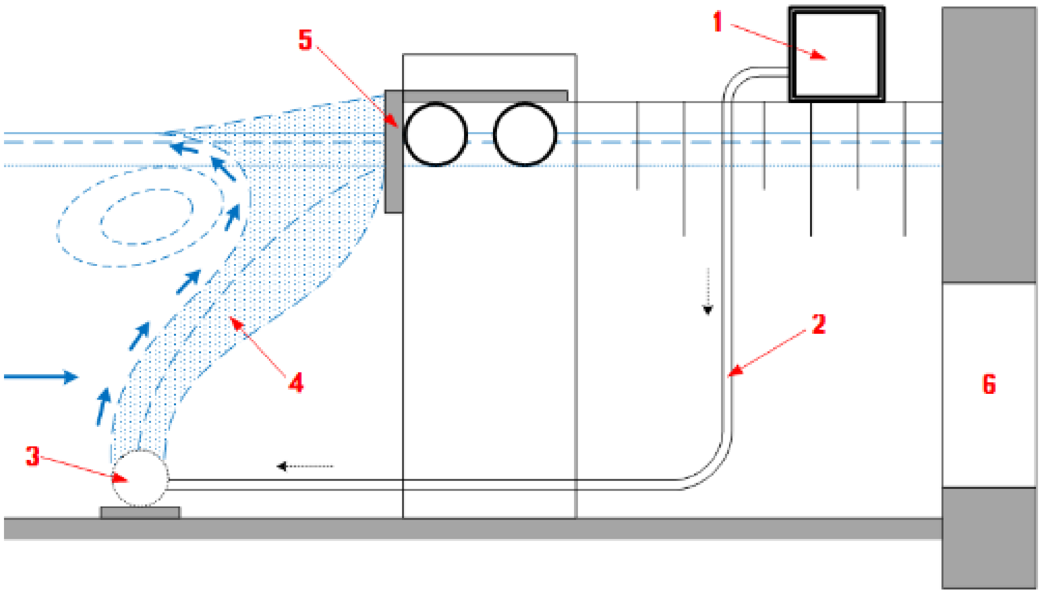
Secondly, solid particles are brought to the surface of water mainly by the intense flow of large air bubbles that adhere to the lower surface of the subject and reduce the subject's own weight, which in turn causes them to float to the surface.

Thirdly, solid particles are brought to the surface of the water by the vertical flows of water mass created by the air-bubble flow.

The effectiveness of this method of fish excluder varies from 75% to 90%.

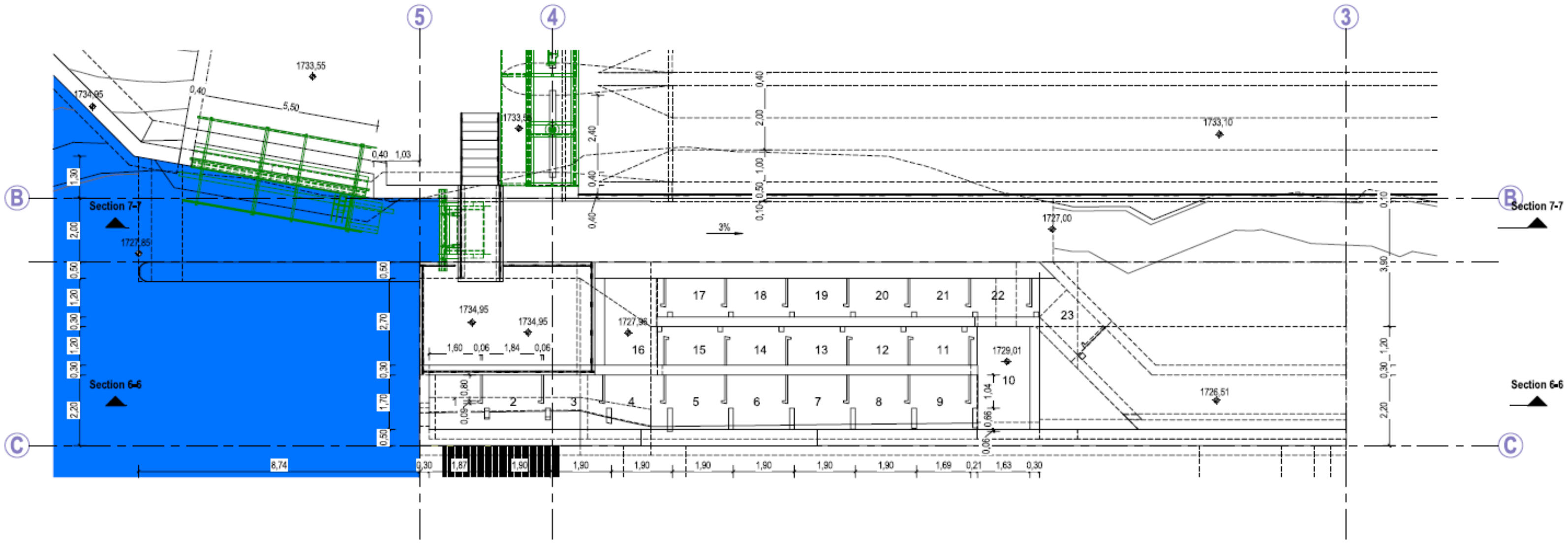
The operation principle of the proposed fish excluder is shown in Figure 4.1.1.2.1.

Figure 4.1.1.2.1. Scheme of airlift method-based fish excluder planned on intake

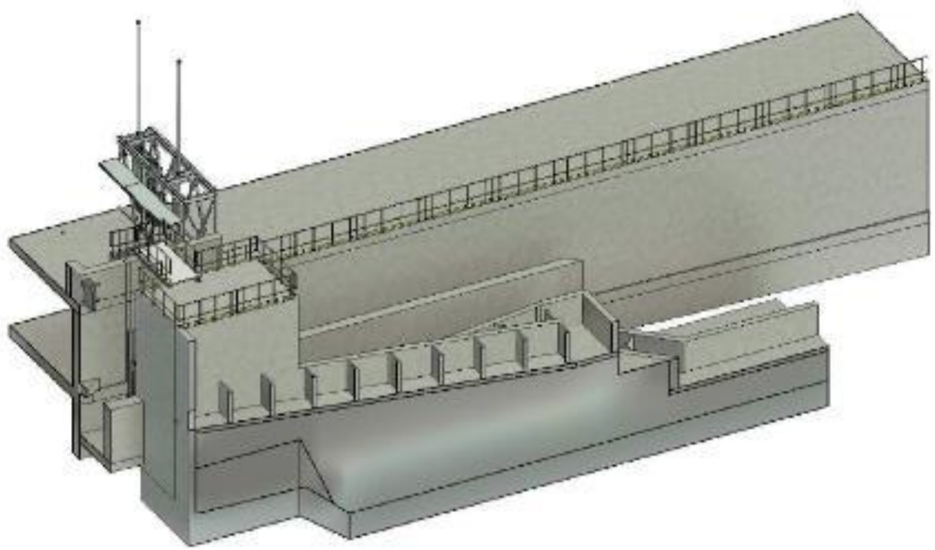


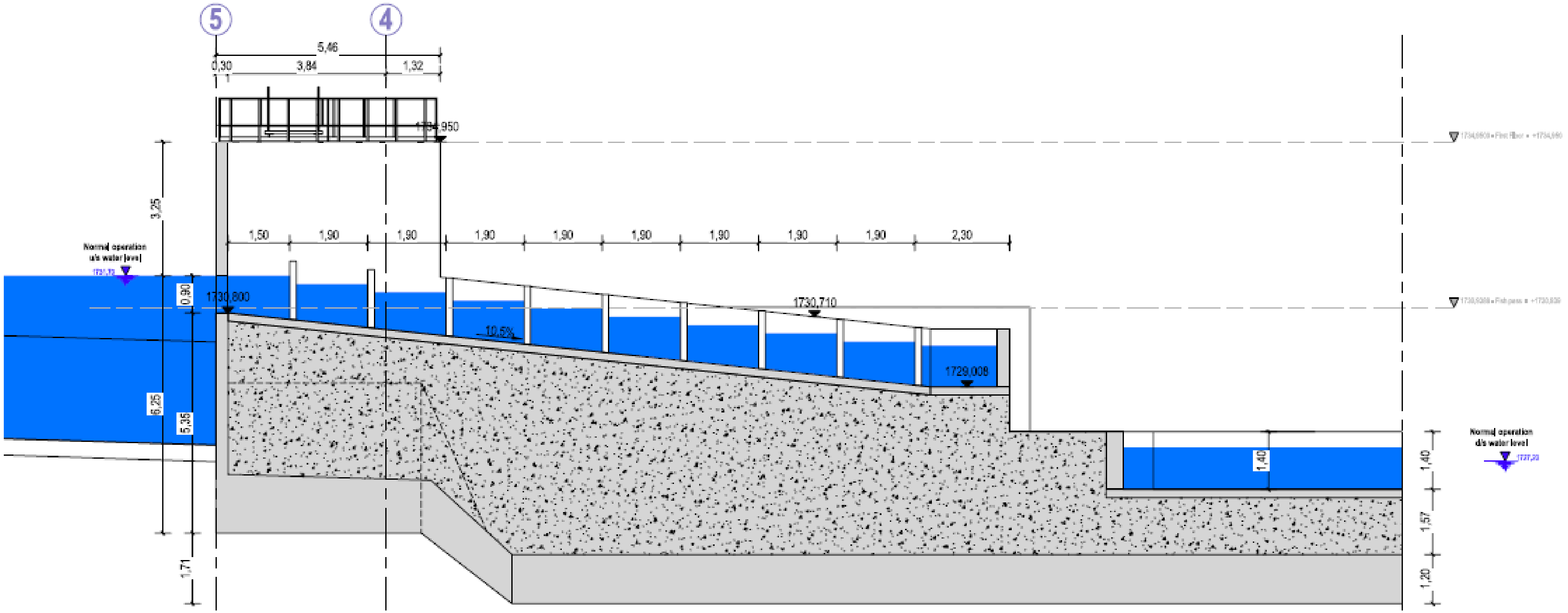
1- air compressor; 2 - air intake pipe; 3 - perforated pipe; 4 - ir-bubble curtain; 5 - floating boom; 6 - water intake.

Figure 4.1.1.2.2. Plan, 3-D image and section of fish pass



Plan View at El. 1734.95 m asl
1:75





Section 6-6
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4.1.2 Penstock

Water will be supplied from headworks to powerhouse via penstock planned on the left bank of Bakhvistskali River. The penstock consists of two sections, namely: 3209 m long low pressure reinforced fiberglass (GRP) penstock and 598 m long high pressure steel penstock. Penstock will be arranged underground. The scheme of the penstock is given in Figure 4.1.2.1.

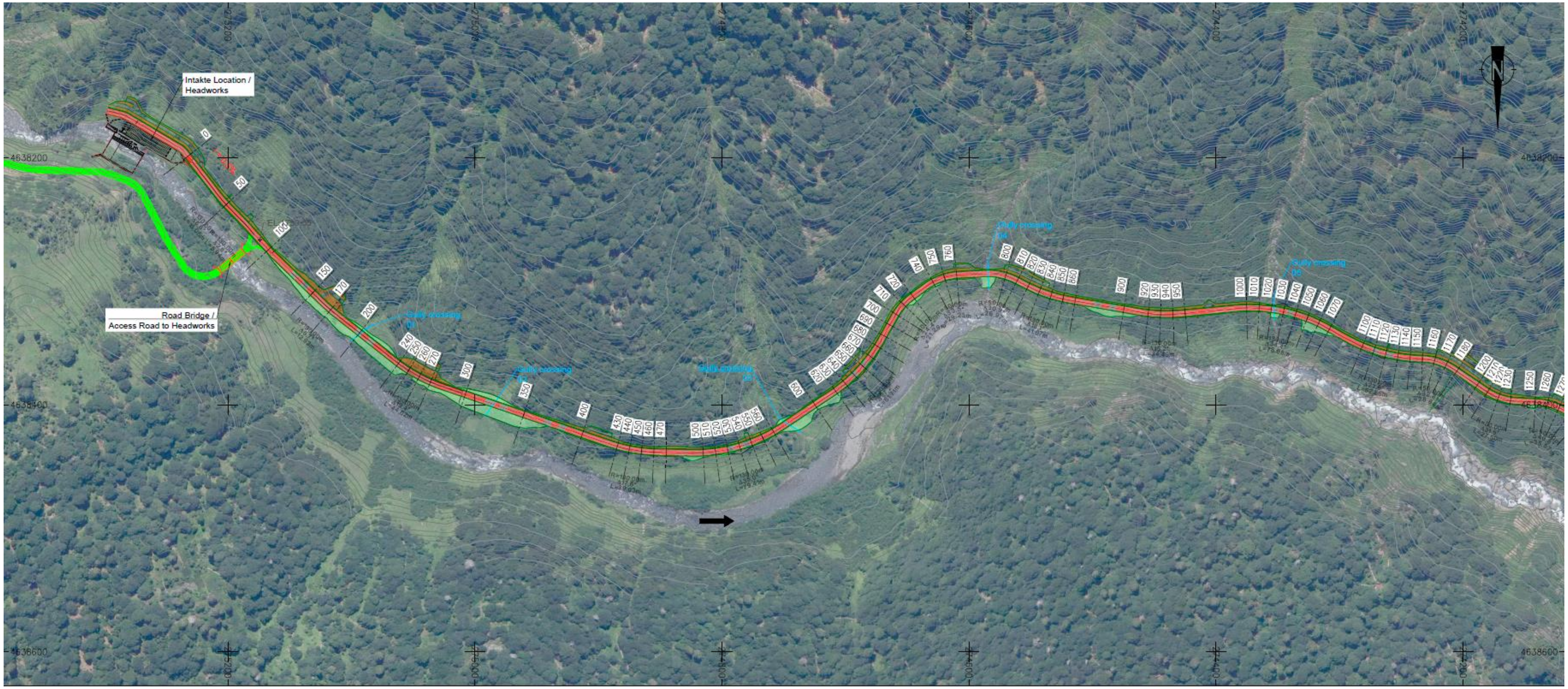
The diameter of the reinforced fiberglass pipe will be 1300 mm. The starting point of the pipeline axis will be 1728.70 m a.s.l., and the end point will be 1648.03 m above sea level. Initially, the road will be arranged in the corridor of the penstock. The penstock will be arranged under the road base, at a depth of not less than 1 m from the ground surface. The average trench depth for the pipeline will be 2.53 m and the width of the trench bottom - 2.50 m.

Typical sections of the penstock are given in Figure 4.1.2.2.

There are 8 natural ravines in the corridor of the reinforced fiberglass penstock, which will be crossed by bridges. The diameter of the underground steel penstock is 1100 mm. The starting point of the pipeline will be at 1648.0 m a.s.l., and the end point will be at 1389.30 m above sea level. Arrangement of the initial 520 m long section of the penstock will be arranged with spiral welded steel pipes, and the last 78 long section - with high pressure steel pipes.

The steel penstock will be placed on the anchor blocks. The project envisages the arrangement of 8 anchor blocks.

Figure 4.1.2.1. Scheme of penstock (3 parts)



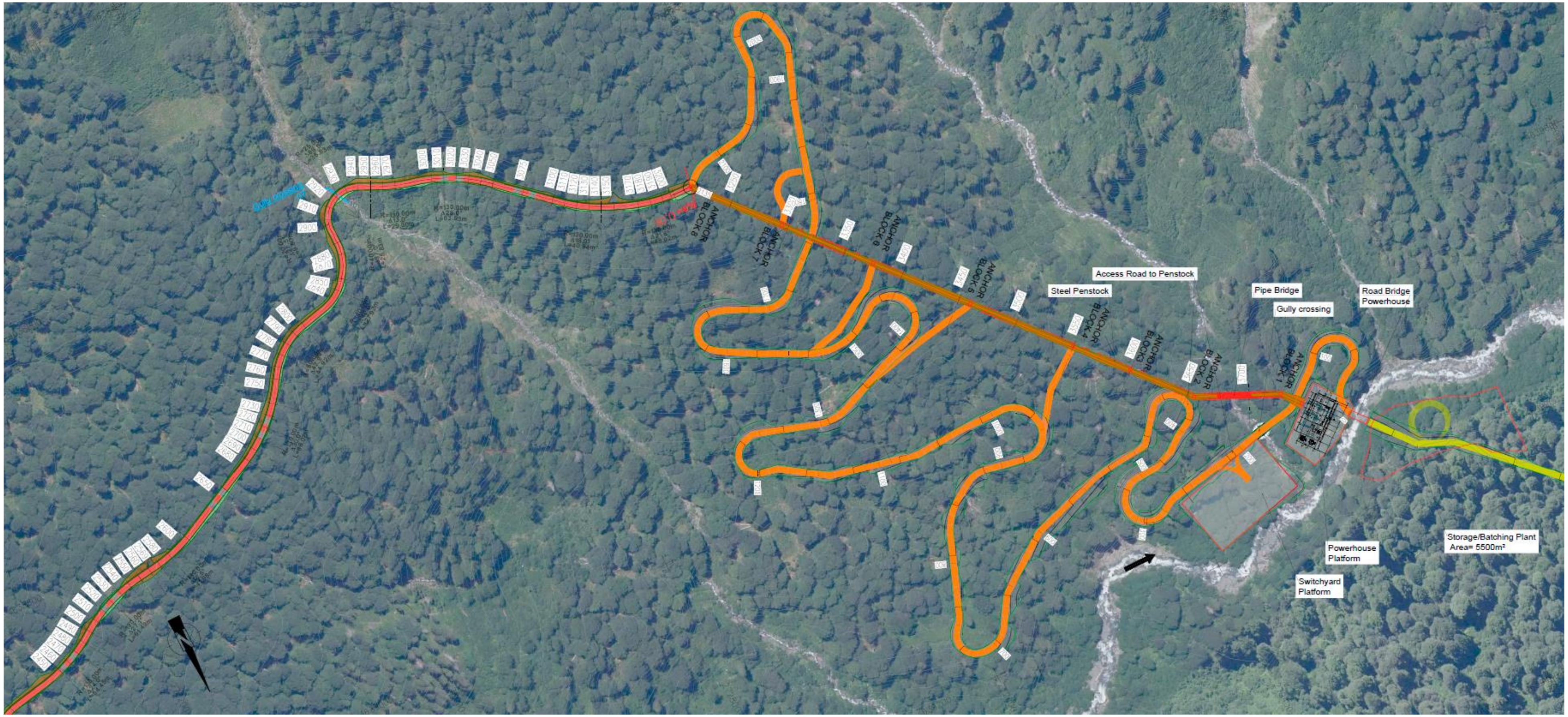
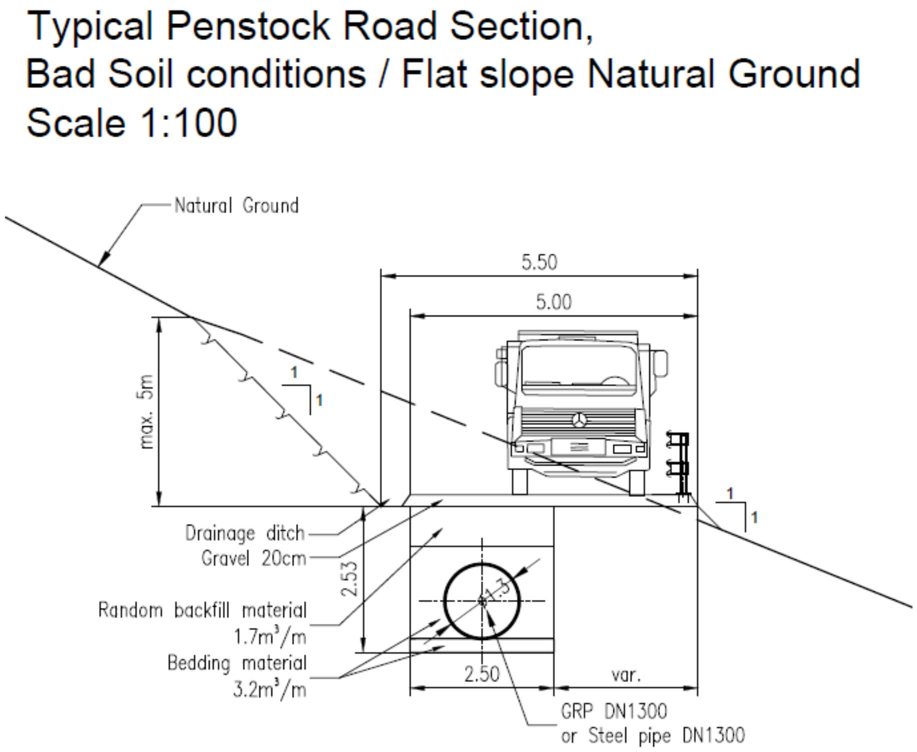
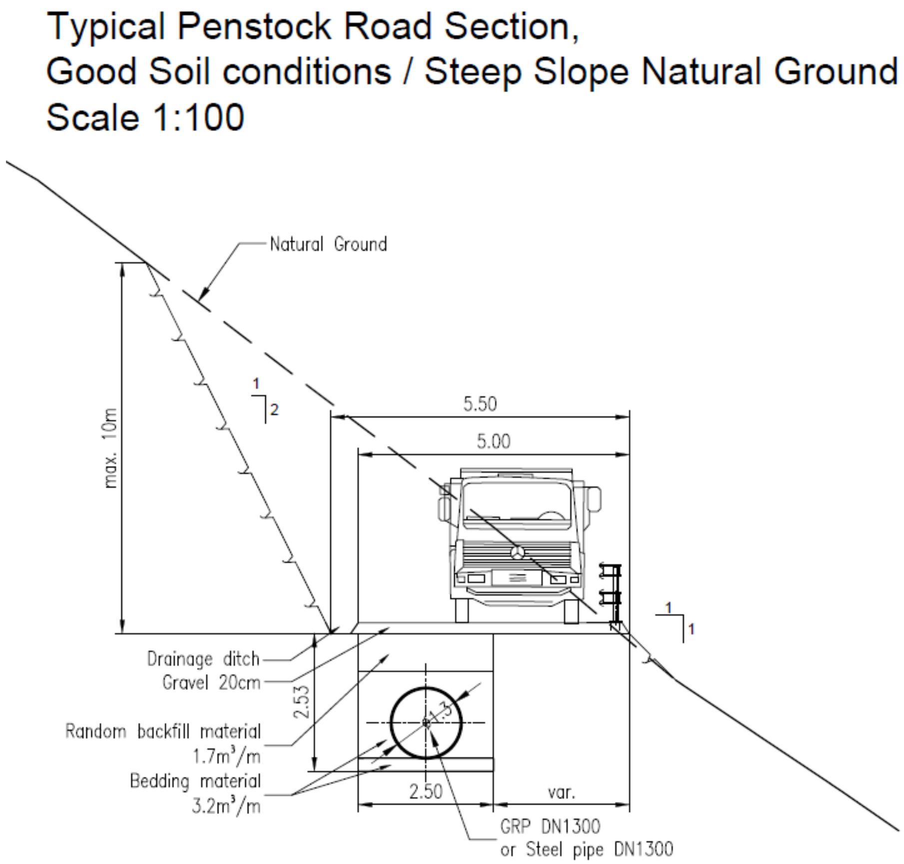
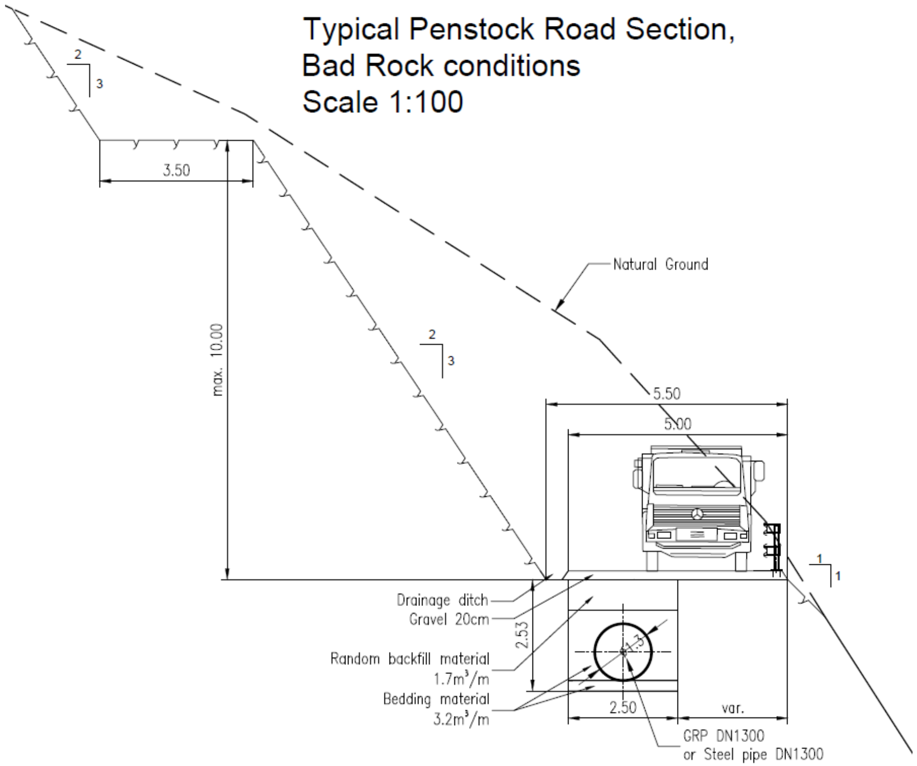
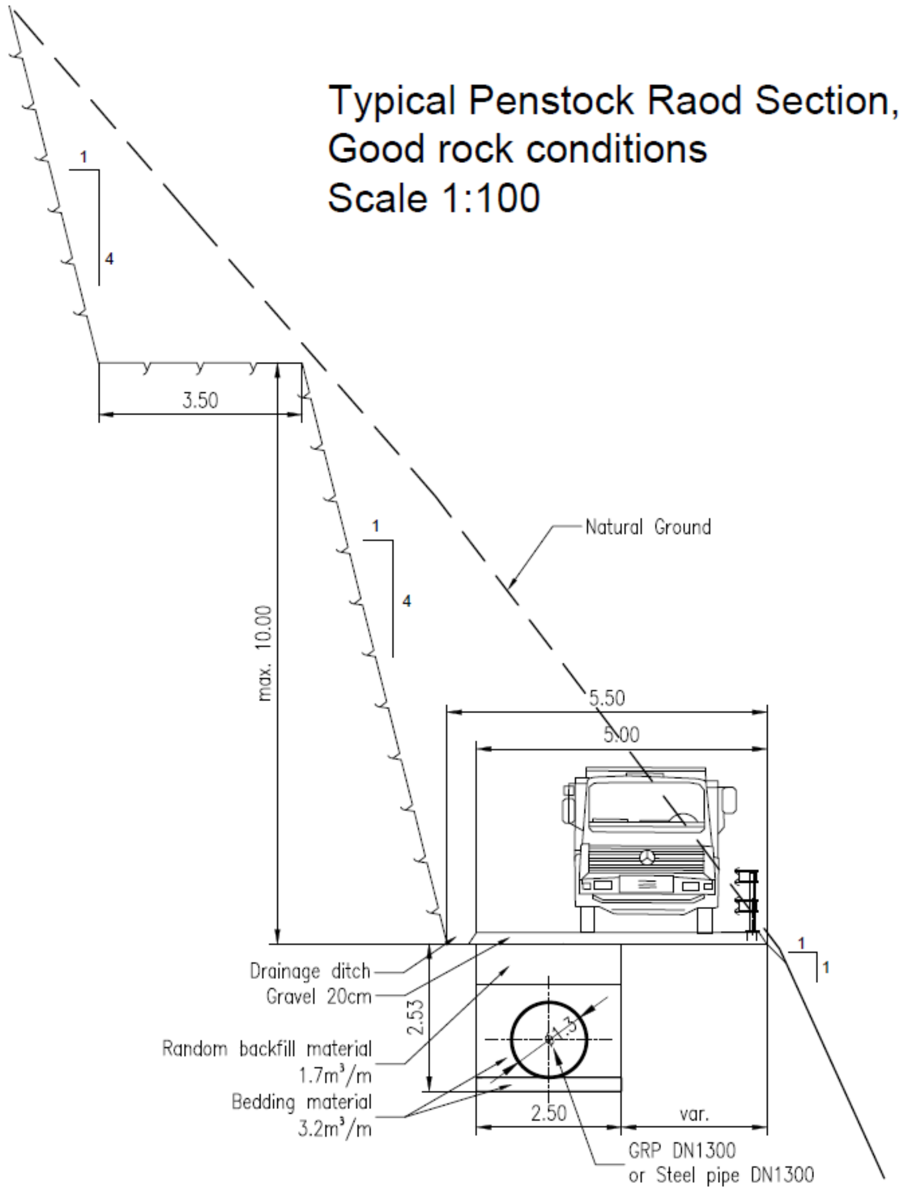

Access Road to Penstock
Steel Penstock
Pipe Bridge
Gully crossing
Road Bridge Powerhouse
Storage/Batching Plant Area= 5500m²
Powerhouse Platform
Switchyard Platform
ANCHOR BLOCK 8
ANCHOR BLOCK 7
ANCHOR BLOCK 6
ANCHOR BLOCK 5
ANCHOR BLOCK 4
ANCHOR BLOCK 3
ANCHOR BLOCK 2
ANCHOR BLOCK 1

Figure 4.1.2.2. Typical sections of pipeline

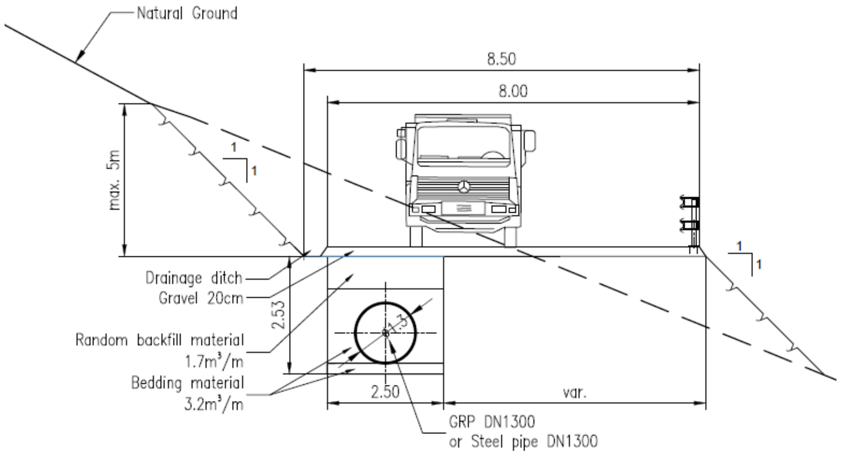




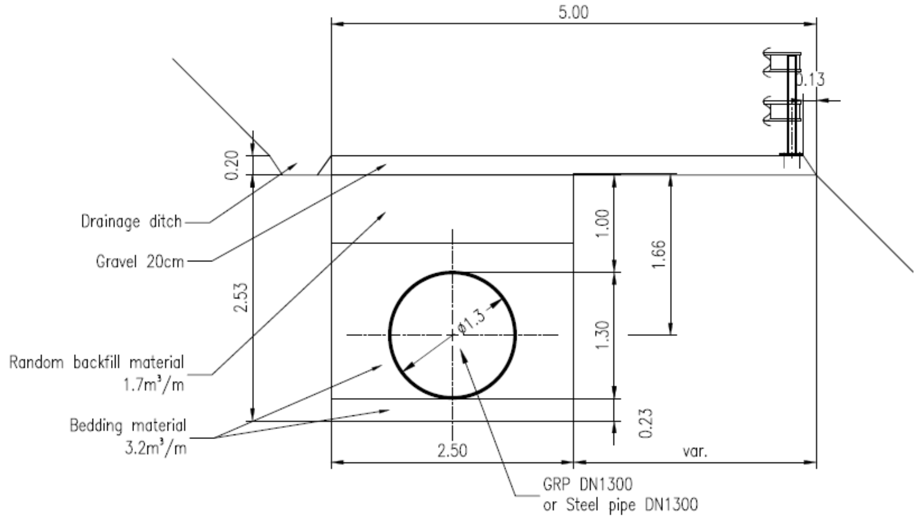

Typical Penstock Road Section,
Bad Rock conditions
Scale 1:100
2
3
3.50
max. 10.00
Natural Ground
5.50
5.00
1
1
Drainage ditch
Gravel 20cm
2.53
Random backfill material
1.7m³/m
Bedding material
3.2m³/m
2.50
var.
GRP DN1300
or Steel pipe DN1300


Typical Penstock Raod Section,
Good rock conditions
Scale 1:100
1
4
3.50
max. 10.00
Natural Ground
5.50
5.00
1
1
Drainage ditch
Gravel 20cm
2.53
Random backfill material
1.7m³/m
Bedding material
3.2m³/m
2.50
var.
GRP DN1300
or Steel pipe DN1300

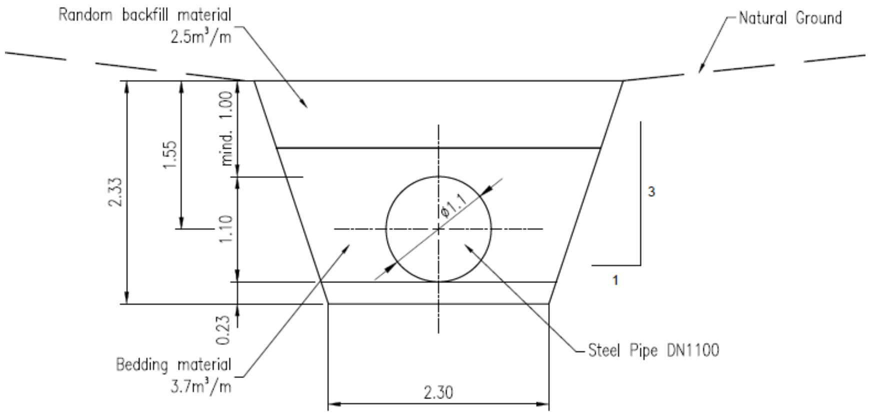
Typical Penstock Road Section, Road widening/ lay-by (road bay)
Bad Soil conditions / Flat slope Natural Ground
Scale 1:100



Typical Section for Penstock Road
Scale 1:50



Typical Section for Penstock without Road
Scale 1:50



4.1.3 Powerhouse

Power unit of Bakhvi 1 HPP includes the powerhouse and 110 kV substation. The following key criteria were considered in the process of selecting the location of the power unit:

- Safety of structures, their protection from rock falls, avalanches and landslides;
- Sufficient space for all facilities (water supply, warehousing, car parking, infrastructure, etc.);
- Protection from flooding of the river bed;
- Arrangement of the tail-water channel at the lowest elevation to ensure the achievement of the installed capacity of the HPP.

According to the project, it is planned to arrange the powerhouse on the first terrace of the left bank of Bakhvitskali River, at 1386.10 m above sea level. The above-ground power house will be equipped with: a bridge crane, two horizontal Pelton turbines, control equipment and auxiliary electrical equipment. Approximate dimensions of the powerhouse are: Length - 40.0 m, width - 16.2 m, and height - 16.8 m. According to the project, each unit will have its own tailrace channel at the end of which a gate will be provided. The tailrace channel is a several meters long concrete channel through which water will be discharged back to Bakhvistskali River.

In addition to machine hall, spaces such as storage cells, electrical, service, management and wardrobe, kitchens and toilets will be also provided. The power house will be equipped with a modern fire-fighting system and fire reservoirs.

The main characteristics of the turbine are given in Table 4.1.3.1. The characteristics of the turbine provided in the powerhouse were determined based on the technical analysis of the turbines produced by different manufacturers.

Table 4.1.3.1. Key characteristics of the turbine

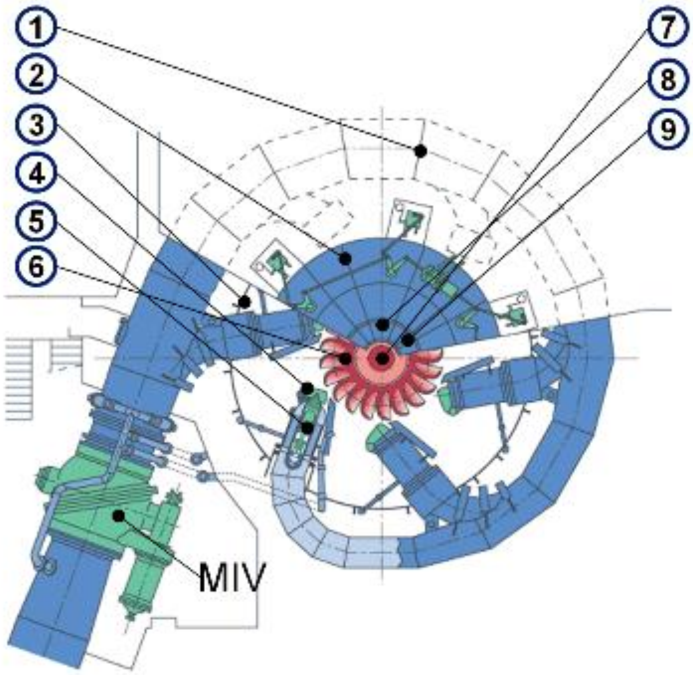
Turbine Characteristics		Unit
Rated net head	320,7	m
Rated discharge per unit	2,00	m^3/s
Discharge at maximum net head	1,90	m^3/s
Discharge at minimum net head	2,00	m^3/s
Maximum turbine capacity at shaft	5,70	MW
Synchronous speed	750	rpm
Runner pitch diameter D2	960	mm
Centreline elevation	1389,3	m a.s.l.
Number of nozzles	4	Unit

During the implementation phase those dimensions may deviate in the order of magnitude of about ±10%, depending on the selected manufacturer.

The Pelton turbine main components are shown in Figure 4.1.3.1. and consist of the following main parts:

1. Distributor/turbine manifold
2. Turbine cover
3. Turbine housing
4. Jet deflectors
5. Injector system
6. Turbine runner
7. Turbine shaft
8. Turbine shaft seal

Figure 4.1.3.1. Pelton turbine main components



The technical parameters of the generators are given in Table 4.1.3.2.

Table 4.1.3.2. Technical parameters of generators

Parameter	Unit	Value
Nominal capacity	MVA	7
Capacity ratio	-	0,85
Nominal voltage	kV	6,3
Frequency	hz	50
Rated speed	rpm	750
Number of idle turns	rpm	1425
Cooling system		Air / Water
Insulation class		F class
Dimensions of transportation	m	Apprex. 4,5 x 3 x 3
Transport weight	t	30
Number of units	Unit	2

Each turbine will be equipped with an oil pressure regulating system that ensures the operation of the turbine and the turbine front valve and combines the following components: oil tank, pumps, valves, high pressure pipes, sensors and nitrogen cylinders. The maximum pressure of the system is 150 bar. It is located next to the turbine and the main inlet valve.

The oil pressure regulating system will be equipped with spare oil pumps, which ensure self-suction and continuous operation through the reduction (regulating) and discharge valves under the conditions of maximum oil pressure.

In the event of a malfunction of the oil pumps, the nitrogen cylinders provide the proper oil pressure to complete the operation of the turbine front valve in the following sequence - closing-opening-closing.

Equipment is designed to minimize the risk of oil spills. The tender will consider the use of biodegradable oil to avoid negative impacts on the environment.

The high pressure unit will be placed on stainless steel pallets, where the oil extracted from the unit will be fully collected and its leakage will be prevented during emergency situations.

The powerhouse is provided with a sewerage system, which ensures the collection of drainage water and its discharge into the tailrace channel. The drainage system will be equipped with a standard oil separator to discharge oil-purified water into the tailrace channel. On the other hand, the dehydration system ensures that the turbine manifold is drained of water and the water is discharged under high pressure into the tailrace channel.

A water cooling system consisting of a cooling radiator and a circulation pump will be used to cool the turbines, which will supply cooling water to the following components:

- Generator bearings;
- Generator cooler.

Figure 4.1.3.1. General plan of the powerhouse and substation

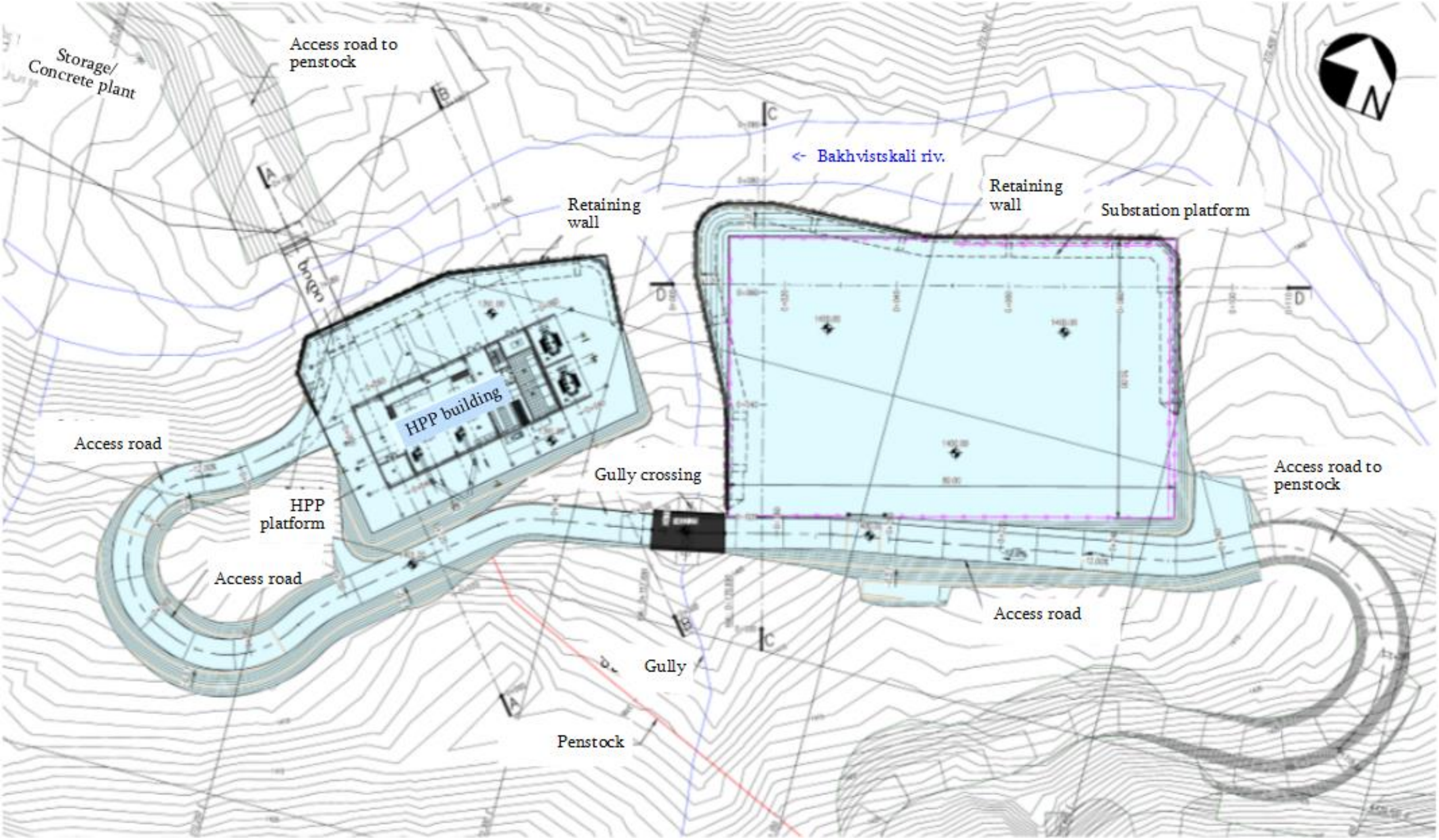


Figure 4.1.3.2. Section of powerhouse platform

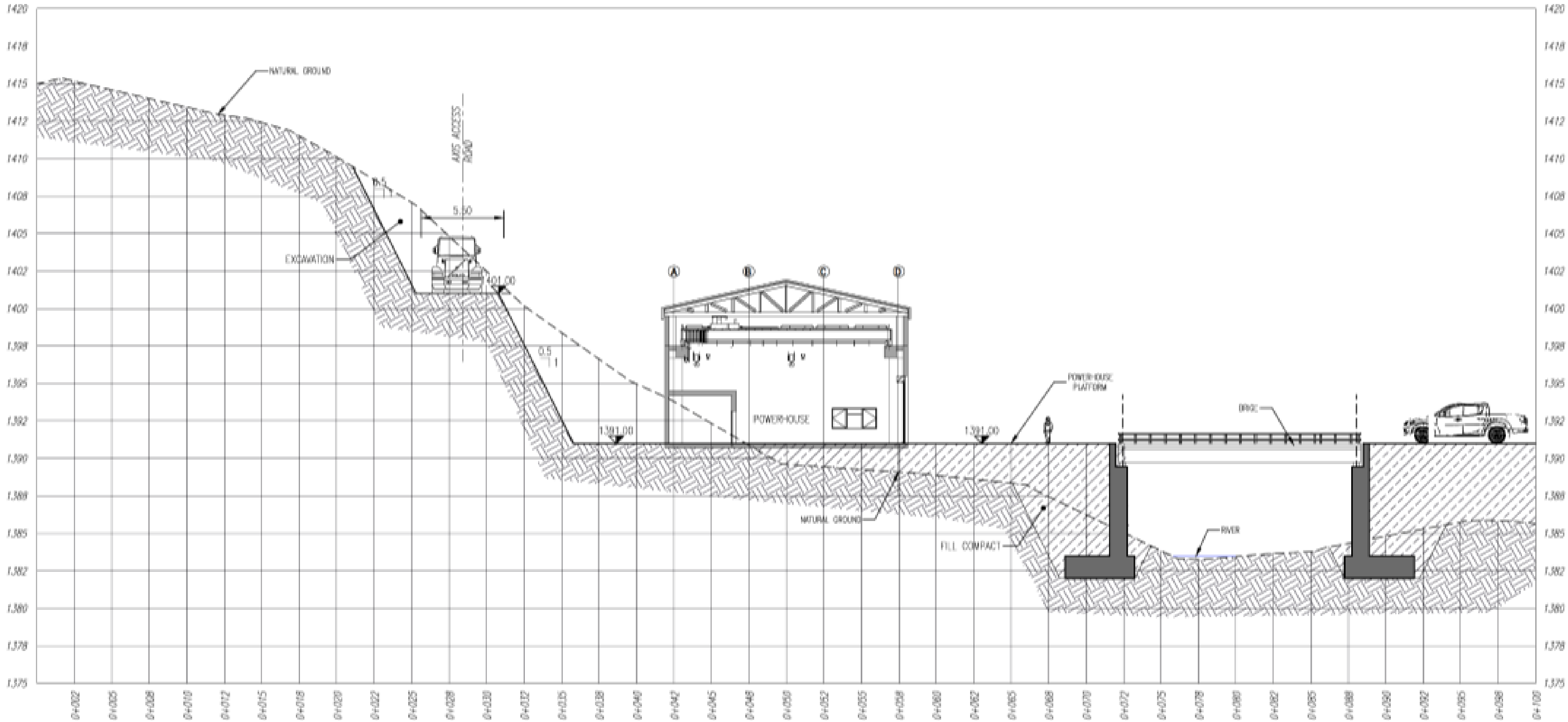


Figure 4.1.3.3. Powerhouse floor at 1391.00 m a.s.l.

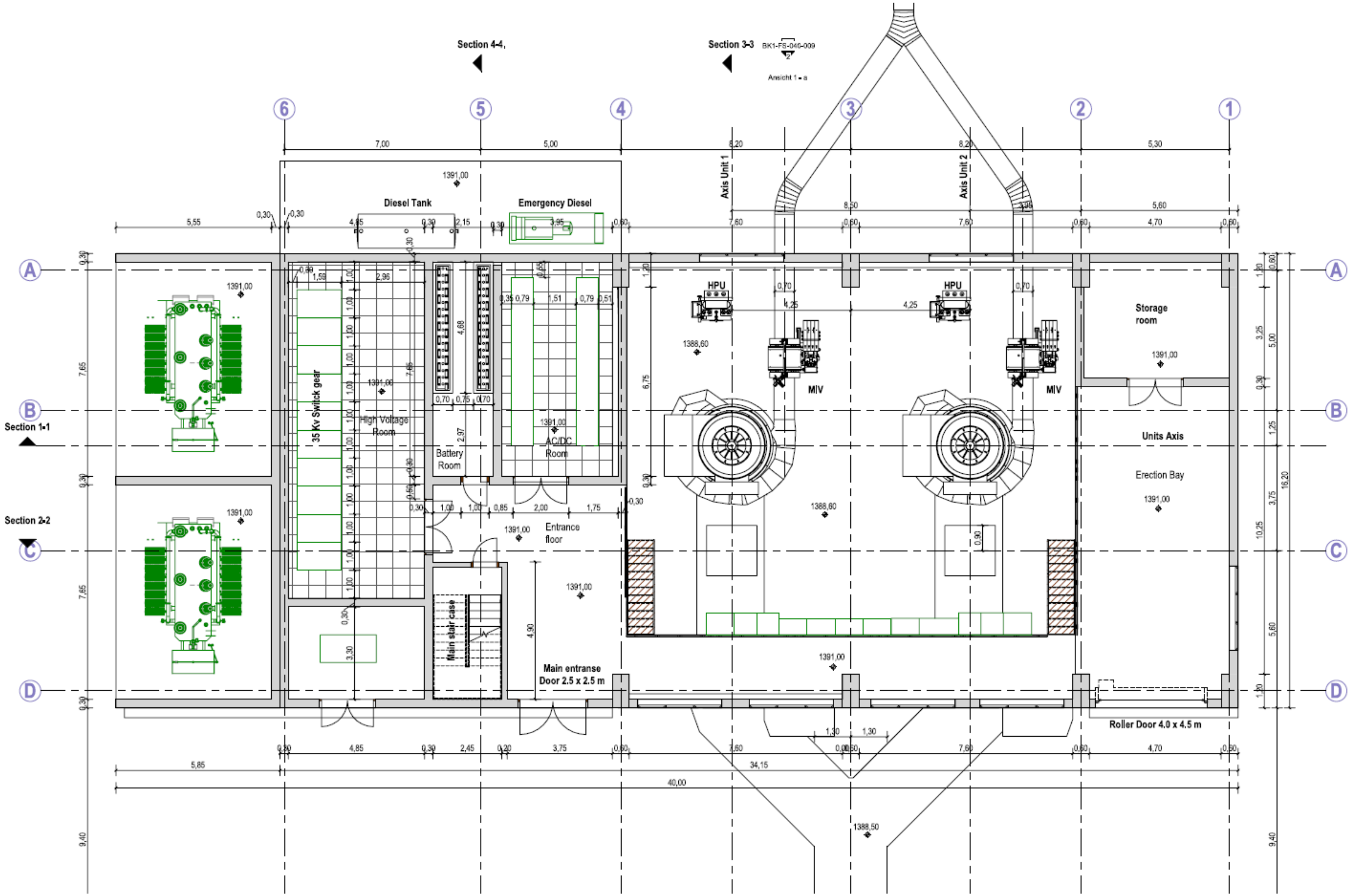
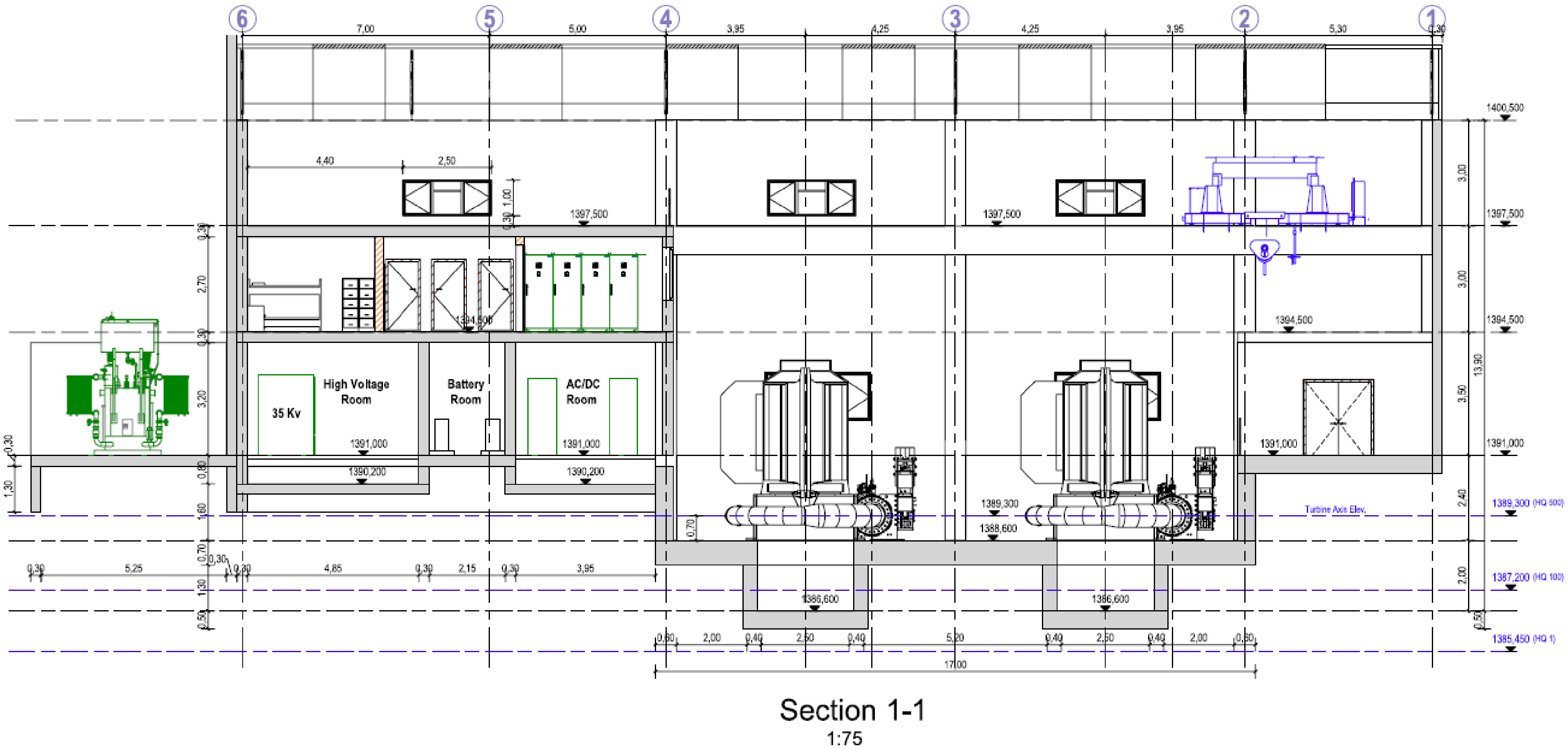


Figure 4.1.3.4. Powerhouse section 1-1



4.1.4 Substation

According to the project, two 6.3 / 35 kV voltage transformers will be installed for the supply of electricity generated by Bakhvi 1 HPP, which will convert the 6.3 kV generator voltage of Bakhvi 1 HPP to 35 kV and will be located outside of the powerhouse, from where it will be integrated into the electricity grid at the 110 kV substation planned in the vicinity of the powerhouse.

As mentioned, the project envisages the arrangement of 2 three-phase transformers of 6.3 / 35 kV voltage, which will be placed in separate transformer boxes outside of the powerhouse. For fire protection reasons the transformers are separated from each other by a fire-proof wall. The unit transformers must be capable of transferring around 75% of the rated power with natural air cooling. For the remaining 25% forced air cooling with a ventilation system has been selected. Thus, the cooling system of the transformers will be of ONAN/ONAF type.

Table 4.1.4.1. 6.3 / 35 kV voltage transformer technical data

Parameter	Unit	Value
Rated output	MVA	7
Type	-	Oil immersed (synthetic oil)
Rated primary voltage	kV	35
Rated secondary voltage	kV	6,3
Cooling system	-	ONAN/ONAF
Transport weight	t	20
Number of units	Unit	2

The transformer fire protection system is intended to ensure the protection of the unit transformers and will be realized according to relevant standards as a stationary water spray system. The water will be taken from the penstock of the plant. The main components of the system for each step-up transformer are two hydraulic remote-controlled valve sets, hot dip galvanized piping systems including open spray nozzles, fire detectors and control cubicle. The water spray duration time will be selected according to National Fire Protection Association.

The 35 kV switchgear is the central connection hub for the interconnection of the energy of Bakhvi 2B, Bakhvi 2A and Bakhvi 1. With two outgoing feeders to the 35/110 kV step-up transformers the energy will be evacuated to the two 110 kV grid.

Table 4.1.4.2. Technical data of 35 kV closed switchyard

Parameter	Unit	Value
Nominal voltage	kV	35
Rated voltage	kV	40,5
Rated short time current	kA	25
Feeder	#	9+1 Spare

From the 35 kV switchgear room in the powerhouse two systems of 35 kV cable connection leads the power to the two 35/110 kV transformers at the 110 kV switchyard. Outside of the powerhouse the cable connection will be laid in cable trench to the bridge and after the bridge to the step-up transformers. Together with the 35 kV cables the control and small power cabling will be also laid in the same cable trench.

The arrangement of a 110 kV substation is planned next to the powerhouse on an artificially created site the dimensions of which will be: length 80 m and width 50 m. In order to prepare the area selected for the substation, a concrete retaining wall will be arranged, and the area will be planned with excavated rocks generated during the construction of the HPP.

The installation of 2 units of 35/110 kV step-up transformers is envisaged on the territory of the substation. Transformers will be installed on foundations that will be equipped with oil pits and oil separators.

Table 4.1.4.3. Technical parameters of 35/110 kV booster transformer

Parameter	Unit	Value
Rated output	MVA	28
Type	-	With oil (synthetic oil)
Rated primary voltage	[kV]	110 ±5x2,0% OLTC
Rated secondary voltage	[kV]	35
Winding connection group	-	Ynd5
Cooling system	-	ONAN/ONAF
Transport weight	[t]	45
Transport dimensions: length x width x height	[m]	4,0x2,0x3,5
Number of device	[#]	2

The 110 kV switchyard will be erected close to the powerhouse and shall insure a safe and reliable connection to the overall transmission system with a line in – line out design. The connection switchyard will be arranged in the ring bus topology with four circuit breakers

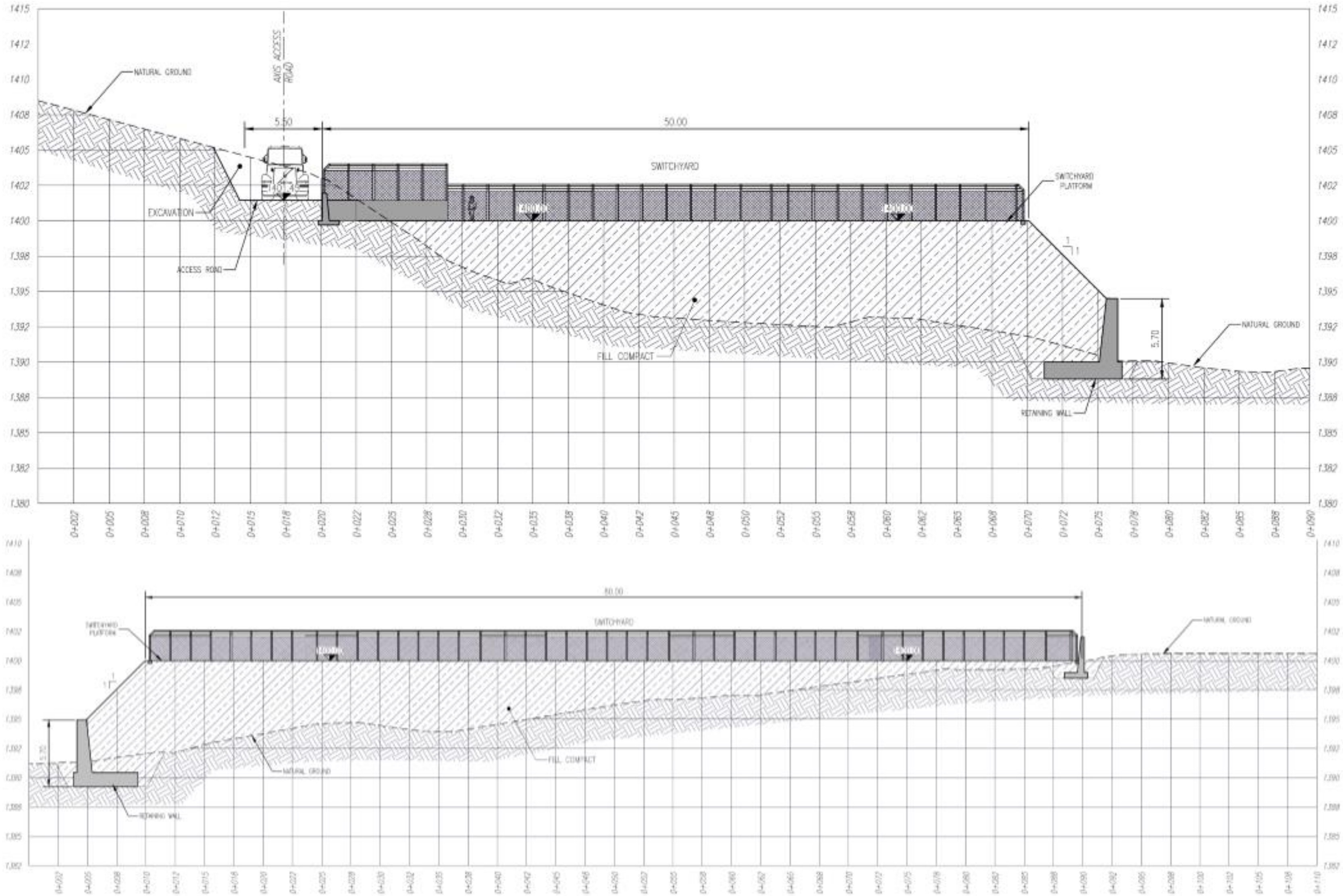
The 110 kV switchyard will be erected on the territory of the substation and shall insure a safe and reliable connection to the overall transmission system with to the 110 kV transmission line "Ozurgeti - Zoti HPP". The connection switchyard will be arranged in the ring bus topology with four circuit breakers

The switchyard consist mainly of:

- Steel structures as gantries, towers, etc. for the below equipment
- Circuit breakers
- Disconnectors
- Surge arrestors
- Current- and voltage transformers
- Wiring
- Grounding and lightning protection
- Metering equipment

The auxiliaries will be supplied with corresponding cables from the powerhouse 400VAC, 110 VDC distribution.

Figure 4.1.4.1. Transverse and longitudinal sections of the substation area

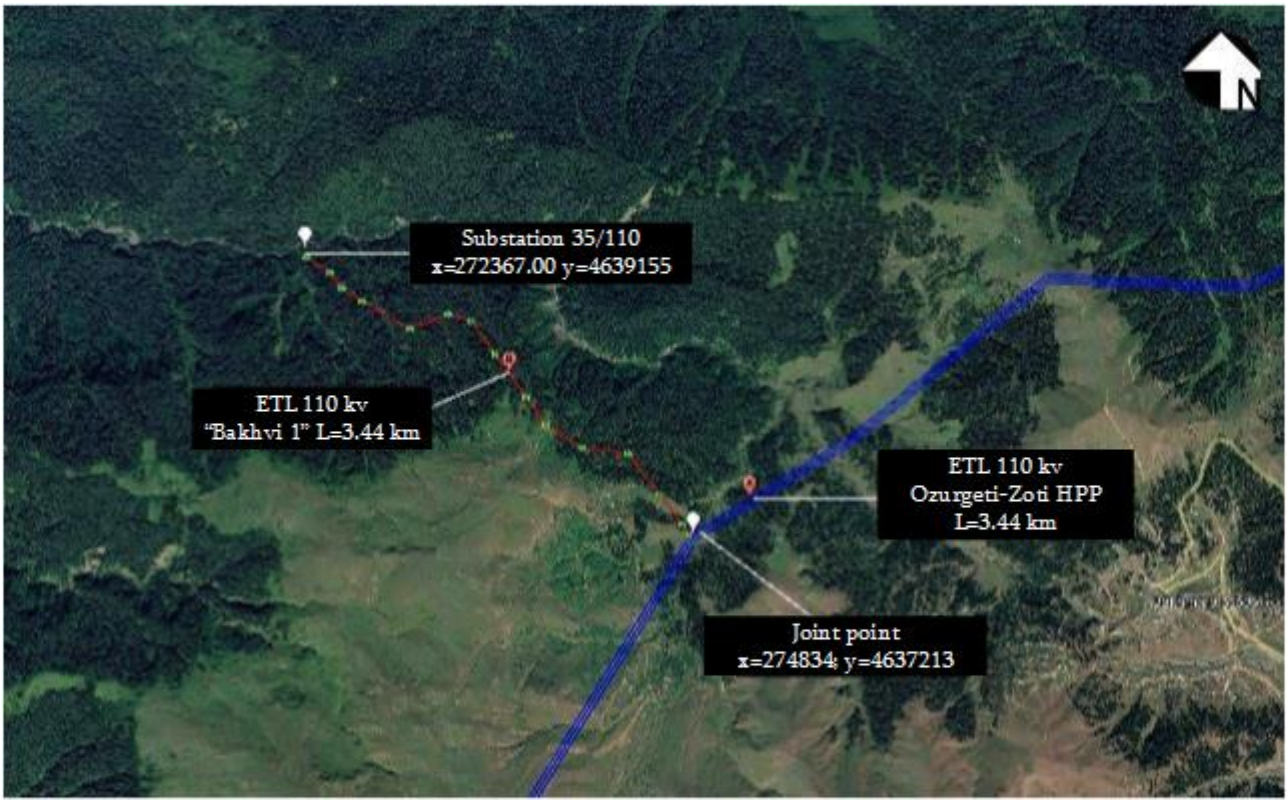


4.1.5 Grid Connection

Integration of the electricity generated by Bakhvi 1 HPP into the electricity system of the country is envisaged through the Ozurgeti-Zoti HPP double-circuit 110 kV transmission line, for which a 3.44 km long double-circuit 110 kV transmission line is planned. The proposed power transmission line, from the 110 kV substation of Bakhvi 1 HPP, will pass on the upper reaches of the left bank of the Bakhvi River and will be integrated into the Ozurgeti-Zoti HPP power line at the point the approximate coordinates of which are: X=274834; Y=4637213.

The transmission line project will be implemented by JSC Georgian State Electrosystem, for which relevant project documentation will be prepared. Environmental impact assessment procedure for the power trasnmission line project will be performed independently.

Figure 4.1.5.1. Preliminary layout of the proposedt power transmission line



4.2 Construction Works

The construction phase of the HPP can be divided into the following main stages:

- Preparation of construction camp, construction sites and mobilization of equipment needed for construction;
- Construction-rehabilitation of access roads;
- Main works:
    - Earthworks, preparation of foundations;
    - Management of generated soil;
    - Construction of permanent structures;
    - Reclamation works and preparation for commissioning of facilities.

Preparatory works include the following: fencing of the sites, placement of informational boards, arrangement of the road at the construction site, supply of temporary elements of the site.

4.2.1 Construction Timelines and Work Schedule

According to the project, the duration of construction of Bakhvi 1 HPP will be about 2.5-3.0 years. Daily schedule: 07:00 to 22:00 (two-shift schedule). The number of employees will be about 200 people, a significant number of whom will be local (Guria region) residents.

In the first stage of construction, it is planned to mobilize the construction infrastructure and arrange access roads, which will last for about 8 months. After that, the construction of the main infrastructure of the HPP (headworks, penstock and power unit) will start, which will be carried out in parallel and will last approximately 21 months. At the last stage, the construction infrastructure will be demobilized, reclamation works for temporary accommodation areas will be carried out, and the duration of the works will be 3-4 months.

The number of employees in the operation phase will be 10-15 people.

4.2.2 Construction Camps

In order to properly organize the construction work, it is important to properly select the location of the construction camps and the infrastructure placed on them. Accordingly, the following key recommendations should be taken into account when selecting the camp area:

- Arrangement of the camp in the vicinity of construction sites, in an easily accessible area to limit the scale of transport operations and ease of movement;
- Terrain of the area should be favorable so that the arrangement of infrastructure is not related to large-scale earthworks;
- Arrangement of the construction camp as far away from the residential area as possible in order to minimize disturbance of the population with the spread of harmful substances and noise in the ambient air, as well as with increased traffic;
- Selection of an area with poor fertile soil layer and vegetation;
- The area shall be away from the surface water body, which will reduce the risks of surface water pollution;
- Facilitation of the supply of drinking and industrial water and electricity to the construction camp, as well as the organized withdrawal of wastewater from the area.

Depending on the specific conditions of the Bakhvi 1 HPP project area, several construction camps are planned, namely: two construction camps (Camp 1 and Camp 2) will be arranged on the territory of headwork structure, and one construction camp (Camp 3) will be arranged for the construction of power unit. In addition to the above, it is planned to arrange two storage areas, one in the vicinity of the headwork and the other in the vicinity of the power unit. The geographical coordinates of the areas selected for the construction camps are given in Table 4.2.2.1.

It should be noted that the construction camps of Bakhvi 1 HPP and all other infrastructure will be located outside the resort area of Bakhmaro resort and therefore impact is not expected.

The total area of the construction camps planned at the headworks area will be 7918 m2, including the area of Camp 1 being 6500 m^2 and the area of Camp 2 being 1418 m^2. See Figure 4.2.2.1.

The area selected for Camp 1 is located on the upper reaches of the right bank of Bakhvitskali River. The area is mostly straight and slightly sloping in the direction of the natural ravine on the south side. There is practically no vegetation in the area. The minimum distance from the natural gorge is 60 m, the distance from the nearest seasonal residential area is 780 m, and from the residential area of the resort Bakhmaro is 1300 m. The capacity of the fertile soil layer in the area ranges from 0.12-0.15 m.

Worker container offices, mechanical workshop, equipment parking, water tank, fuel tank (10 m3 capacity) and diesel generator for emergency situations will be arranged on the territory of construction camp 1. In addition to the above, concrete palnt of 30 m^3/h capacity, inert materials crushing-sorting plant and warehouses of auxiliary materials can be arranged on the territory of Camp 1.

The power supply to the construction camp will be provided from the local power grid.

Photo 4.2.2.1. View of construction camp 1 area

Arrangement of Camp 2 is planned on the first terrace of the right bank of the Bakhvitskali River, on the upper side of the access road to the headworks. Distance from Bakhvitskali River bank will be 40 m. The distance from the nearest residential house is 795 m, and from the residential area of the resort Bakhmaro - 1800 m.

The area selected for the camp is free of vegetation, and the capacity of the fertile soil layer ranges from 0.10-0.12 m. Auxiliary construction infrastructure will be mainly present in the area of Camp 2, including: container type buildings for the construction contractor's administrative staff and others. The camp will be supplied with electricity from the local network.

Photo 4.2.2.2. View of Camp 2 area

Figure 4.2.2.1. Layout scheme of construction infrastructure of the headwork structure

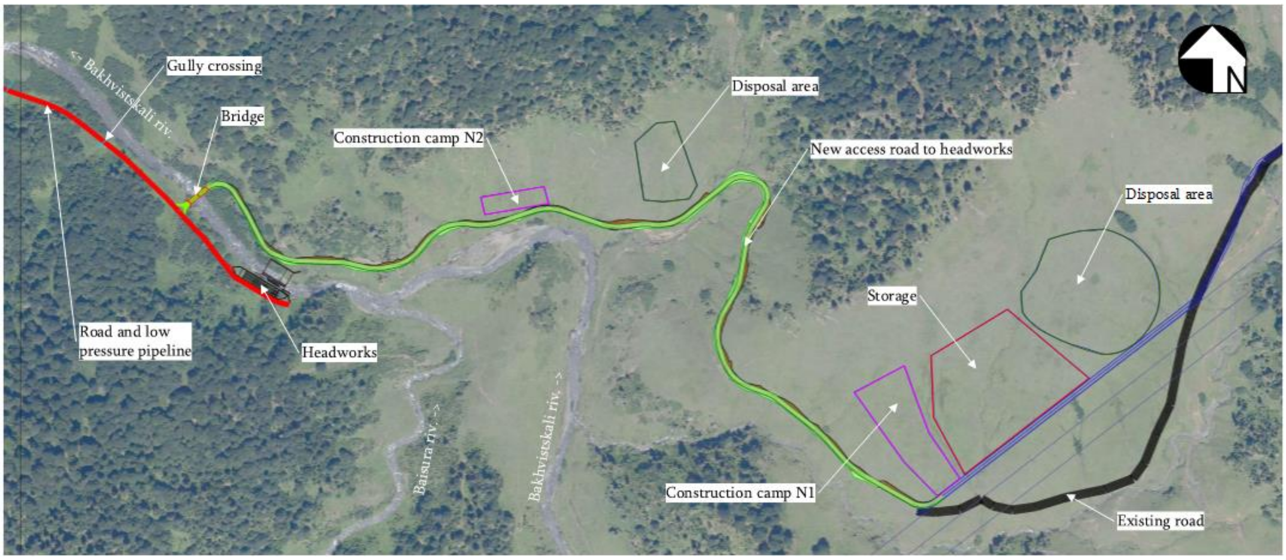


Figure 4.2.2.2. Situational scheme of construction camps N1 and N2

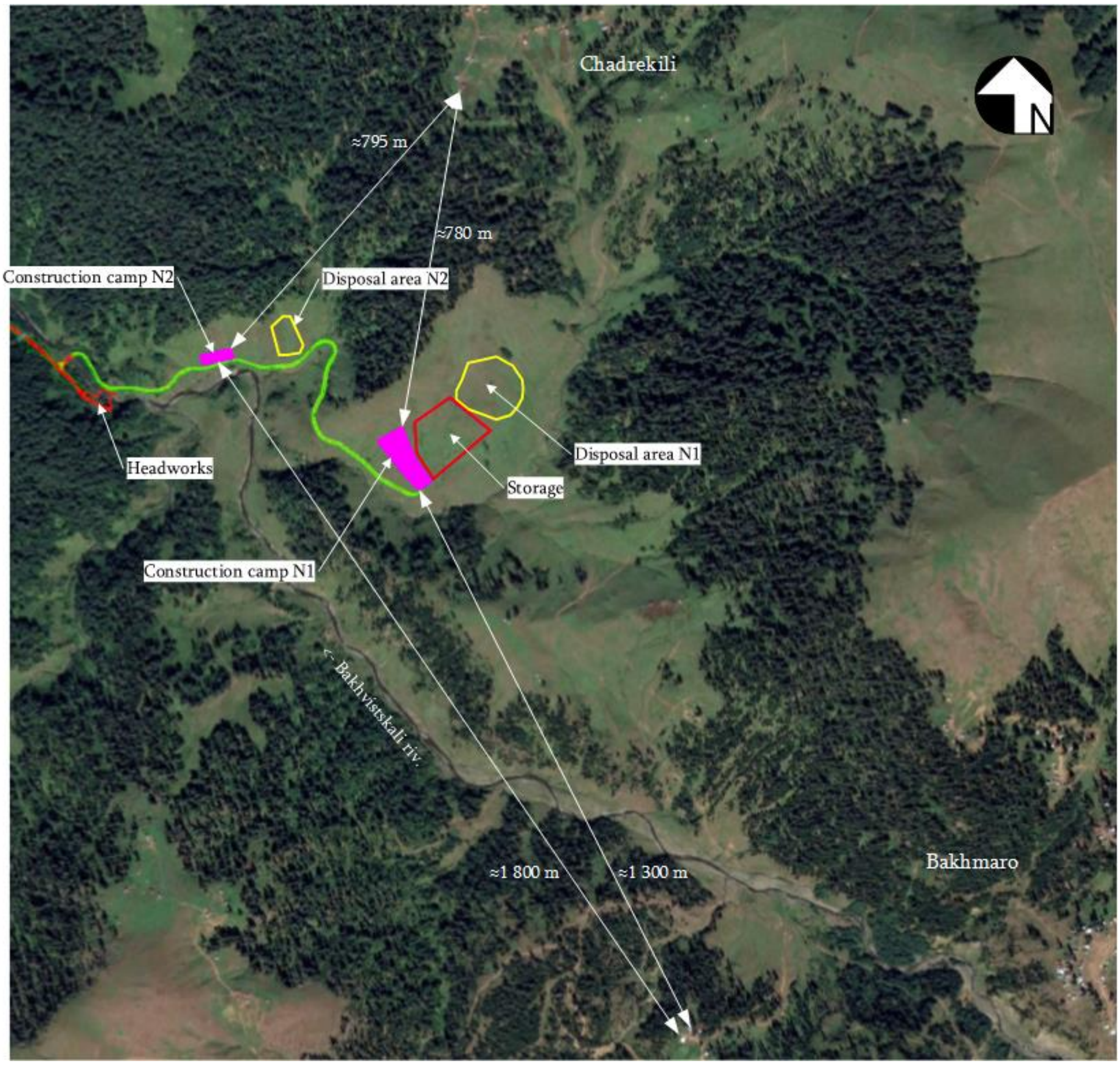


Figure 4.2.2.3. Plan of the construction camp N1

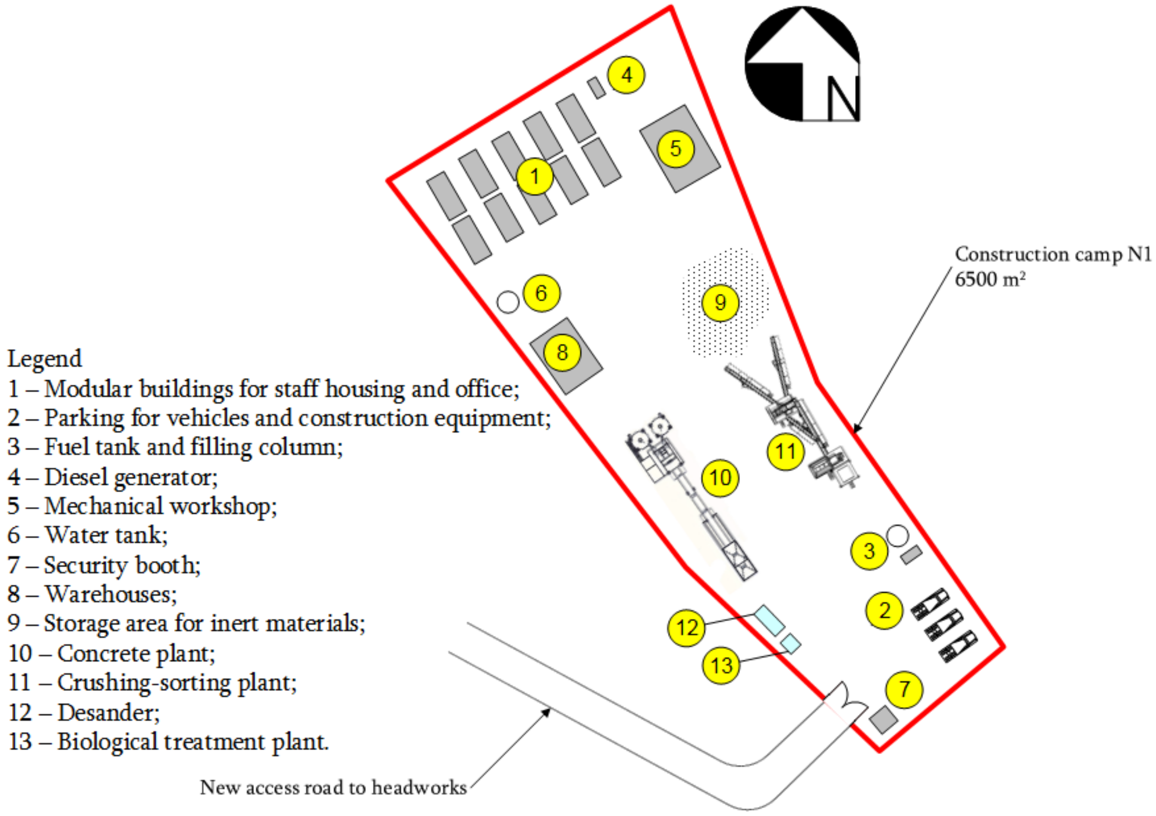
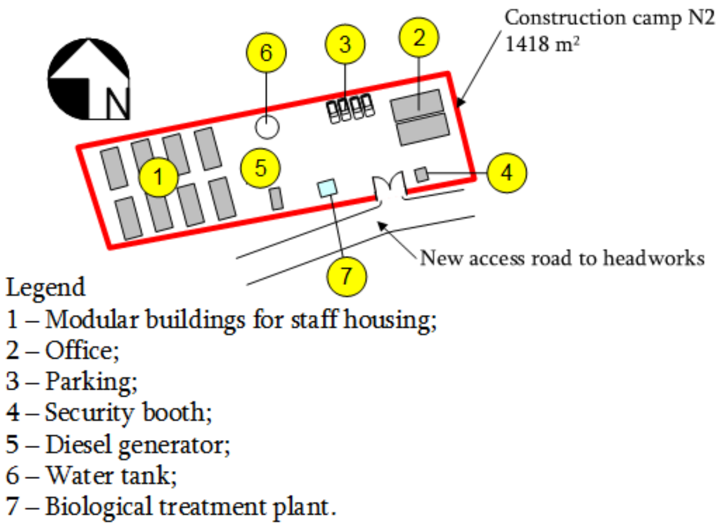


Figure 4.2.2.4. Plan of the construction camp N2



The construction of the power unit construction camp (Camp N3) is planned on the last section of the existing access road from downstream side (from the village of Vaniskedi), on the upper elevations of the right slope of Bakhvitskali river gorge. The selected area is mostly flat, there are signes of high anthropogenic load, which is related to the production of forestry, due to which a significant part of the vegetation is removed from the environment. At present, deciduous tree plants are represented in the area. As it was found during the audit, the capacity of the fertile soil layer averages 0.10 m. The area is 37400 m^2.

The distance between the Camp N3 area and Bakhvitskali river is about 700 m, and the distance from the nearest residential area is about 7.0 km. The distance from the resort area of Bakhmaro is about 5.5 km.

The water supply of construction camp N3 will be provided directly from the spring water within the territory.

Worker container offices, mechanical workshop, equipment parking, water tank, fuel tank (10 m³ capacity), filling column and diesel generator are planned on the territory of Camp N3.

Figure 4.2.2.5. Layout scheme of power unit construction infrastructure

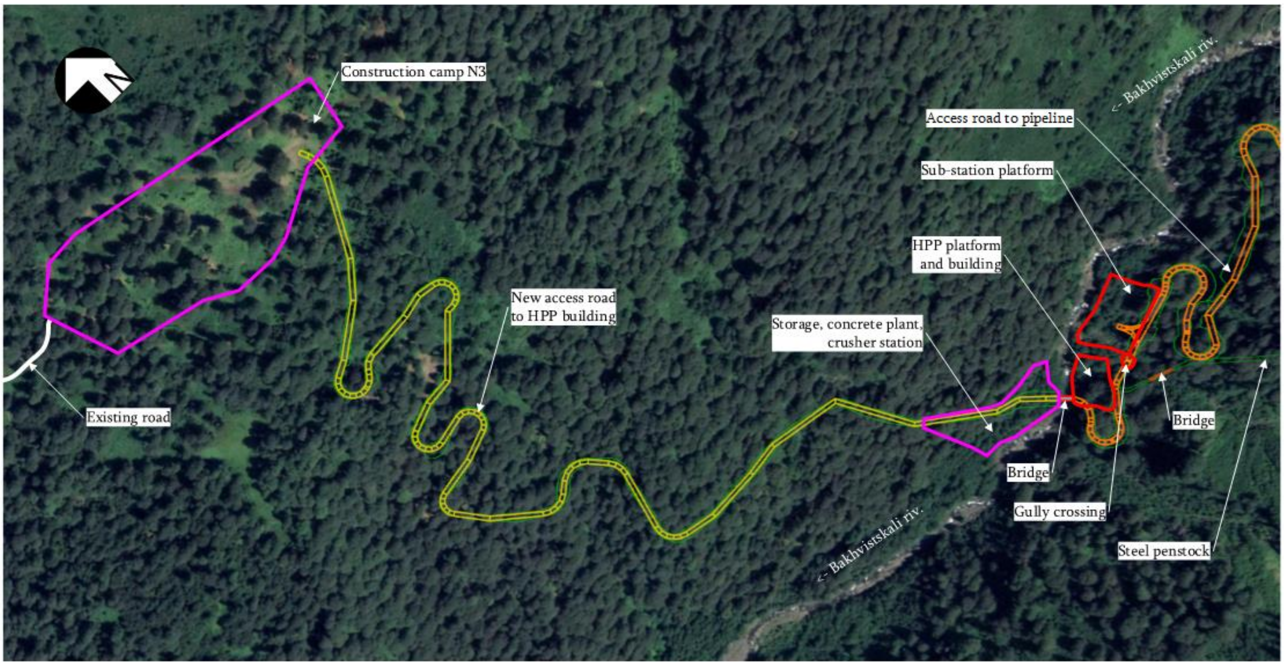


Figure 4.2.2.6. Situational scheme of construction camp N3

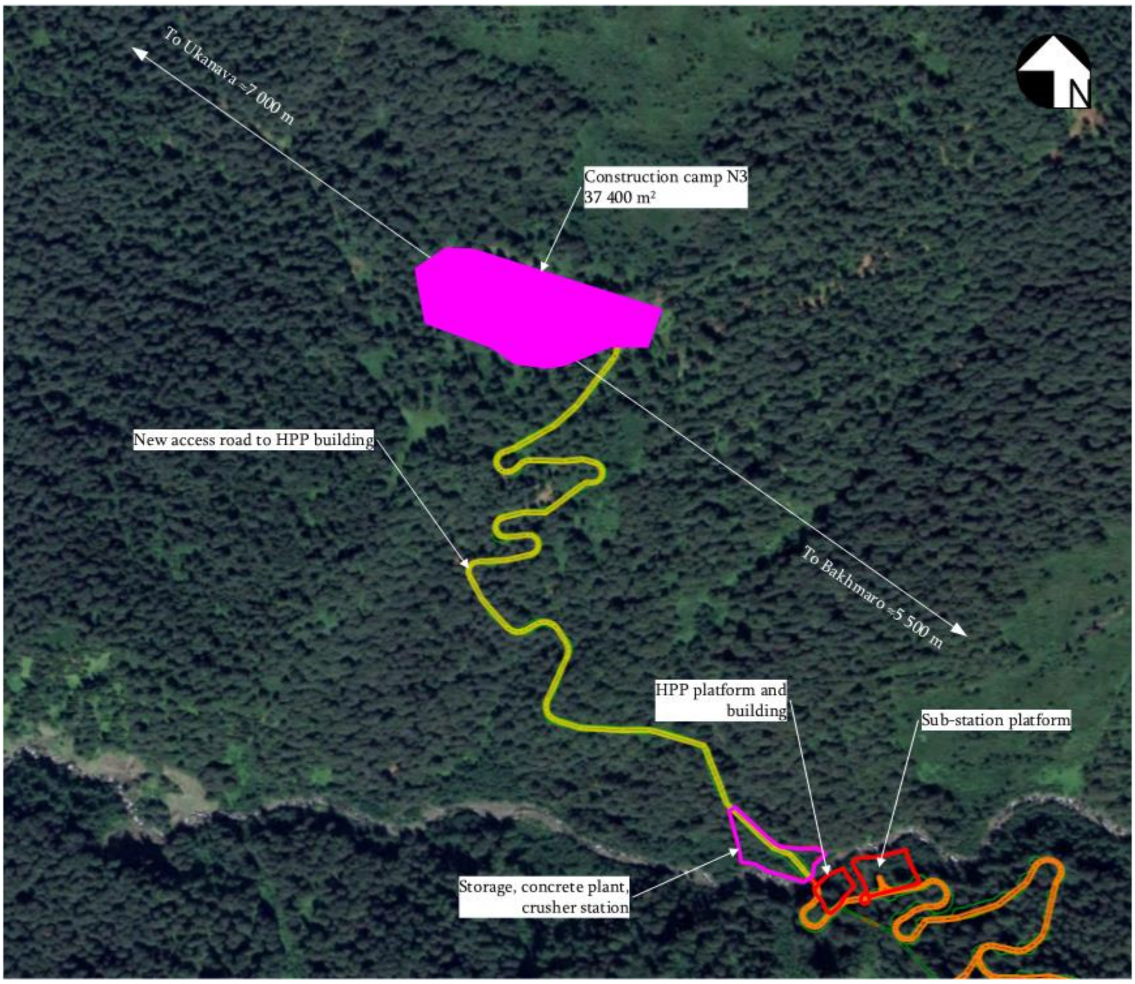


Figure 4.2.2.7. Plan of the construction camp N3

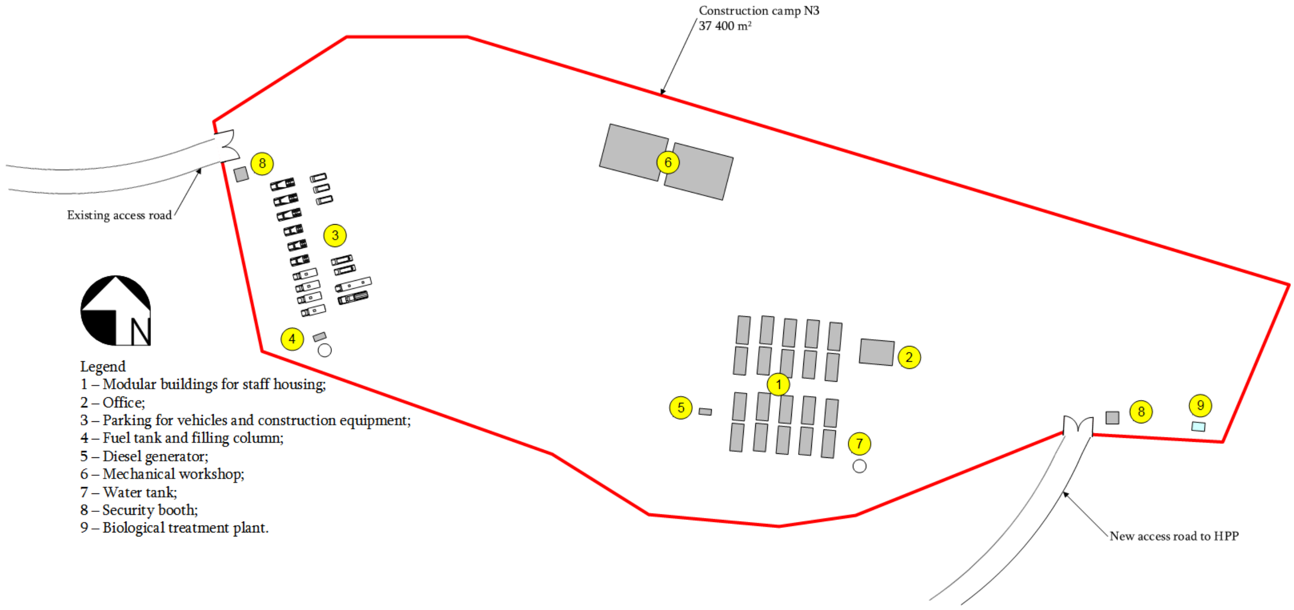


Table 4.2.2.1. Geographical coordinates of construction camp areas

Camp 1 F= 6500 m^2			Camp 2 F= 1418 m^2			Camp 3 F= 37 400 ð^2		
N	X	Y	N	X	Y	N	X	Y
1	275978	4638094	1	275580	4638292	1	272003	4640013
2	276006	4638021	2	275585	4638274	2	271984	4639961
3	276040	4637970	3	275515	4638261	3	271925	4639963
4	276015	4637951	4	275510	4638281	4	271832	4639938
5	275976	4637992				5	271782	4639945
6	275923	4638065				6	271654	4640003
						7	271642	4640077
						8	271690	4640104
						9	271731	4640102

As mentioned above, the project envisages the arrangement of 2 warehouses, one of which (Area 1) will be used for the construction of the headworks, and the other (Area 2) for the construction of the power unit. The need for storage areas is due to the difficult terrain of the HPP project corridor, as it will not be possible to store pipes and other auxiliary materials in the construction corridor.

The location for the warehouse area of the headworks is selected to the east of Construction Camp 1, in its immediate vicinity (see Figure 4.2.2.1.). The area will be 17 700 m^2. There is no vegetation cover in the area and the capacity of fertile layer of soil is in the range of 0.12-0.15 m. The minimum distance from the natural ravine is 150 m, and from the nearest residential house (seasonal) 650 m.

Warehouse Area 1 is intended primarily for the storage of pipelines and other large materials and equipment.

The geographical coordinates of the warehouse area are given in Table 4.2.2.2.

Photo 4.2.2.3. View of Warehouse Area 1

Warehouse Area 2 will be located on the right bank of the Bakhvitskali River, opposite the power unit. It covers 7020 m2 area. The area is located on the first terrace of the river, the surface is completely covered with boulders and therefore there is practically no fertile layer of soil. The area is covered with vegetation, where alder is dominant. According to the results of the research, the species included in the Red List of Georgia were not recorded. Prior to construction, area planning is envisaged, for which rocks excavated in the process of road construction will be used.

According to the project, Warehouse Area 2 will be used as a storage area for construction materials, and it will be also used as a construction site, since it will not be possible to place construction equipment and other infrastructure on the power unit area due to the difficult terrain. A concrete plant of 30 m^3/h capacity and inert materials crushing-sorting plant will be arranged on the territory.

Photo 4.2.2.4. View of Warehouse Area 2

Figure 4.2.2.8. Plan of the warehouse in the vicinity of the HPP

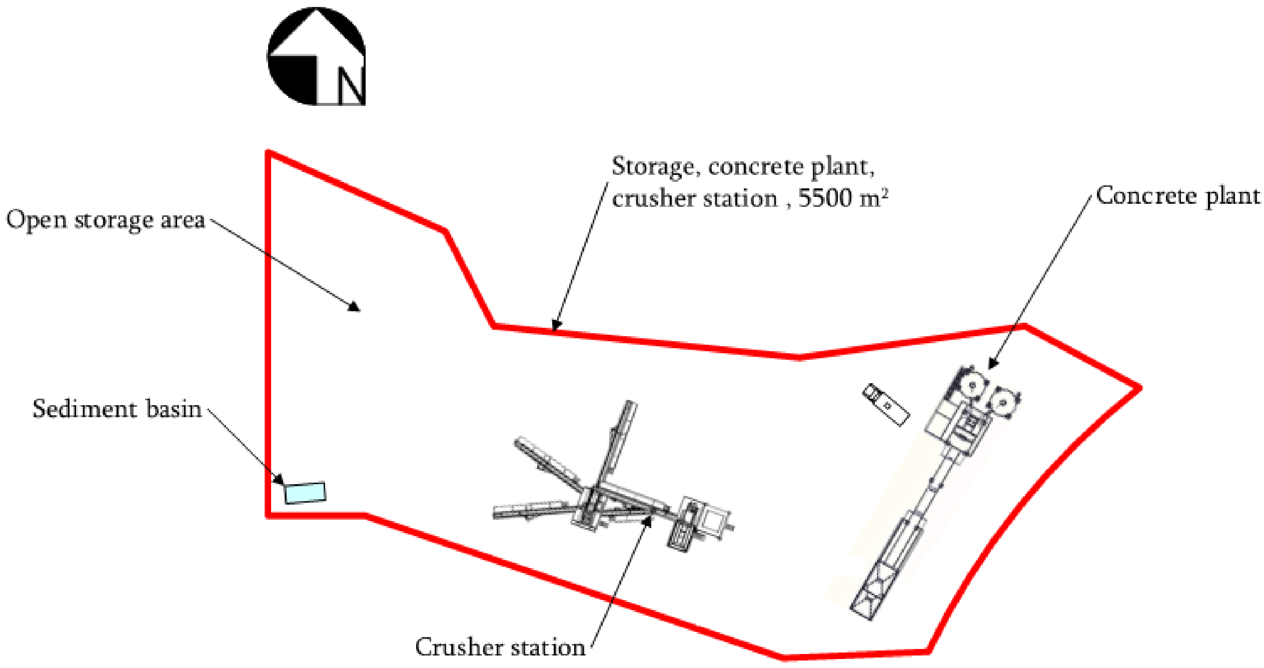


Table 4.2.2.2. Geographical coordinates of warehouse areas

Warehouse Area 1 F= 17 700 m²			Warehouse Area 2 F= 7020 m²					
N	X	Y	N	X	Y	N	X	Y
1	276092	4638156	1	272122	4639255	6	272244	4639147
2	276183	4638080	2	272197	4639191	7	272233	4639138
3	276046	4637974	3	272251	4639188	8	272160	4639161
4	276011	4638037	4	272264	4639179	9	272135	4639164
5	276008	4638104	5	272247	4639161	10	272115	4639248

4.2.3 Construction Equipment and Vehicles used during the Construction Phase

The construction equipment and vehicles given in Table 4.2.3.1 will ensure the continuous supply of construction materials and installation equipment. The composition of the transport park is determined by the structure and volume of construction-installation works, variability of cargo delivery regime. Models and quantities of machinery may be changed during the construction period at the discretion of the winning construction contractor.

It is impossible to determine the quantity of fuel and lubricants in advance, as it depends on the brands of vehicles and mechanisms to be procured and the quantity to be determined by the winning construction contractor.

Table 4.2.3.1. List of equipment and vehicles used in the construction process

N	Name	Quantity	Note
1	Hydraulic Excavator, t	6	20-30 t
2	Frontal loader	2	
3	Bulldozer, heavy	3	
4	Articulated lorry	4	
5	Dump truck	6	
6	Vibrating compactor	2	10-20 t
7	Grader	1	>15 t

8	Vibrating crusher	1	
9	Concrete pump	2	
10	Mobile crane	1	<50 t
11	Mobile crane	1	>50 t
12	Tower crane	2	
13	Concrete truck	6	
14	Concrete plant	1-2	

4.2.4 Construction Material

The suppliers of construction materials are:

- Gravel, sand - quarries in the construction region with the permission of the Ministry of Environment Protection of Georgia;
- Reinforced concrete and concrete products - the company winning the construction tender;
- Steel structures - the company winning the construction tender;
- Fuel - local market;
- Timber - local market;
- Steel pipes - the Client or the company winning the relevant tender.

Construction materials will be required for the arrangement of road, penstock and for the concrete works.

Road construction: Gravel will be used as the main material for paving road surfaces. The road base will be arranged by natural soil removal-filling method.

The material required for the road pavement will be extracted by removing the rocks, which will be crushed and processed if necessary. Given that most of the excavated material (approximately 70-80%) will be rocks, sufficient amount of construction material will be available.

Installation of penstock: The GRP pipeline will be placed in the trench and filled with appropriate material, therefore, sand-gravel will be required for the works.

The gravel required to fill the penstock trench is planned by excavating the rocks, which will be crushed and processed if necessary. Given that most of the excavated material (approximately 70-80%) will be rocks, sufficient amount of construction material will be available.

Concrete works: Main structures such as weir, intake, desander, anchor blocks for the penstock, powerhouse, bridges and retaining walls will be constructed using concrete.

A temporary concrete plant is planned to be arranged near the powerhouse (on the right bank), as most of the concrete material will be needed for both the powerhouse and the facilities planned around it. In addition, a second concrete plant may be arranged at the headworks area or concrete may be delivered from the main concrete plant at the powerhouse area or from other existing concrete plants. This issue will be decided by the contractor based on detailed construction design and logistics.

The filling material required for concrete (gravel and sand) will be obtained from quarries in the region.

Table 4.2.4.1. Distances from sand-gravel quarries to the powerhouse area

Quarries	Distance to the powerhouse
Quarry N1	50 km
Quarry N2	43 km
Quarry N3	99 km
Quarry N4	99 km
Quarry N5	99 km

4.2.5 Construction Works of HPP Infrastructure

4.2.5.1 Road Construction

It is planned to arrange access roads to the proposed infrastructure of the HPP both from the side of the headwork and from the side of the power unit. To access the headwork from the Chokhatauri-Bakhmaro road, an earth road existig outside the area of the resort Bakhmaro will be used, which extends to construction infrastructure of the headwork. The technical condition of this road needs to be improved, in particular: expansion in some places and arrangement of gravel cover.

Forest road leading to Vaniskedi village will be used to access the territory of the power unit, the technical condition of which needs to be improved. Movement on the road is possible only with off-road vehicles. From the mentioned road to the project area of the power unit, it is planned to arrange a new road, for which the corridor of the old forest road will be partially used. A bridge will be constructed on Bakhvitskali River to reach the territory of the power unit, which will be further used for operation purposes.

The project roads will be two-lane and 5.50 m wide. The total length of the proposed new roads will be 8364 m, including: length of the access road to the headwork is 1256 m, the length of the access road to the powerhouse is 1747 m, the length of the road to be constructed in the GRP penstock corridor is 3209 m, and the length of the road to be constructed in the steel penstock corridor is 2152 m.

Layout scheme of the proposed new roads is given in Figures 4.2.5.1. and 4.2.5.2.

Arrangement of new roads will be done mainly by bulldozers and excavators. Rocks can be crushed on rocky areas, while other parts require the use of an excavator equipped with a hydraulic hammer.

Excavated material will be transported by trucks to areas to be filled or spoil grounds. The road base should be prepared and leveled with an excavator or grader and compactor. The road surface (gravel surface) is then arranged using trucks, loaders, graders and compactors.

Side trenches and water pipes will be arranged to remove atmospheric water from the road base. Natural ravines will be crossed by means of pipe bridges through calculation of estimated maximum flow of a particular ravine.

The layout scheme of the proposed new roads is given in Figures 4.2.5.1. and 4.2.5.2., typical sections of roads - in Figures 4.2.5.3., while a typical plan and section of natural ravines crossings - in Figure 4.2.5.4.

Figure 4.2.5.1. Scheme of access road to the powerhouse

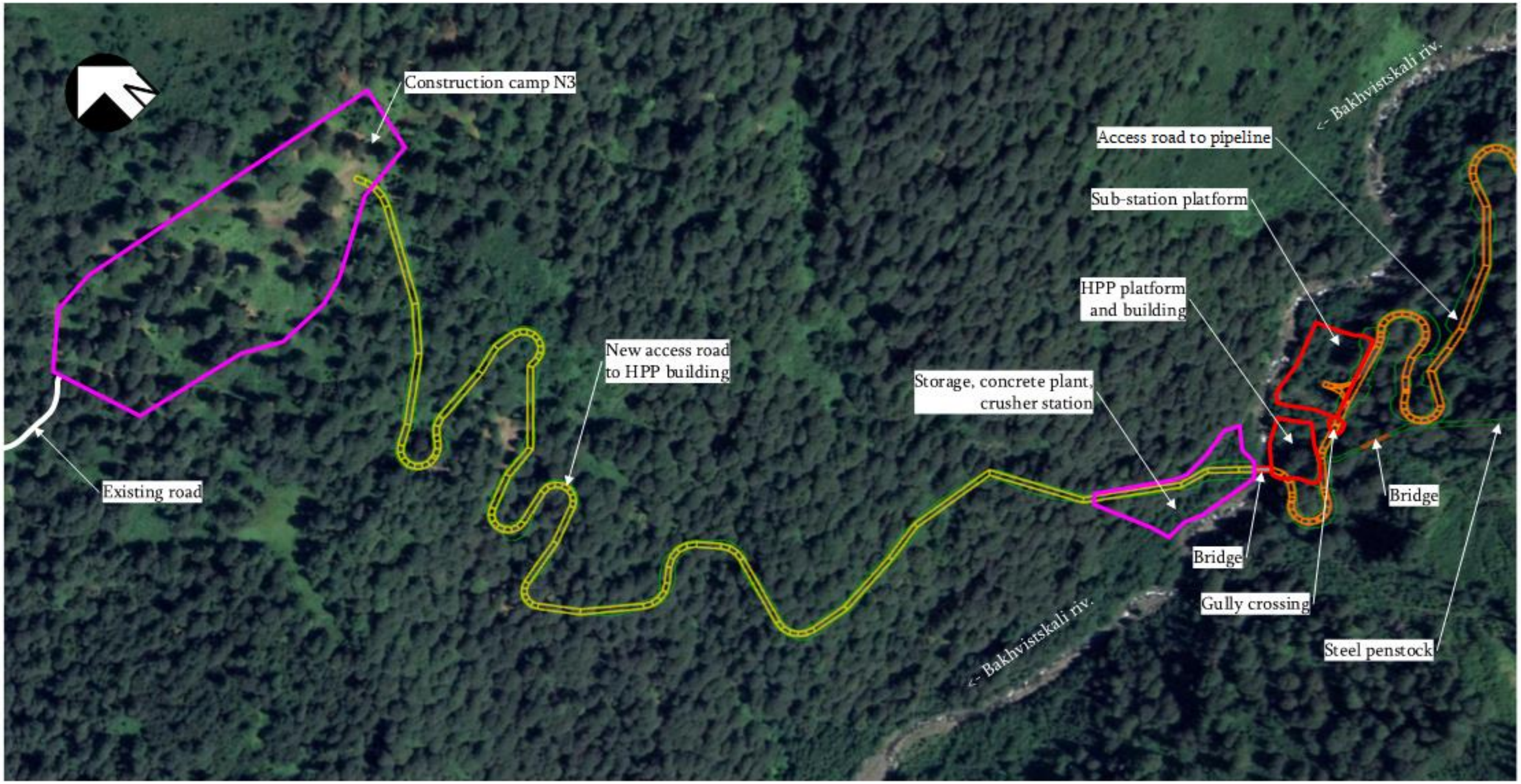


Figure 4.2.5.2. Scheme of access road to the headwork

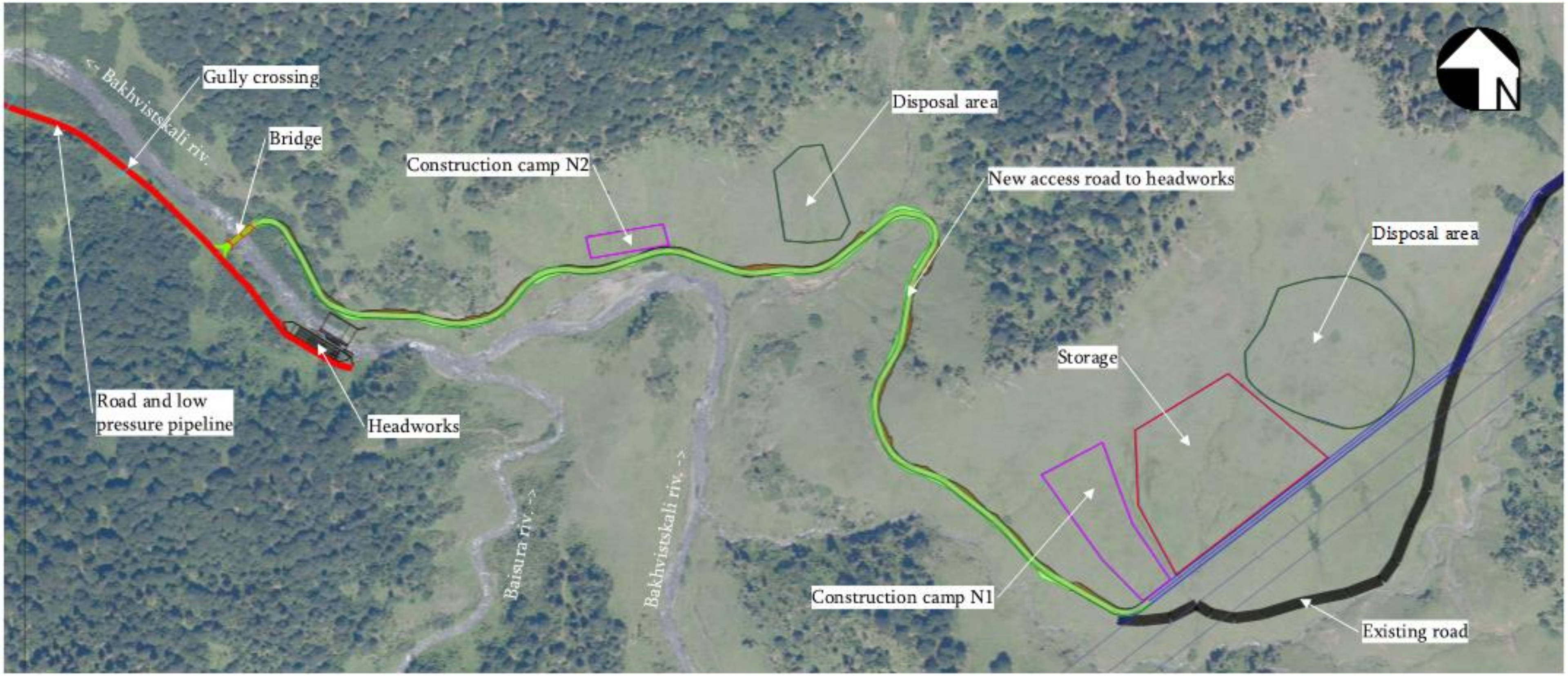
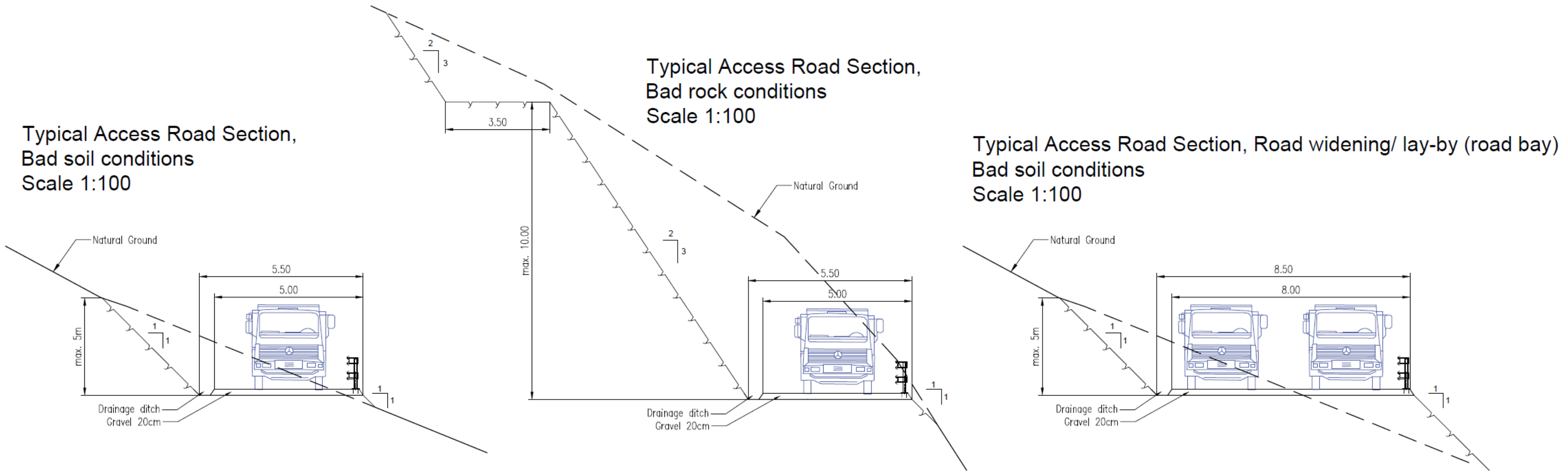
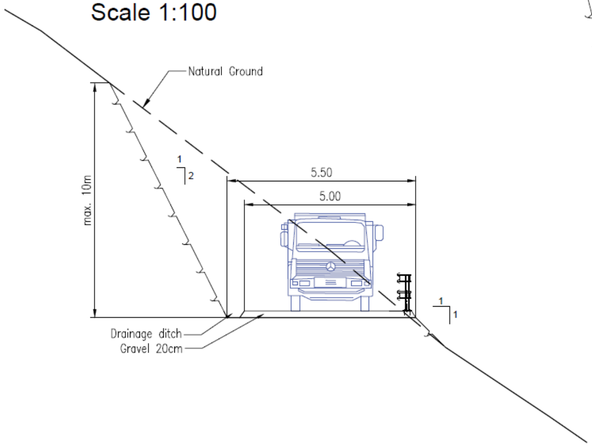


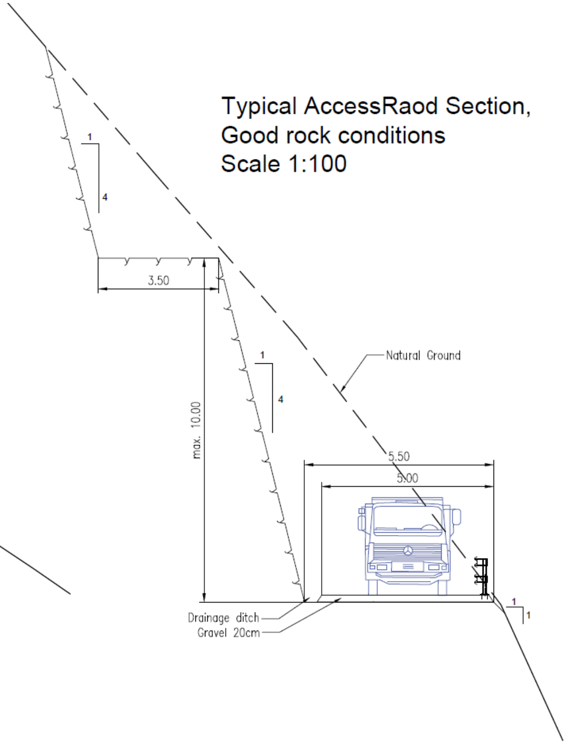
Figure 4.2.5.3. Typical sections of design roads



Typical Access Road Section,
Good soil conditions
Scale 1:100



Typical AccessRaod Section,
Good rock conditions
Scale 1:100



Typical Access Road Plan View,
Road widening / lay-by (road bay)
Scale 1:100

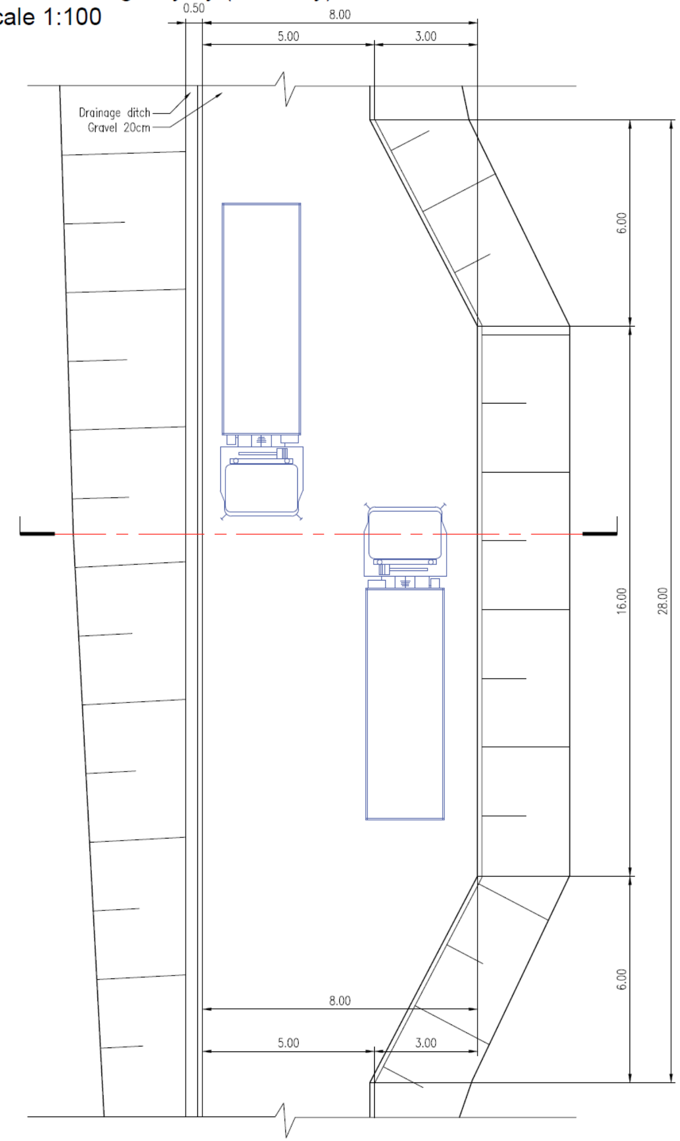
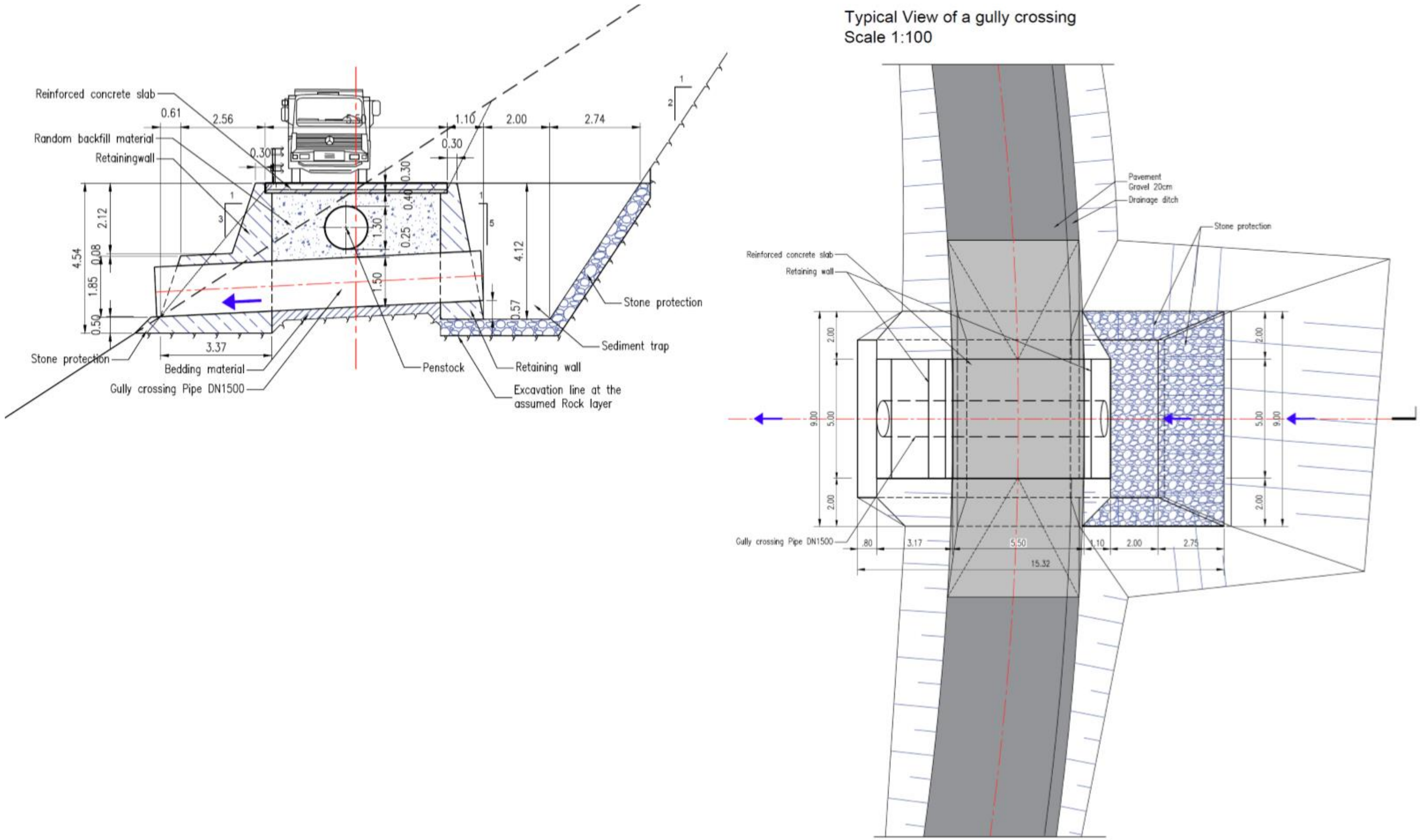


Figure 4.2.5.4. Typical plan and sections of natural ravine crossings



4.2.5.2 Construction of Headwork

The construction of the heaworks will be carried out in two stages, using weirs and a diversion channel. These temporary structures are designed to release a 10-year recurrence flow.

At stage I, a weir will be constructed on the left bank of the river and water will be passed through a channel along the right bank. The width of the channel at the bottom will be 6 m and the height will be 2.5 m.

At stage II, the construction of the complete infrastructure of the headworks will be carried out. After the completion of construction works, the water will be passed through the flushing gate and the temporary diversion channl and the weir will be dismantled and the river will return to its natural bed.

4.2.5.3 Construction of GRP Penstock

The pipeline (upper side) will be arranged in a new road alignment. In the first stage, the road base will be arranged by the intersection-filling method (where possible). The road will be arranged mainly by bulldozers and excavators. Rocks can be crushed on rocky areas, while other parts require the use of an excavator equipped with a hydraulic hammer.

Excavated material will be transported by trucks to areas to be filled or spoil grounds.

In the second stage, a pipeline trench will be arranged by an excavator. It is expected that most of the trench will be rocky. Rocks can be crushed on rocky areas, while other parts require the use of an excavator equipped with a hydraulic hammer.

If available, the contractor can use rock excavator as an alternative.

The underground penstock is divided into two sections - GRP penstock (upper part) and steel penstok (lower steep part).

GRP pipeline will be delivered on site and placed in the withdrawn trench. The pipes can be lifted and placed with an excavator. Installation requires connecting separate sections of the pipe and backfilling with the appropriate material (gravel). The required gravel material is obtained by excavation of the rock and it is crushed by means of a mobile crusher. In some areas, a thin layer of concrete is used in the form of backfilling.

The top of the trench will be filled with filler removed as a result of excavation. Finally, the road surface (compacted gravel) will be arranged.

Steel pipeline will be delivered on site and placed in the trench. Pipes can be lifted and placed by means of excavators or mobile cranes. Installation requires welding individual sections of pipe and backfilling with appropriate material (gravel). The required gravel material is obtained by excavation of the rock and it is crushed by means of a mobile crusher.

The upper part of the trench will be filled with filler removed as a result of excavation. For construction purposes, access to the steep trench and anchor blocks of the pipe will be temporarily possible from the new road.

4.2.5.4 Concrete Works

Concrete will be made on site, in a concrete plant that will be temporarily located near the powerhouse (on the right side of the river). Aggregates and cement will be delivered on site, while water can be delivered locally.

In addition, a second concrete plant will be temporarily arranged at the site of the headworks. Concrete will be imported from the main concrete plant near the powerhouse or from other existing concrete plants. This issue will be decided by the contractor based on detailed construction planning and logistics.

Concrete is transported from the concrete plant to the individual structures via a mobile concrete mixer. A concrete pump will be used to pour the concrete as needed.

Armature will be delivered on site.

4.2.5.5 Volume of Earthworks

Table 4.2.5.5.1 presents the volumes of earthworks at different project sites. The given values assume a loosening coefficient of 1.2 (20%).

Table 4.2.5.5.1. Volumes of earthworks

Headworks	**Volume of excavated material**
Access road to the headworks	7,000 m^3
Headworks structure (weir, intake, desander)	15,500 m^3
Penstock alignment (upper part of GRP pipe) including road	90,000 m^3
Full volume of material to be placed:	112,500 m^3
Volume of N11 and N2 spoil grounds:	180,000 m^3
Powerhouse	**Volume of excavated material**
Access road to the powerhouse	15,000 ∂^3
Powerhouse and substation	11,500 ∂^3
Access road to the penstock	54,000 ∂^3
Penstock (Steep Steel Pipeline)	7,000 ∂^3
Total volume of excavated material	87,500 ∂^3
Filling material required for construction and warehousing sites (backfillings)	87,500 ∂^3

4.2.6 Management of Waste Rocks

As given in Section 4.2.5.5., a significant amount of earthworks will be performed during the construction process. The total amount of waste rock during the construction period will be about 200,000 m^3, of which approximately 87,500 m^3 of waste rock will be used as backfill material for the substation site, storage area 2 (concrete plant location) and the penstock corridor. Therefore, according to the preliminary calculation, 112,500 m^3 will be subject to permanent disposal.

The project envisages the arrangement of two spoil grounds for waste rock, which are planned to be located in the vicinity of the construction site near the Construction Camp 1 (see Figure 4.2.2.1.). The spoil ground area is 15,920 m^2 and the capacity is 160,000 m^3.

Areas selected for the arrangement of spoil grouds are under anthropogenic impact. During the field visits, traces of timber extraction and transportation were observed, as well as traces of cattle grazing, which leads to the degradation of the fertile soil layer.

The area selected for the spoil ground is mostly flat, slightly sloping in the direction of the natural ravine, from which the distance is 180 m. No tree plants are present in the area. The capacity of fertile layer of the soil is 0.12-0.15 m.

A relatively small spoil ground is planned on the slope of the right bank a small tributary of the Bakhvitskali River. The area is sloping in the direction of a natural ravine. The distance from the bank of the natural ravine is 60 m. There is no vegetation cover in the area and, therefore, no impact is expected. The average capacity of the fertile soil layer is 0.10-0.12 m. The spoil ground area will be 4 410 m^2 and the capacity will be 20 000 m^3.

Areas of both spoil grounds are located outside the Bakhmaro Resort Recreation Area and are not included in the State Forest Fund. Fertile soil layer will be stored in separate areas, which will then be used during reclamation works.

The geographical coordinates of the spoil grounds are given in Table 4.2.6.1. Project of the spoil grounds is given in Annex N1.

Table 4.2.6.1. Geographical coordinates of spoil grounds

Spoil ground 1 F= 15 920 m^2						Spoil ground 2 F= 4 410 m^2		
N	X	Y	N	X	Y	N	X	Y
1	276138	4638234	7	276256	4638148	1	275703	4638361
2	276175	4638244	8	276228	4638115	2	275724	4638364
3	276188	4638243	9	276199	4638108	3	275749	4638293
4	276200	4638245	10	276110	4638153	4	275741	4638278
5	276230	4638232	11	276108	4638176	5	275691	4638278
6	276261	4638187	12	276125	4638201	6	275680	4638341

Photo 4.2.6.1. Views of areas of spoil grounds

Spoil grounds 1

Spoil grounds 2

4.2.7 Water Supply and Wastewater Disposal

4.2.7.1 Construction Phase

During the construction of the HPP, water will be required for the preparation of the concrete mixture, for drinking-agricultural purposes, for fire-fighting purposes, and for irrigating construction sites and access roads in dry weather. For the territory of the camps, technical water will be taken from Bakhvitskali River, and local springs are used for drinking. Water storage reservoirs with a capacity of 5-10 m^3 will be arranged on the territory of the camps.

The amount of water required to operate a concrete plant depends on the quantities of products produced and volume of water required for the preparation of 1m^3 of mixture. The water consumption required for the production of 1m^3 of mixture is 0.13m^3, and for the treatment of 1m^3 of sand-gravel is 1.5m^3 on average.

According to the project, it is planned to arrange a concrete plant and inert materials crushing-sorting plant on the territory of the power unit. The capacity of the concrete plant will be 30 m^3/h, and of the crushing-sorting plant - 32 m^3/h. In addition to the above, a concrete plant and crushing-sorting plant of similar capacity can be arranged at the headwork site in the area of Camp 1, which will serve the headwork construction site. This issue will be decided by the construction contractor, namely: It is possible to supply the headworks construction site with concrete mixture from the concrete plant planned in the area of the power unit or to be imported from other existing nearby concrete plants. The present report allows a scenario in which concrete plants and crushing-sorting plants will be arranged in the vicinity of both the power unit and the headworks.

Depending on the volume of concrete work to be performed, concrete plants and crushing-sorting plants will work for a maximum of 120 days a year. Working mode will be single shift, and the duration of shift will be 8 hours. The average amount of water required for the production of 1 m^3 of concrete is 0.13 m^3, and for the production of 1 m^3 of inert material is 1.5 m^3.

With this in mind, the amount of water used to produce concrete mixture and inert materials will be:

For the production of concrete mixture:

$$30 * 0{,}13 = 3.9 \text{ m}^3/\text{h}$$

$$3.9 * 8 * 120 = 3\ 744 \text{ m}^3/\text{a}$$

For processing inert materials:

$$32 * 1.5 = 48 \text{ m}^3/\text{h},$$

$$48 * 8 * 120 = 46\ 080 \text{ m}^3/\text{a}$$

In case the concrete plant and crushing plant will be arranged on the territory of the construction camp N1 adjacent to the headworks, the amount of water used will be:

For the production of concrete - 6.18 m^3/h and 7488 m^3/a, and for the production of inert materials 96 m^3/h and 92 160 m^3/a. The total required amount of water will be - 102.8 m^3/h and 99 648 m^3/a.

During the construction phase, the amount of water required for the creation of fire-fighting water supply and staff training, as well as for irrigation of roads and construction sites in dry weather will be approximately **2500-3000 m^3** per year.

Based on all the above, the amount of technical water used during the construction phase will be **102,648 m^3/a.**

The amount of household water depends on the number of staff employed and the amount of water consumed per employee. As mentioned, the maximum number of employees is 200 people. According to the construction norms and rules "Internal water supply and sewerage of buildings" - СНиП 2.04.01-85, water consumption for 8 hours per employee is 45 liters. Accordingly, the consumption of drinking water will be:

$$200 \times 45 = 9\ 000 \text{ l/day, or } \mathbf{9.0\ m^3/day};\ 9.0 \times 260 = \mathbf{2340\ m^3/a}$$

During the construction phase, both sewage and industrial wastewater will be generated. The amount of sewage wastewater is calculated taking into account the 5% loss of used drinking water. Accordingly, the amount of wastewater generated during the construction phase will be **8.55 m^3/h and 2223 m^3/a.**

Industrial wastewater will be generated during the operation of inert material crushing-sorting plant (water is fully used in the production of concrete and wastewater generation is not expected). The amount of wastewater generated during the process of crushing-sorting of inert materials is calculated with a 20% loss of used technical water (wetting of inert material, evaporation). Accordingly, the amount of industrial wastewater will be 76.8 m^3/h and 73 728 m^3/a.

Industrial wastewater will be treated in desanders and the treated water will be returned to Bakhvitskali River. The dimensions of the desander will be calculated by taking into account that the weighted particle content in the purified water will not exceed 60 mg / L. The treated water is discharged into the river Bakhvistskali.

For the treatment of agricultural wastewater generated during the construction phase, it is planned to arrange biological treatment plants in the areas of the construction camps, the treated water will be discharged into the river Bakhvitskali.

Prior to the construction of the HPP, the project on maximum permissible discharges of hazardous substances into surface waters together with wastewater will be prepared and agreed with the Ministry of Environment Protection and Agriculture of Georgia.

According to the project, drainage channels will be constructed on the perimeter of the construction camp areas for drainage purposes, and bulk materials will be stored in shed-type storage areas on the territories with a risk of drainage contamination. Fuel tanks will be enclosed by waterproof barriers, which virtually excludes the spread of oil products in the event of an accident. In view of all the above, the risk of contamination of wastewater will not be high.

4.2.7.2 Operation Phase

During the operation phase, water will be used for drinking, cooling and fire-fighting purposes. Local spring waters will be used for drinking purposes.

At the stage of operation it is planned to arrange a shower. The daily amount of water required for one shower is 500 liters.

Considering the number of HPP service personnel (10-15 people), the total amount of drinking water consumed will be:

$$15 \times 45 + 500 = 1175 \text{ l/day or } 1.175 \text{ m}^3\text{/day and } 428.9 \text{ m}^3\text{/a;}$$

The station will be equipped with a pond for fire-fighting system, which will be periodically filled with Bakhvitskali river water. The amount of water used at one time is 20 m^3. If we take into account that the pond will be filled 7-8 times a year, then the approximate amount of water to be used for firefighting will be 160 m^3/a.

Switches, manometers, level gauges, flow meters, pressure regulators and other necessary equipment will be installed on the pipeline. Piping will be done with galvanized metal or stainless steel pipes.

Cooling water is supplied to all equipment required by the turbine generator manufacturer, and wastewater is discharged back into the downstream through an oil / water separator. The amount of water used in the cooling system is determined according to the technical documentation provided by the turbine-generator supplier company.

The amount of agricultural wastewater generated during the operation of the HPP will be 1.66 m^3/day and 407.5 m^3/a.

In order to treat agricultural wastewater, a compact biological treatment plant will be constructed, after treatment the water will be discharged into the river Bakhvitskali.

4.2.8 Vegetation and Soil Cover Removal Works

At the preparatory stage, the vegetation cleaning works will be agreed with the LEPL "National Forest Agency" of the Ministry of Environment Protection and Agriculture of Georgia. Vegetation removal works will be carried out under the supervision of qualified personnel. Removed vegetation will be temporarily stored in accordance with the requirements of the legislation. The cut trees will be handed over to the local bodies of the LEPL “National Forest Agency” of the Ministry of Environment Protection and Agriculture of Georgia for further management.

The design corridor of the HPP buildings runs through rather difficult terrain conditions, where the soil cover removal-storing works are technically difficult to perform.

Removal of the fertile soil layer will mainly be possible in areas selected for construction camps, storage area 1 and spoil grounds. Information on project areas and topsoil to be removed is given in Table 4.2.8.1.

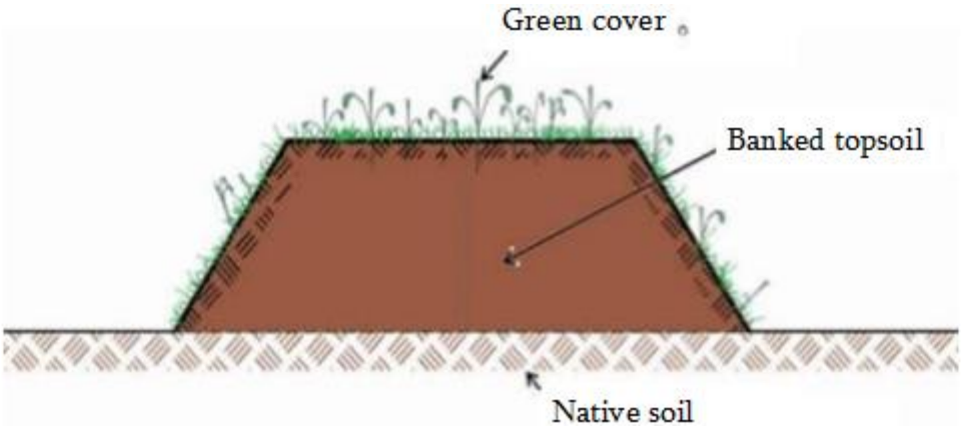
Table 4.2.8.1. Information on the volume of fertile soil layer to be removed in the project areas

N	Territory	Area, m^2	Average depth of fertile soil layer, m	Volume of removable fertile layers, m^3
1	Construction camp 1	6 500	0.15	975.0
2	Construction camp 2	1 418	0.12	170.2
3	Construction camp 3	37400	0.1	3740
4	Storage area 1	17 700	0.15	2 655.0
5	Spoil ground 1	15 920	0.15	2 388.0
6	Spoil grouns 2	4 410	0.12	529.2
7	Access road	16900	0.1	1690
Approximate total volume of removable fertile layers of soil				**12 147.4**

Separate areas will be allocated on the spoil grounds for the storage of the fertile soil layer.

The fertile layer of soil will be stored in a separate area, not more than 2.5 m high in bulk, the slope angle of which should not exceed 450. The storage area should be protected from leaching by arranging drainage channels (if necessary). If the storage of the fertile layer of the soil is intended for a long period (ie more than one year), it will be necessary to protect the bulk slopes from erosion.

Figure 4.2.8.1. Typical scheme for the storage of topsoil



After the completion of the construction works, the fertile layer will be mainly used in the reclamation works of the surrounding areas. Removal and storage of fertile soil layer will be carried out in compliance with the requirements of the technical regulation approved by the Resolution of the Government of Georgia N424 of December 31, 2013 on the removal, storage, use and reclamation of fertile soil layer.

4.2.9 Waste

Different types and quantities of waste are expected to be generated in the implementation process. Hazardous waste is generated among them. The types of waste expected in the implementation process, approximate quantities and management conditions are given in the waste management plan presented in Annex N12. Quantitatively noteworthy are the extracted rocks, the management issues of which are described in the relevant paragraph.

4.2.10 Reclamation Works

Reclamation works include demobilization of temporary structures and equipment used during construction, rehabilitation of damaged areas during construction, removal of contaminated soils / ground for remediation, removal of construction waste, etc.

Reclamation works will be carried out according to the requirements of the technical regulation approved by the Resolution №424 of the Government of Georgia of 31 December 2013 on the removal, storage, use and recultivation of the fertile soil layer, in particular: all categories of damaged and degraded soils are recultivated, as well as the surrounding land plots, which have partially or completely lost their productivity as a result of the negative impact of damaged and disturbed soils.

Reclamation of degraded soil is carried out for the purpose of restoring its agricultural, forestry, water-agricultural, construction, recreational, environmental, sanitary and other purposes.

The company is obliged to ensure the integrity of the soil cover and its fertility to approximately the original condition, which requires: in case of contamination of the area, eliminate the contaminant source and recult the contaminated area as soon as possible to restore the integrity of the soil cover; protect the surrounding area from damage and degradation.

According to the same technical regulation, reclamation works must be carried out according to the reclamation project. The site reclamation project will be developed after the construction contractor is identified (after various technical issues have been clarified). A detailed reclamation project will be submitted to the Ministry for approval.

Reclamation works should be carried out in 2 stages, technical and biological. Autumn-spring is considered to be the best period for carrying out works. Technical recultivation means fulfillment of the requirements and standards provided by the regulations:

- It is necessary to arrange a network of sewage channels, which will ensure the organized removal of abundant atmospheric precipitation and will protect the soil layer scattered in the area from washing out.
- Fertilizing the soil layer will not be carried out in rainy and snowy weather, nor when the soil is frozen or saturated with water.

At the stage of biological reclamation:

- In order to accelerate the process of cord formation in the restored area, seeds of endemic grass species typical for this region will be sown.
- The company performing the reclamation works is obliged to undertake a one-year monitoring obligation, should take care of and observe the recultivated areas, in case of complication of remediation of the grass cover to re-sow the grass.

Results of reclamation works:

- After the completion of the reclamation works, technically and biologically restored land plots will be combined with the local landscape.
- Regardless of the purpose of the plots, the areas will be technically and biologically recultivated.
- Completion of reclamation works will be notified to the Department of Environmental Supervision of the Ministry of Environment Protection and Agriculture of Georgia.

5 Environmental Background

5.1 Gneral Overview

Construction of Bakhvi 1 HPP is envisaged in western Georgia, on the territories of Chokhatauri and Ozurgeti municipalities of Guria region, on the river Bakhvitskali, downstream of the resort Bakhmaro.

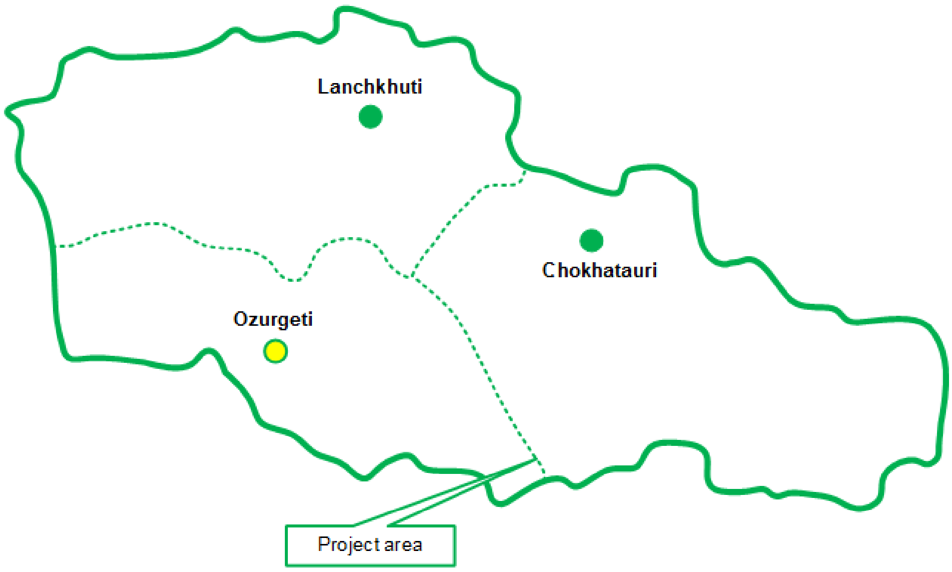
Ozurgeti Municipality is located in the Natanebi and Supsa river basins in the Guria region of western Georgia. The municipality is surrounded by the Black Sea for 20 kilometers to the west, Kobuleti and Shuakhevi municipalities to the south, Chokhatauri municipality to the east, and Lanchkhuti municipality to the north. The territory of the municipality is 675.1 km^2. There are 75 settlements in Ozurgeti municipality, including: 1 city, 4 small towns and 70 villages. The administrative center is the city of Ozurgeti.

Chokhatauri municipality is located in the Guria region of western Georgia. The administrative center of the municipality is Chokhatauri. Chokhatauri municipality is bordered by Samtredia and Vani municipalities to the north, Khulo and Adigeni municipalities to the south, and Ozurgeti and Lanchkhuti municipalities to the west. The area of Chokhatauri municipality is 825.1 km^2. There are 61 settlements in the municipality, including: Town Chokhatauri and 60 villages.

Resort Bakhmaro is located in Chokhatauri municipality, on the Meskheti ridge, in the gorge of the river Bakhvistskali, 1926-2050 m above sea level, 52 km from Chokhatauri, 72 km from Ozurgeti (the nearest railway station). The Bakhmaro area is surrounded by evergreen forest groves of Oriental spruce, fir and Caucasian pine.

Figure 5.1.1. Map of the administrative division of Georgia

Figure 5.1.2. Scheme of Guria region



5.2 Description of Physical-Geographical Environment

5.2.1 Climate and Meteorology

The project area is located in the range of 1380-1732 meters above sea level, in the conditions of divided relief. Its climatic background can be characterized by the data of Bakhmaro meteorological station, which is located at a distance of about 2 km from the project sites, at an altitude of 1926 meters above sea level. If we take into account the difference in heights between the project area and the Bakhmaro meteorological station, then the temperature values presented in the table for the project area should be 1-2^0 more considering the vertical temperature gradients.

The climatic characteristics of the Bakhvitskali basin and the construction area are compiled according to the data of the National Center for Climate Research of the Hydrometeorological Department of Georgia, the resort Bakhmaro and Ozurgeti meteorological stations located in the region (see Table 5.2.1.1).

Table 5.2.1.1 Coordinates of meteorological stations and barometric pressure

Meteorological station	Construction-climatic zone	Coordinates			Barometric pressure (hPa)
		Geographic Longitude (Degrees and Minutes)	Latitude (degrees and minutes)	Height above sea level (m)	
Bakhmaro	I g	41^{0}51'	42^{0}19'	1926	790

River basin is located in the subtropical humid region of the sea. In the area, in terms of climate, there is a certain height zoning and macro-zoning, depending on the location of individual areas and their surrounding mountain ridges.

Table 5.2.1.2 Characteristics of construction-climatic zones

Climatic region	Climatic sub-regions	Average temperature in January, °C	Average wind speed for 3 months in winter, m / s	Average temperature in July, ^{0}C	Relative humidity in July, %

I	Ia	From -4 to -14	5 and more	From +5 to +12	More than 75
	Ib	From -3 to -5	5 and more	From +12 to +21	More than 75
	Ic	From -4 to -14	-	From +12 to +21	-
	Id	From -5 to -14	5 and more	From +12 to +21	More than 75
II	IIa	From -14 to -20	-	From +21 to +25	-
	IIb	From -5 to -2	-	From +21 to +25	-
	IIc	From -5 to -14	-	From +21 to +25	-
III	IIIa	From -10 to +2	-	From +28 and more	-
	IIIb	From +2 to +6	-	From +22 to +28	50 and more 13ს
	IIIc	From 0 to +2	-	From +25 to +28	-
	IIId	From -15 to 0	-	From +25 to +28	-

5.2.1.1 Ambient Air Temperature

Data from Bakhmaro meteorological stations are used to characterize the temperature regime at the construction site. Current Technical Regulation - "Construction Climatology" was issued in 2008 and its use is mandatory on the territory of Georgia.

Temperature characteristics are given in Tables 5.2.1.1.1- 5.2.1.1.5.

Table 5.2.1.1.1. Ambient air temperature taken from the data of Bakhmaro and Ozurgeti meteorological stations

Meteorological station	Ambient air temperature °C															
	Average of the month															
	Januray	February	March	April	May	June	July	August	September	October	November	December	Average of the year	Absolute minimum	Absolute maximum	Average maximum for the hottest month
Bakhmaro	-5.8	-4.6	-2.3	2.5	7.3	10.4	13.4	13.5	9.6	4.8	-1	-1.4	2.5	-38	30	19.2
Bakhmaro 1966-2010	-4.6	-5.1	-4.9	3.0	7.3	10.9	13.6	14.0	10.8	6.3	1.3	-2.8	4.4	-24.0	31.8	

Figure 5.2.1.1.1. Ambient air temperature taken from Bakhmaro meteorological station data, average of the month, ^0C

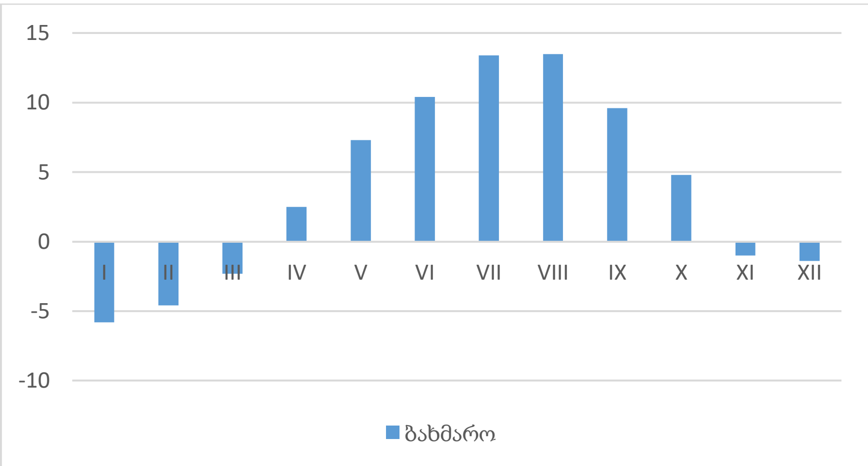


Table 5.2.1.1.2. Ambient air temperature for different periods, taken from Bakhmaro meteorological station data

Meteorological station	Period with average monthly temperature <8 ⁰C		Average temperature at 13 p.m.		The coldest five-day average	The average of the coldest day	The average of the coldest period
	Duration in days	Average temperature	For the coldest months	For the hottest months			
Bakhmaro	238	-1.2	-7.9	18.6	-19	-23	-9.8

Table 5.2.1.1.3. Air temperature amplitude taken from Bakhmaro meteorological station data

Meteorological station	Average of the month, ⁰C											
	Januray	February	March	April	May	June	July	August	September	October	November	December
Bakhmaro	8.6	8.9	10.2	9.8	9.0	9.1	8.9	9.6	10.0	9.4	8.7	8.2

Figure 5.2.1.1.2. Air temperature amplitude taken from Bakhmaro meteorological station data, ⁰C

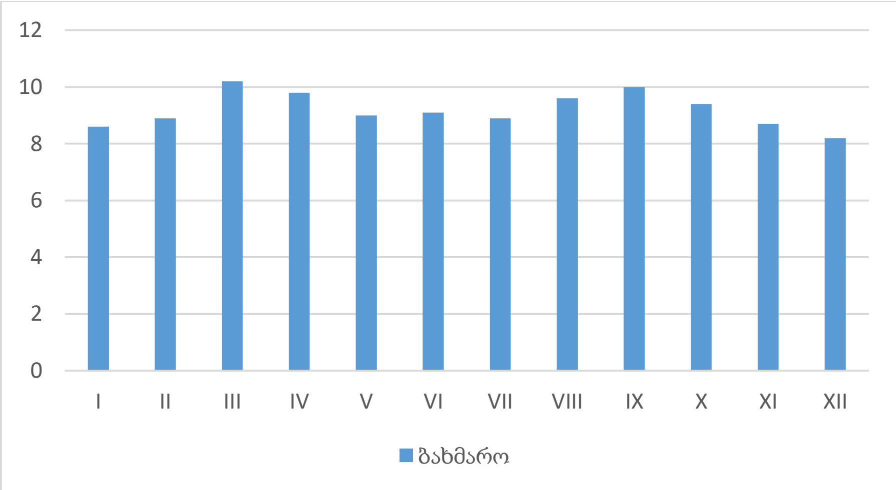


Table 5.2.1.1.4. Maximum amplitude of air temperature taken from Bakhmaro meteorological station data

Meteorological station	Maximum of the month, ⁰C											
	Januray	February	March	April	May	June	July	August	September	October	November	December
Bakhmaro	18.3	18.6	21.4	20.3	20.0	20.2	19.7	20.1	22.0	20.5	18.8	18.3
Ozurgeti	16.9	18.0	19.4	22.3	23.6	21.0	19.5	20.5	21.4	21.2	19.0	19.5

Figure 5.2.1.1.3. Maximum amplitude of air temperature taken from the data of Bakhmaro and Ozurgeti meteorological stations, ^{0}C

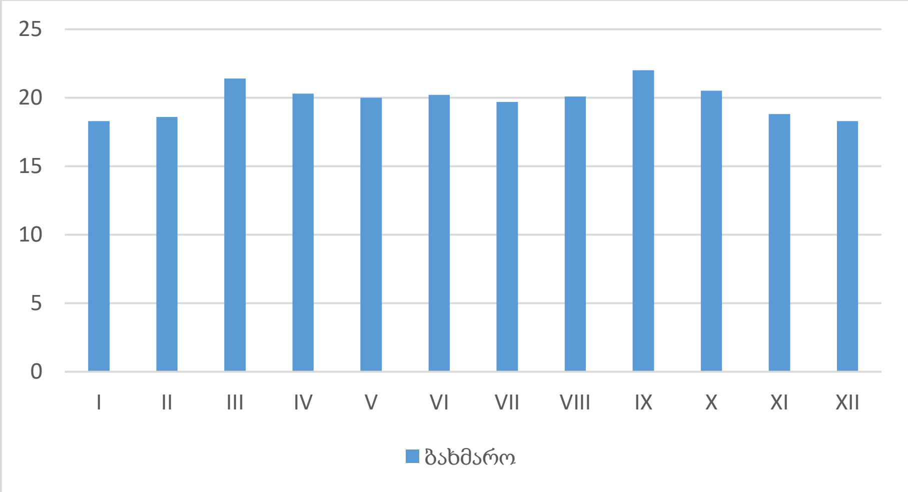


Table 5.2.1.1.5. Air temperature distribution (C^0) on the construction site of Bakhvi 1 HPP

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Average temperature	2.6	3.2	6.3	10.4	14.4	17.8	19.4	20.5	17.6	14.2	9.4	4.8
Aver. max. temperature	7.4	8.1	12.3	16.8	20.6	22.8	23.5	24.2	21.7	18.4	14.3	9.3
Aver. min. temperature	-1.6	-1.2	2.3	6.9	10.3	14.7	17.5	18.2	14.8	11.4	7.5	0.8
Abs. max. temperature	22	23	29	31	33	36	38	38	34	31	28	22
Abs. max. Temperature 1966-2010	11.0	9.7	14.3	19.0	25.0	25.8	31.8	31.0	28.8	23.0	17.2	16.8
Abs. min. temperature	-18	-12	-6	3	6	8	10	10	5	1	-6	-15
Abs. min. temperature 1966-2010	-24.0	-22.0	-20.1	-15.3	-7.7	-2.1	0.5	1.3	-4.0	-9.0	-13.4	-18.7

The date of the first frosts of autumn in the construction area is 10.11-30.11, the date of the last frosts of spring is 20.03-10.04, the average duration of the freezing period is 200-250 days a year, while the longest freez-free period in Bakhmaro is 180 ays, and the shortest period - 93 days.

5.2.1.2 Humidity

Humidity characteristics of the construction area are given in Tables 5.2.1.2.1.-5.2.1.2.3.

Table 5.2.1.2.1. Relative humidity taken from Bakhmaro meteorological station data

Meteorological station	Relative humidity of ambient air, %												
	Januray	February	March	April	May	June	July	August	September	October	November	December	Average
Bakhmaro	73	74	72	67	70	76	80	78	77	72	71	70	73
Ozurgeti	72	74	74	73	77	78	81	82	82	78	74	70	76

Figure 5.2.1.2.1. Relative humidity of the ambient air taken from the data of Bakhmaro meteorological station, %

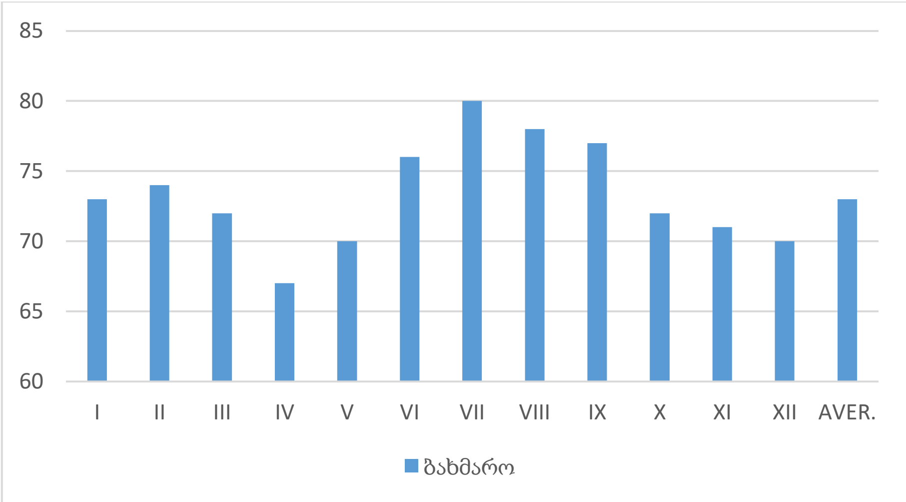


Table 5.2.1.2.2. Relative humidity of ambient air from the data of Bakhmaro meteorological station taken at different hours of the day, %

Meteorological station	Januray	February	March	April	May	June	July	August	September	October	November	December	Average	Januray
Bakhmaro	1:00	76	76	76	72	75	81	85	82	80	75	74	73	77
	7:00	77	78	75	65	66	70	76	74	75	74	74	73	73
	13:00	65	65	63	59	65	73	76	72	69	63	61	60	66
	19:00	75	75	75	72	75	79	84	83	83	78	74	73	77

Table 5.2.1.2.3 Relative humidity of the ambient air at 13 o'clock of different days and daily amplitude taken from the data of Bakhmaro meteorological station, %

Meteorological station	Average relative humidity at 13 p.m.		Average daily amplitude of relative humidity	
	For the coldest months	For the hottest months	For the coldest months	For the hottest months
Bakhmaro	65	76	13	24

5.2.1.3 Atmospheric Precipitation

The data of atmospheric precipitation observations in Bakhvitskali basin are given in Tables 5.2.1.3.1.-5.2.1.3.3.

Table 5.2.1.3.1. Average monthly and annual precipitation (mm)

Meteorological station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XI-III	IV-X	Year
Bakhmaro	209	203	174	87	96	126	107	114	153	214	201	185	972	897	1869
Bakhmaro 1966-2010	156	108	70	81	103	127	83	100	130	170	171	142			1467
Kvedaa Bakhvi	198	166	133	76	64	115	125	156	212	243	200	193	890	991	1881
Ozurgeti	198	186	139	110	81	130	156	179	224	235	223	212	958	1115	2073
Vakijvari	226	192	154	87	74	128	142	176	238	276	226	221	1019	1121	2140

Figure 5.2.1.3.1. Average monthly precipitation (mm)

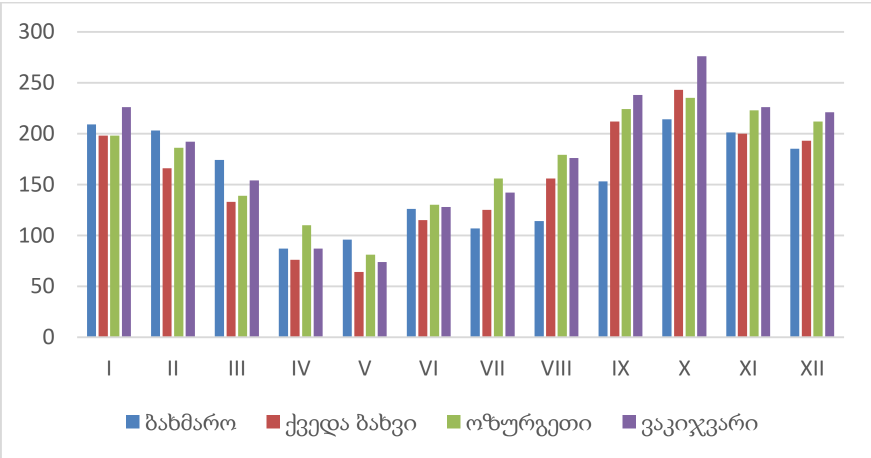


Table 5.2.1.3.2. Precipitation (mm / s) distribution according to basin heights

River	Basin height, m								
	0	500	1000	1500	2000	2500	3000	3500	4000
Bakhvistskali		1940	2100	2340	2500	2620			

Table 5.2.1.3.3. Precipitation (mm / s)

Meteorological station	Precipitation per year, mm	Daily maximum of precipitation, mm
Bakhmaro	1869	250
Ozurgeti	2168	216

5.2.1.4 Evaporation

Table 5.2.1.4.1. Evaporation (mm / s); Distribution according to basin heights

River	Basin height, m								
	0	500	1000	1500	2000	2500	3000	3500	4000
Bakhvistskali		760	760	740	700	620			

5.2.1.5 Wind

Wind direction in mountainous areas mainly depends on the direction of the valley and the slope exposure. Wind speed monitoring data in the Bakhvitskali River gorge are available at the Bakhmaro meteorological station (1850 m a.s.l.), which is 3-7 km away from the construction site of the HPP. As the exposure of the slopes of the gorge is close enough and high enough at this site, with acceptable accuracy for the future construction site we can be guided by the data of both Bakhmaro and neighboring (village Anaseuli, Ozurgeti) meteorological station, the results of which are given in Tables 5.2.1.5.1 - 5.2.1.5.2.

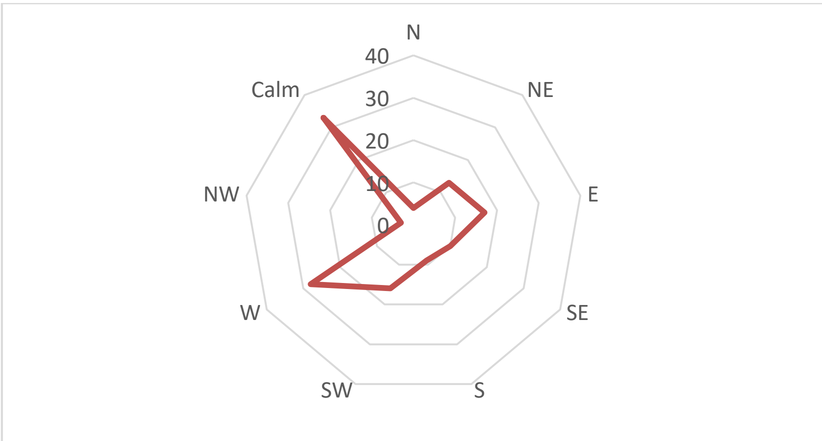
Table 5.2.1.5.1. Bakhmaro, average wind speed

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Bakhmaro	3,0	3,2	2,9	2,4	1,8	1,6	1,5	1,6	1,4	2,0	2,2	2,5	2,2
Bakhmaro 1966-2010	3,0	2,3	2,8	2,0	2,0	104	1,0	1,0	1,1	1,7	2,1	2,2	1,9

Table 5.2.1.5.2. Wind characteristics are taken from Bakhmaro and Ozurgeti meteorological stations

Meteorological station	Maximum wind speed possible once in 1,5,10,15,20 year, m / s					Repeatability of wind direction (%) January, July								Average maximum and minimum wind speed, m / s	
	1	5	10	15	20	N	NE	E	SE	S	SW	W	NW	January	July
Bakhmaro	19	23	24	25	26	2/2	10/3	42/9	13/12	13/15	1/4	17/47	2/8	6,1/2,2	2,8/0,9

Figure 5.2.1.5.1. Repeatability of wind direction and calm, Bakhmaro, %



5.2.2 Geological Environment

5.2.2.1 Geomorphological Conditions

The valley slopes of Bakhvistskali river are mostly steep, forested, while above their grade decreases and they gradually transfer into an unforested zone at the highest level. The valley floor is narrow, V-shaped and its width is mainly 10-30 m. Generally, the existing thick forest on both banks is preventing the clear evidence of rock outcrops for better interpretation of the overall rock conditions. The areas with no heavy vegetation show steep rock cliffs and rarely areas where surface erosions are present.

According to the geomorphological zoning scheme of the territory of Georgia, the research territory belongs to the medium height mountain-valley terrain subzone (of South Georgia highland zone) spread on volcanogenic folded structures of the Tertiary age. The mentioned subzone is a western termination of the Meskheti ridge, which is dissected with the ridges of meridional direction and river-gorges between them. The subzone is characterized by numerous denudation-erosion, landslide, mudflow, and snow avalanche processes.

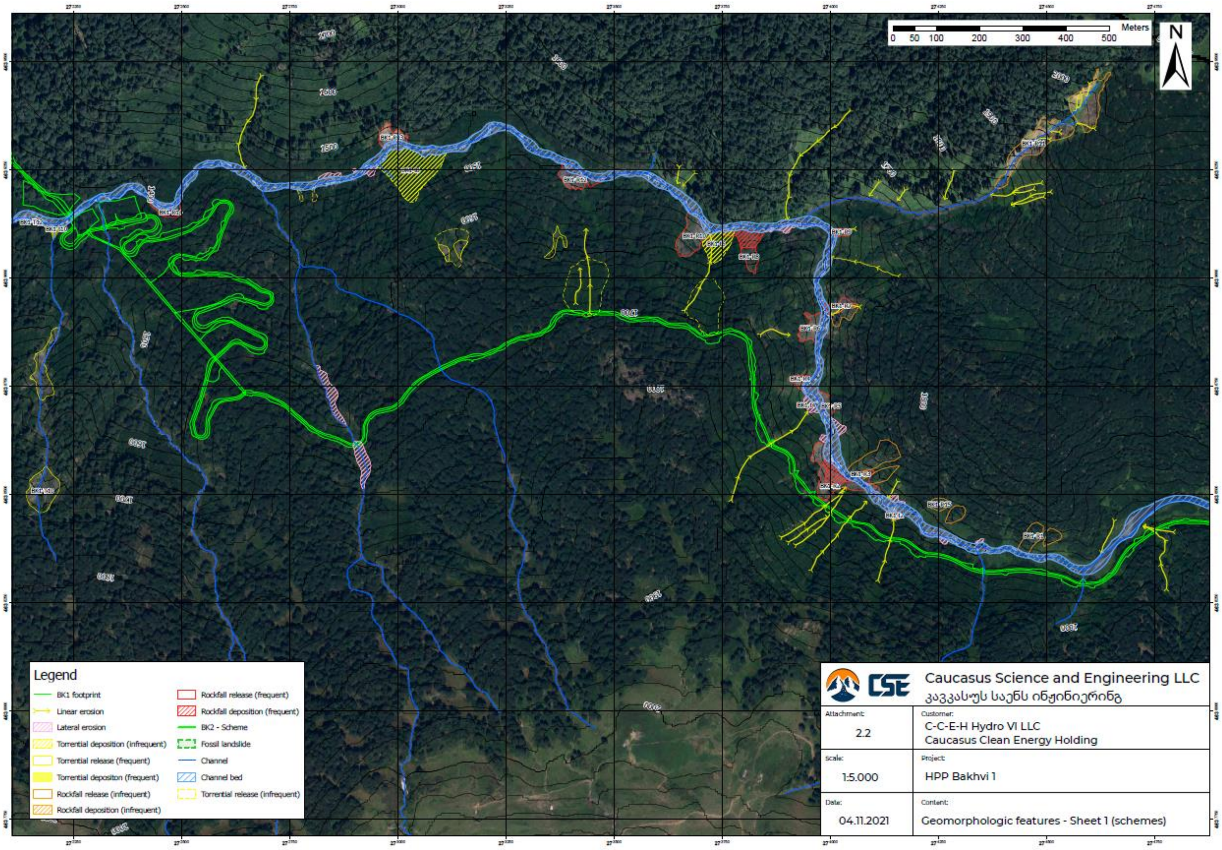
The geological, tectonic, and lithological features of the rocks building the area determine the specific morphological structure of the area, in the formation of which rivers, abundant precipitation, sharp temperature variability in a short time period and heavy snowfall also participate. The river Bakhvistskali is the main hydrological artery of the region. Like all typical mountain rivers, it largely participates in the formation of the morphological and morphostructural relief of the area. The river originates on the northwestern slope of the Meskheti ridge. It is fed mainly by rain, snow and groundwater.

In some parts of the Bakhvistskali valley fragments of terraces with roughly rounded boulder-pebbles can be observed, the sizes of which can reach from one meter to tens of meters. The middle and bottom of the slope are mostly covered with soils of Quaternary deluvial, deluvial-colluvial, and deluvial-proluvial origin. In the hypsometrically elevated areas, tertiary volcanogenic rocks are exposed, in which rockfalls and rock avalanche processes often appear. As a result of these processes, strong colluvial formations are observed at the foot of rocky slopes.

On both slopes of the river valley in the deluvial, deluvial-proluvial, and deluvial-colluvial sediments landslide processes can be observed. Besides these factors, the development of erosion-denudation and landslide processes is facilitated by rock lithology, since the slopes are mainly built up of volcanoes, which under the intense influence of water and sharp temperature fluctuations, are easily disintegrated and change their state, thus weakening the physical and mechanical properties of rocks.

The lateral ravines are present on both slopes in the surveyed section of the Bakhvistskali river gorge and form debris cones of various thicknesses at the confluence points. Snow avalanches are also observed in lateral ravines. It can be stated that snow avalanches in the valley are quite intense phenomena, which also contributes to the further intensification of landslide, rock-landslide and colluvial processes.

Figure 5.2.2.1.1. Geomorphological map

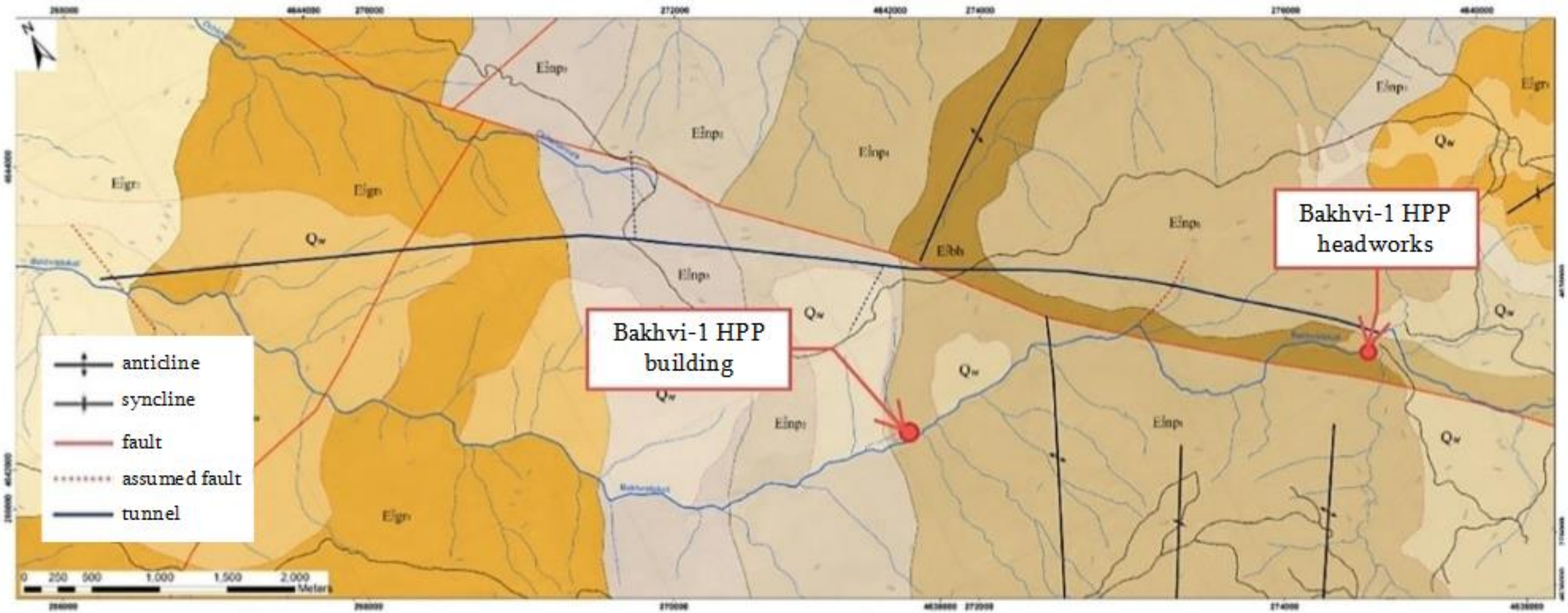


5.2.2.2 Geological Structure

The studied area, according to the tectonic zoning scheme of Georgia, is located in the northern subzone of the Adjara-Trialeti fold zone of the Lesser Caucasus fold system.

According to the geological map most the HPP facilities will be located entirely in Kintrishi Suite. The geological map of the volcanic rock and the quaternary deposits given by Gamkrelidze are shown in the map below.

Figure 5.2.2.2.1. Geologic map of the project area



5.2.2.2.1 Volcanic Rocks

All aspects of volcanic processes in Adjara-Trialeti fold-thrust belt developed during the opening and closure of the "back-arc basin" where magmatic-arcs are formed. Back-arc basins are "subduction-related" spreading-centers developed under compression tectonics eventually giving rise to volcanic rocks of the project area. Accordingly, the volcanic rock types produced under these conditions can be organized under the Effusive and Explosive eruptions:

Effusive Eruption: is a type of volcanic eruption in which lava steadily flows out of a volcano onto the ground.

Effusive eruptions are most common in basaltic magma, but they can also occur in intermediate (andesitic) and felsic (rhyolitic) magma. These eruptions form lava flows and lava domes, each of which varies in shape, length, and width. If the volcanic rock types given in previous studies are examined based on "Bowen's Reaction Series" the following conclusions could be arrived:

- Guria sub-suite (P^2 gr $_{1+2}$): Substantial part of seems to be the product of effusive eruption products represented by "massive lavas". These rock types constitute the "sharp ridges" of the project area due to their high resistance against both "glacial and atmospheric weathering".
- Napotskhari sub-suite (P^2 np $_{1+3}$): represented by "mass lava breccias of basalt among which there are rare layers of lava".
- Bakhmaro uplift, mainly made up of "andesitic lava, agglomerate and tuff" is a good example both for "massive lava dome" and "combination of effusive and explosive eruptions".

Photo 5.2.2.2.1.1. Example for the visible Andesit-Basalt rock outcrops close to the riverbed

Explosive eruption: differs from "effusive eruption" wherein magma is violently fragmented and rapidly expelled from volcanoes. These rocks called "pyroclastics" are mainly represented by:

Volcanic Tuffs: Type of rock formed from material ejected from during an explosive volcanic eruption. In these eruptions, fragments of volcanic material (≤64 mm) are blasted from the volcano.

Photo 5.2.2.2.1.2. Example for the visible Volcanic Tuff at project area

Volcanic Breccia: Is a rock composed predominantly of angular fragments (≥2 mm) formed from compaction of lava chunks with ash.

- Napotskhari sub-suite (P^2 np $_{1+3}$) represented by mass lava breccias of basalt is a good example of explosive eruption. Due to their compaction characteristics under rock load and heat of volcanism, however, these rock types are tightly interconnected; hence they are inherently competent.

Agglomerate: Typical rock type with large, coarse rock fragments (>64 mm) associated with lava flow that is ejected during an explosive eruption. Fragments are angular or rounded, poorly sorted in a tuffaceous matrix, or appear in lithified volcanic ash. By their mode of formation, they usually involve a substantial amount of volcanic bombs.

Volcanic Bombs: are vicious at the moment of ejection and by rotation in the air acquired their round to oval shape. They are commonly 30-60 cm in diameter but specimens as large as over 3.0 m.

5.2.2.2.2 Quarternary Deposits

In the geologic time, inherently relatively weak rock layers volcanic rocks described above have also been under the adverse effects of “fold-thrust” tectonic activities. Therefore they are very susceptible to both atmospheric and glacial weathering and erosion, giving rise to the development of Quaternary Deposits. These unconsolidated Pleistocene to Holocene aged soil-like geologic formations are represented by; diluvial, colluvial, proluvial, and occasionally alluvial deposits. Below their brief descriptions are presented based on their mode of formation.

Photo 5.2.2.2.2.1. Typical composition of alluvial deposit in the river bed and colluvial deposits at the base of slopes

5.2.2.2.3 Diluvial Deposits

This terminology refers to flat/angular rock particles produced by "weathering effects of glaciers" and "transportation of deluge water". These rock particles eventually give rise imperfectly stratified deposits constituting the "flood plains" observed along with the ancient watercourses. These deposits reveal relatively stable morphology due to their geologic past.

5.2.2.2.4 Colluvial Deposits

A general term applied to any loose, heterogeneous and incoherent mass of soil material and/or rock fragments deposited by rain wash, sheet wash, or slow continuous downslope creep, usually collecting at the base of gentle slope or hillside. The important point with this definition lies in that these deposits are mostly unstable and ready to move under heavy rain or excavation.

5.2.2.2.5 Proluvial Deposits

Mostly refers to a complex, friable, deltaic sediment accumulated at the foot of a slope as a result of occasional torrential washing of fragmental material. The definition suggests that the proluvial deposits mostly occur at the mouth of side valleys, hence they are under the continuous threat of subsequent torrential rain.

5.2.2.2.6 Alluvial Deposits

The Bakhviskali riverbed is filled with alluvial deposits which can be described as mainly sandy gravel with cobbles and boulders. At some river sections the cobbles and blocks can provide the primary fractions.

Photo 5.2.2.2.6.1. Typical composition of alluvial deposit in the river bed

5.2.2.3 Hydrogeological Conditions

According to I. M. Buachidze (1968), the studied area is included in the hydrogeological region of Adjara-Imereti ridge. The formation of hydrogeological conditions of the area is conditioned by: climate, relief, lithological composition of the massif, tectonics and degree of weathering of rock. As mentioned, the area is built mainly of massive tuff breccias, lavas, lava breccias and tuffs of andesite-basalt composition. The upper, intensely fissured zone of the rock mass has no collecting properties and the atmospheric precipitation is rapidly discharged through it at the level of the local erosion base, directly into the riverbeds. Water circulation in the depths of the massif is somewhat difficult due to the decrease in the frequency and opening of the fissures, however, its circulation in the deeper zones is facilitated by tectonic and some other deep fissures, along which the collected water flows to the surface in some places in the form of springs. Unloading of the surface zone of the massif from groundwater is facilitated by the frequent hydrographic pattern of large and small erosive ravines, most of which are deeply incised in the slopes of the Bakhvitskali gorge and at the bottom of which water streams constantly flow.

According to the chemical composition, groundwater is hydrocarbonate-chloride-sodium-magnesium or hydrocarbonate-calcium sodium, rarely hydrocarbonate-sulfate-magnesium-potassium, with mineralization up to 124 mg / l. The waters are mostly non-aggressive.

Alluvial aquifers are common within the floodplain of the Bakhvitskali Valley and the first floodplain terraces. This horizon is built of sandy and coarse-grained sediments. The waters of this horizon are pressureless and of the porous circulation type. The flow rate of some sources is from 0.002 to 0.5 l / s, while the mineralization does not exceed 0.22 g / l.

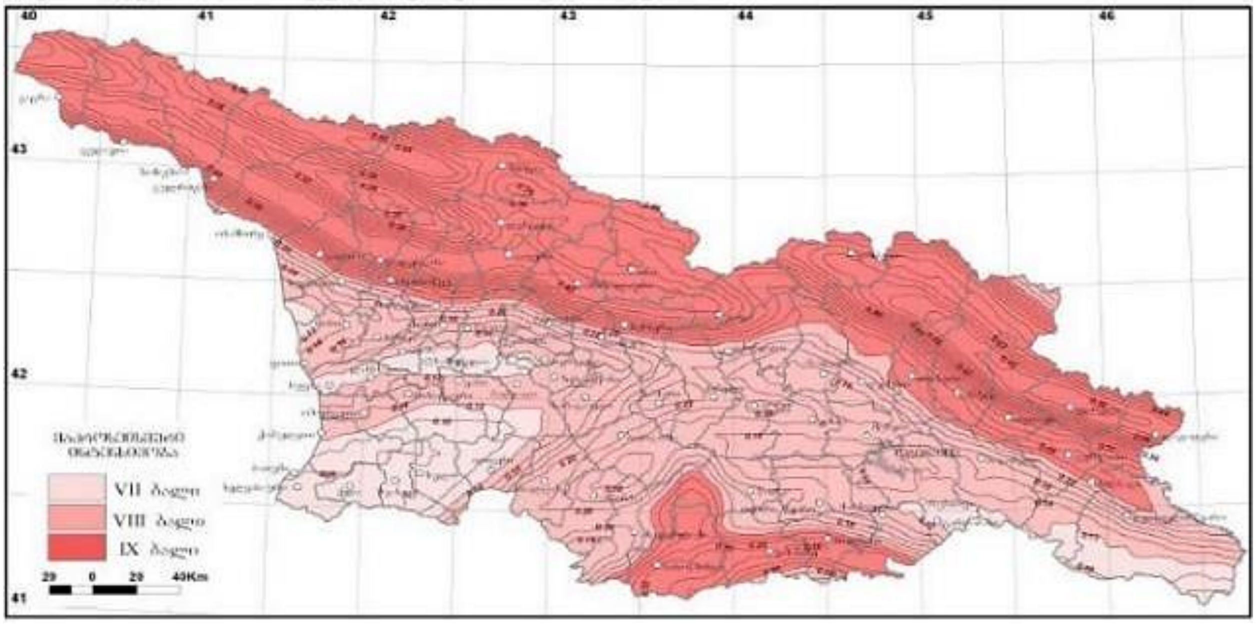
Chemically, it is of sulfate-hydrocarbonate-sodium-calcium type. Colluvial-Deluvial and Eluvial sediments are mainly associated with flattened ridge surfaces, sources of rivers, base of ridge slopes and river confluences. In addition, they contain certain resources of groundwater. The sediments of this horizon are built of clayey, clayey-gravel, limestone-gravel and gravelly material.

On the steep slopes of the ridges, where the capacity of deluvial sediments is small, the flow rate of the springs does not exceed 0.08 l / s, while on steep slopes and mountain slopes it reaches 1.0 l / s. Of particular note here is the secondary detection of groundwater of tuff rock cracks in deluvial sediments. They are chemically hydrocarbonate-calcium-calcium-magnesium or chloride-calcium-magnesium, more rarely hydrocarbonate-sulfate-calcium-sodium and are weakly mineralized (with total mineralization up to 0.08 g / l).

5.2.2.4 Seismic Hazard Assessment

According to the corrected scheme of seismic zoning of Georgia, the study area belongs to the seismic activity zone with the magnitude of 7 (MSK64 scale), (Order №1-1/2284 of the Minister of Economic Development of Georgia, October 7, 2009, Tbilisi, on approval of Construction Norms and Rules – "Earthquake-proof Construction" (PN 01.01-09)).

Figure 5.2.2.4.1. Seismic hazard map



Detailed seismic hazard assessment was carried out in the project area of Bakhvi 1 HPP. According to ICOLD recommendations, for small hydropower plants similar to Bakhvi 1 HPP, three levels of seismic motions (V_{S30} = 801 m / s) were selected to assess the seismic hazard of the construction site. Earthquakes of the first and second (relatively low) levels are Operating Basis Earthquake (OBE) or motions corresponding to 50% or 20% probability of exceeding once every 100 years (recurrence period 145 or 475 years). OBE ground motions should typically have an average AEP of at least 1/145. However, structures such as penstocks, power plants, water intakes and tunnels should at least be designed in accordance with the seismic code of such structures. Therefore, the OBE for a particular site should have a recurrence period specified in the seismic building codes, which is typically 475 years. The third (higher) level earthquake is called a Safety Evaluation Earthquake (SEE). For low-risk dams and critical structures, such as bottom spillways, spillway gates, control gates are rated at the 0.5 quantile level if a deterministic approach is used and with motions corresponding to 10% probability of exceeding once every 100 years (recurrence period 1000 (975) years), if a probabilistic approach is used.

Based on seismic noise measurements, a study was conducted to determine the resonant frequencies of the ground at the construction site, which have a significant impact on seismic hazard. Knowledge of ground resonance frequencies is also important when designing buildings so that the core frequency of the building does not coincide with the ground resonance frequency. A seismograph Tromino 3G was used to record seismic noise. Analysis of seismic noise records at the study site showed that the construction area of the Bakhvi 1 HPP headworks is represented by base soils and here the seismic noise record corresponds to the rock, which allows us to assess the seismic hazard for the rock. In this case the gain coefficient will be 1. Seismic noise recordings on the construction site of Bakhvi 1 HPP showed that the area is homogeneous, the layer along the whole site is characterized by high frequencies in the narrow range 13.31-18.41 Hz, which corresponds to the period 0.05-0.08 s and that the base-soils are close to the surface. Thus, the seismic hazard for the power plant area will also be calculated for the rock if the foundation of the building is reduced to the base-soils during construction.

Seismicity analysis of the study area observations was conducted. It was found that the study area is covered with earthquake epicenters but with different densities. The highest concentrations of moderate and strong instrumental earthquakes (Mw> 3.5) will be observed in the northern part of the district, where the epicenters of strong historical earthquakes are concentrated, indicating that many areas of the study area were seismically active and currently significant during the entire historical observation period. Many weak earthquakes that occurred in the vicinity of the facility during the instrumental period indicate modern local activity. In addition, many strong and powerful earthquakes in Georgia and Turkey were detected at MSK intensities from 5 to 7.5.

In order to determine the regularity of seismotectonic conditions in the study area or to separate the zones of seismogenic sources, 14 active faults in the given area were described. They were identified on the basis of geological, geophysical, morphological and seismological data.

15 national and 7 EMME models of area sesimic sources (ASS) were selected based on active faults identified by complex data and a corresponding map was developed to present the potential seismic capabilities of the study area. These ASS zones are differentiated into six magnitude bands taken by 0.5 steps (5.0≤Mwmax≤7.5). Seismic sources were parameterized. The EMS model of ASS zones was used to calculate the seismic hazard of the site, as they have undergone extensive review by international experts as part of the EMME project.

The seismic hazard assessment of the site was carried out using probabilistic and deterministic approaches for peak ground accelerations (PGA), as well as for different period spectral accelerations (SA), for rocky ground (V_{S30} = 801 m / s). The well-known program OpenQuake was used in seismic hazard calculations.

Probabilistic values of ground motions corresponding to the mean geometric value of two horizontal components with fixed recurrence periods of 145, 475 and 975 for the standard rocky ground (V_{S30} = 801 m / s), for the two survey sites (headworks and powerhouse), for PGA were 0.148 g, 0.256 g, 0.346 g (headworks) and 0.150 g, 0.261 g, 0.353 g (powerhouse), respectively. The vertical component of ground motions is taken as 2/3 of the horizontal component. The Unified Hazard Spectrum (UHS) was built for the study areas, which is the basis for determining the level of seismic design of new structures.

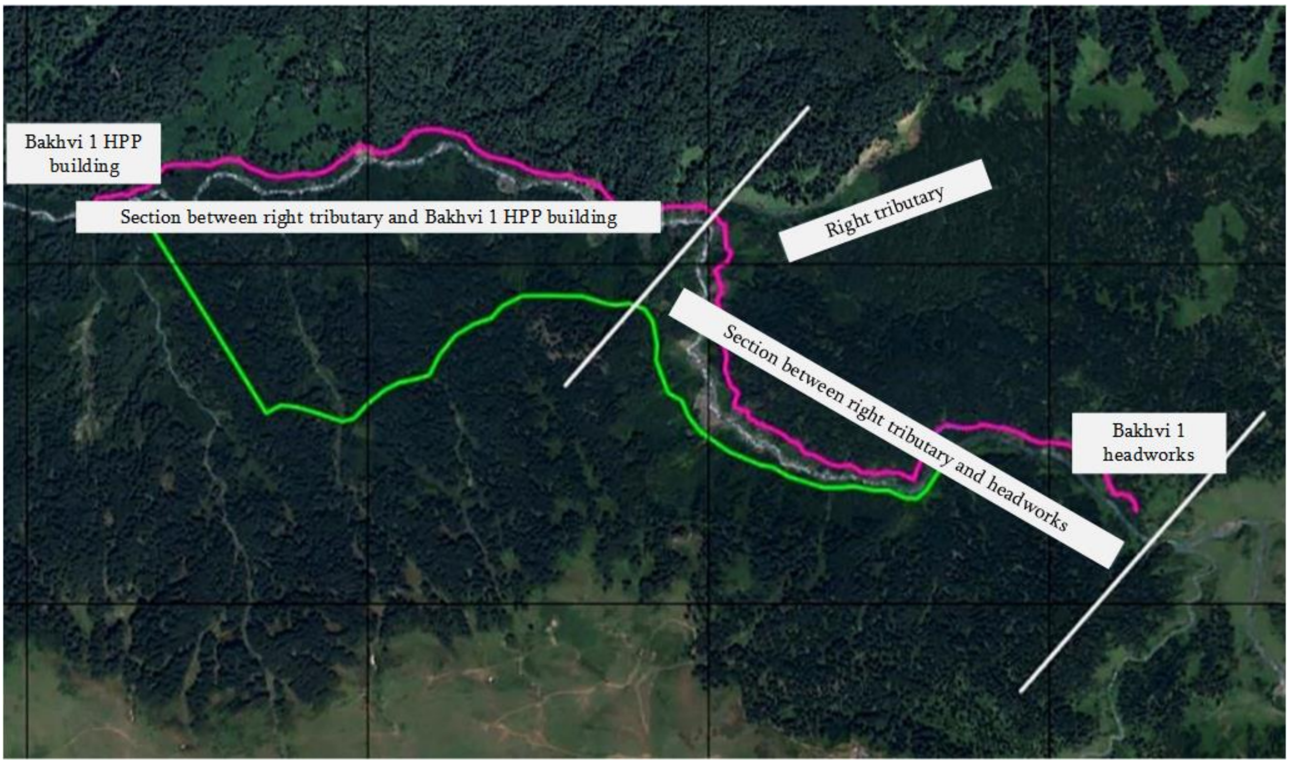
For an analysis of geophysical surveys and seismic risks, see Appendix N2.

5.2.2.5 Geological-Geomorphological Assessment of Geohazards

The project area lies in “fold-thrust belt” where rock formations inter-mingled during the compression tectonic processes in geologic time and the rock formations have been tectonically deformed in the fold-thrust belts of lesser Caucasus. Therefore a detailed geo-hazard study along the valley was done by CSE.

At the beginning of the feasibility study, two alternative pipeline schemes were foreseen. One scheme on the orographic left side (south) of Bakhvistskali river that is located rather high on the slopes and one on the orographic right side (north) of Bakhvistskali river that is located approximately 40m to 60m above the river bed.

Figure 5.2.2.5.1. Left and right scheme alternatives



Geological maps of the project area are given in Appendix N3.

5.2.2.5.1 Left and Right Schemes

The most challenging part for the left scheme is assumed at the area of BK1-R2 (red circle in Figure 5.2.2.5.1.1.), where not only rockfalls occur, but erosion can prograde further sliding processes. It is assumed that most probably this area can be passed by stabilizing the foot and slope properly another solution could be a short tunnel segment. This has to be decided after further geological investigations.

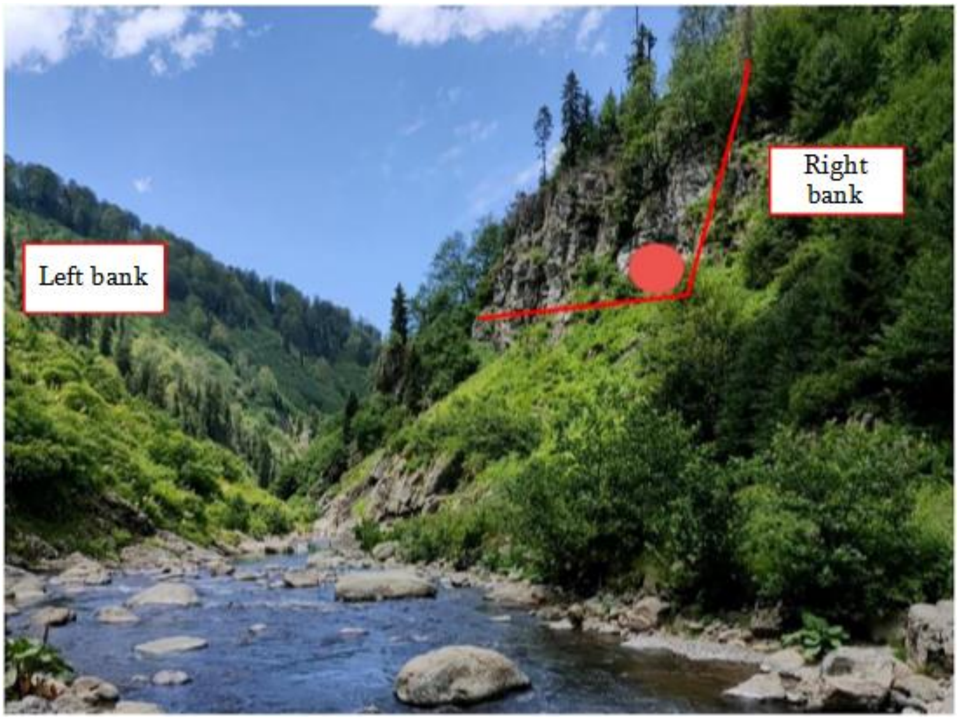
Figure 5.2.2.5.1.1. Geo-hazard areas by CSE

The left scheme is crossing more smaller tributaries, but these areas are not prone to large to very large rockfalls, the right scheme is crossing the right tributary (see Figure 5.2.2.5.1.2. and Figure 5.2.2.5.1.3.) where a landslide event was documented in the year 1970. Due to the presence of rocks in the slopes, this area appears to be stable at the moment but the repetition of a similar event cannot be excluded.

Figure 5.2.2.5.1.2. View to the right tributary, upper art (left pic.) and middle part (right pic.)

It is assumed that a higher percentage of hard rocks could be expected at the right scheme but this scheme is crossing three ridges of lava rock where steep rock walls have to be crossed which is both challenging from a geological-geotechnical point of view (large to very large rockfalls expected). Passing these sections might be only possible with short tunnel segments. Additionally, the right scheme is closely following the river bed where it may be more susceptible to sliding hazards in general with a higher number of potential hazard (especially rockfall) zones. Figure 5.2.2.5.1.3. (BK1-R13 area) shows one of the very difficult areas on the right bank.

Figure 5.2.2.5.1.3. One of the steep ridges which has to be crossed at right scheme alternative

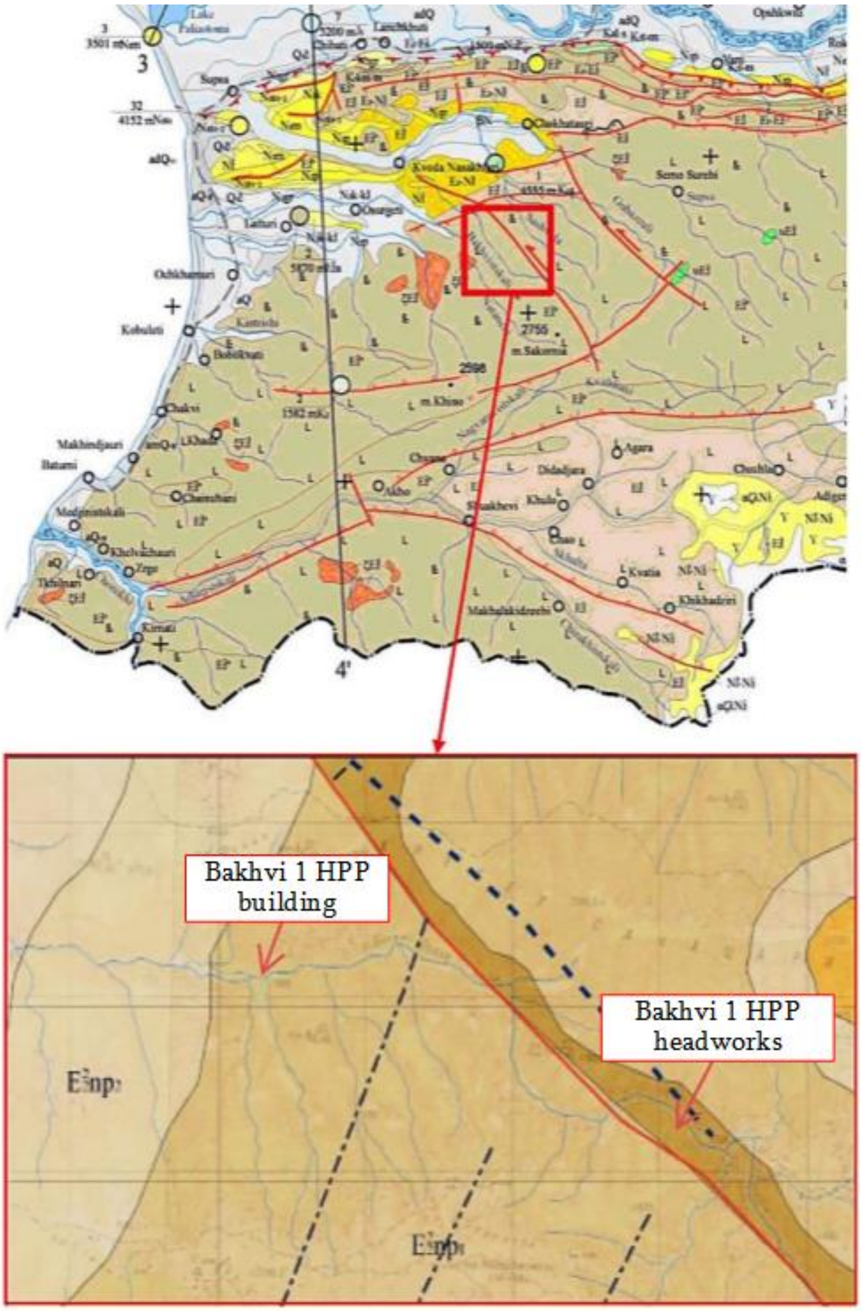


5.2.2.6 Main Fault in the Project Area

Approximately parallel to the Bakviskali river bed, a strike-slip main fault (called Bakhvistskali fault) is observed. The headworks and the upper part of the pipeline of Bakhvi-1 project will be located very close to this main fault (see red line in Figure 5.2.2.6.1.).

According to this map, both alternatives of the pipeline have to cross this strike-slip fault (left scheme one time and the right scheme two times). The total length of this fault line is shown on the maps (Figure 5.2.2.6.1.) as longer than 30 km. It is highly recommended to make detailed fault investigation studies at these areas at further design stages.

Figure 5.2.2.6.1. Geologic map, of the project area, showing the fault line



5.2.2.7 Engineering-Geological Conditions at Different Construction Sites

Due to the existing higher geo-hazard risks at the right scheme and disadvantages in the design and during construction, it is advised to continue with the left scheme alternative. Therefore in the following chapters of this geological report, the left scheme alternative will be evaluated in more detail.

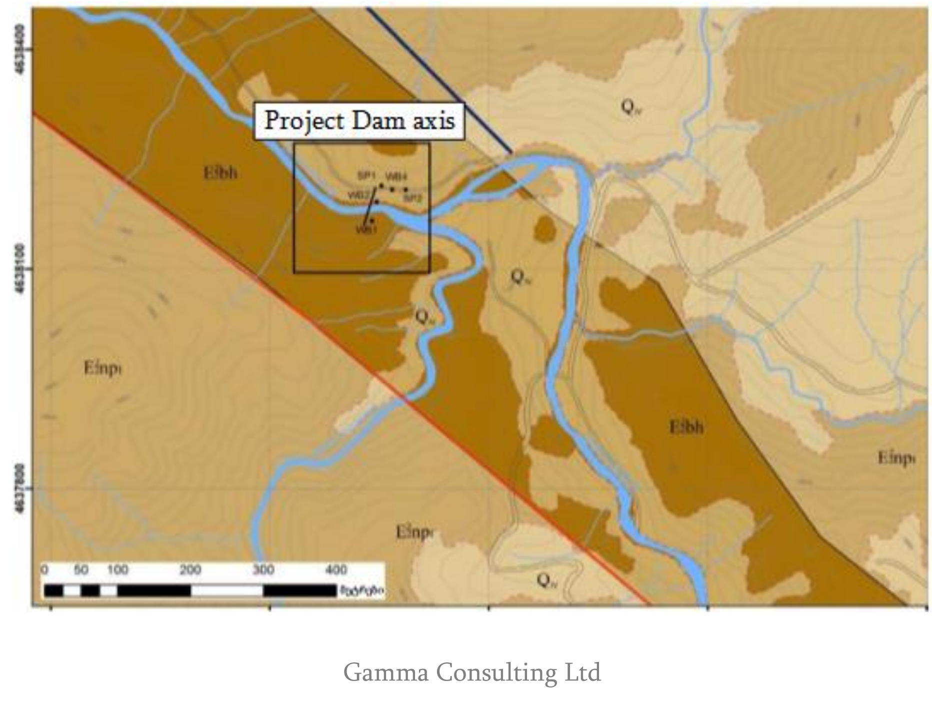
5.2.2.8 Headworks

The weir site and the relevant structures are planned to be located on the main tributary of Bakhvistskali River (see below Figure 5.2.2.8.1.).

Figure 5.2.2.8.1. View towards proposed weir location

The weir site is located on Bakhmaro Subsuite (P2 bh2+2). The river valley is narrow in this section and the width of the flood plain does not exceed 10 meters. The river bed is filled with well-rounded pebbles (of low thickness), clay-sand filler and with boulder inclusions. The slopes of the river gorge have a high inclination angle. The left and right slopes are represented by cliffy (hard) rocks (basaltic tuffs and volcanic breccias), partly Quaternary deluvial-colluvial sediments (rock debris with loam filler and boulder inclusions) of medium thickness are present. It is noteworthy that on the left slope, near the dam axis, small ravines occurred, which form small fans in the river confluence point.

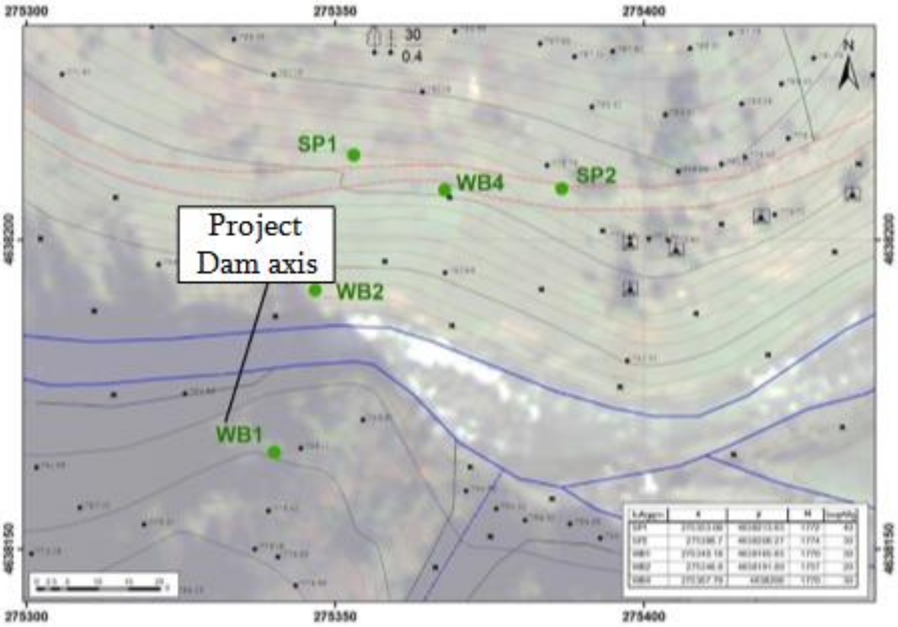
Figure 5.2.2.8.2. Geological map showing the headworks area



5.2.2.8.1 Geological investigations at Headworks site

During the studies of 5 drilling were executed at the weir area as can be seen at the below figure. Because of the closeness to the new location of the headworks the boreholes WB-1 (left bank) and WB-2 (right bank) are discussed in this report.

Figure 5.2.2.8.1.1. Executed drilling at the weir area



According to the borelog of the WB1 borehole is drilled in Basaltic tuff strata from begging up to end (0.0m – 18.6m). Except the first 2m the core recovery was almost %100 in fresh rock condition, which indicates to a very sound conditions for the weir foundation. The core recovery at the first 2m is low, it can be assumed that the missing cores (approximately 1m) are from the slope debris and therefore it can be assumed that approx. 1m of slope cebris/alluvial debris needs to be excavated for a sound weir foundation.

Figure 5.2.2.8.1.2. First 8m core samples from WB-1

The borehole WB-2 (right bank) shows similar conditions. Fresh and hard basaltic tuff formation, with a high percentage (almost 100%) of core recovery can be observed in the borelogs. Unfortunately, the photos of the first core box are not presented in the report, but according to the borelog again approximately 1m core could not be recovered at the beginning of the borehole, which lead to the same assumptions as in WB-1.

As the river section is rather narrow, a maximum 2m thickness of river sediment should be taken into account in the design.

Figure 5.2.2.8.1.3. Core samples from WB-2 (5-10m)

The Laboratory data for these basaltic rock samples are summarized below:

- Density -2.8 gr/cm^3
- Unconfined compression – 80 Mpa
- Indirect tensile strength – 8 Mpa

Figure 5.2.2.8.1.4. Headworks – Geological plan

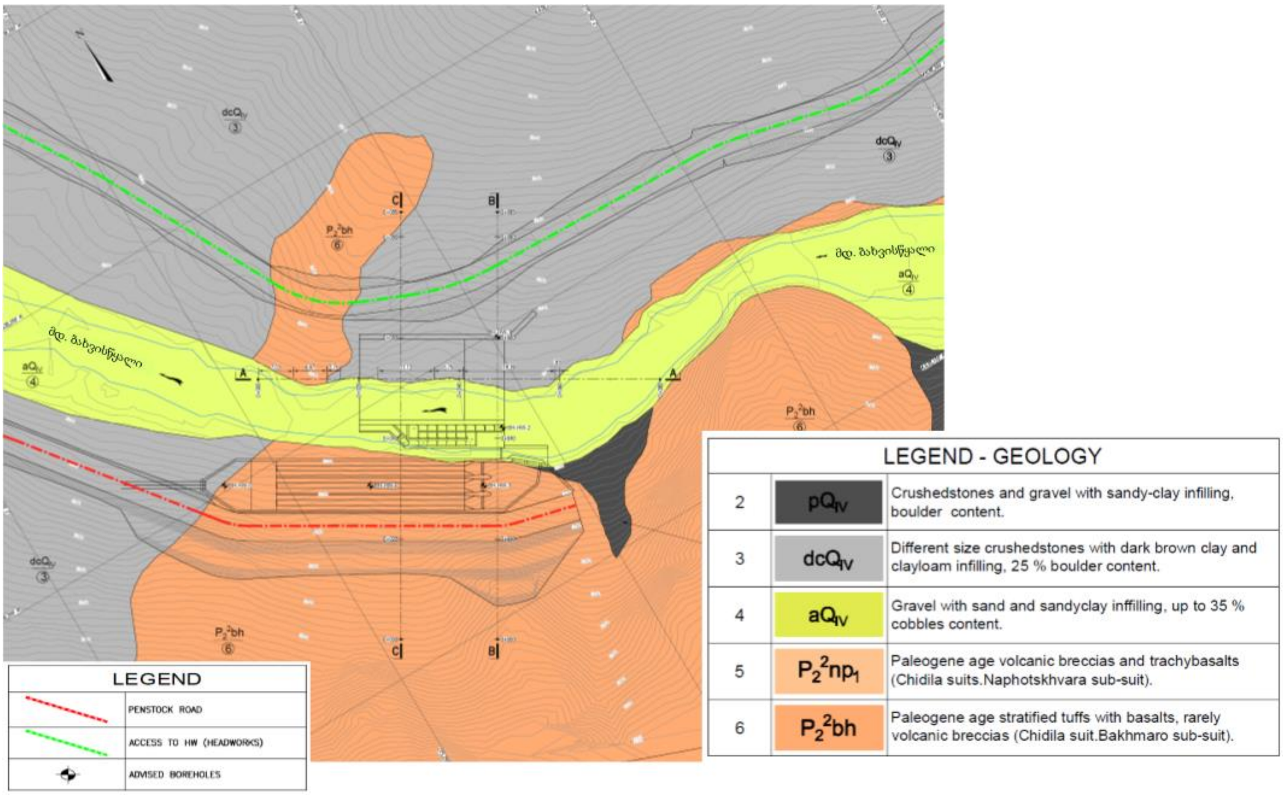
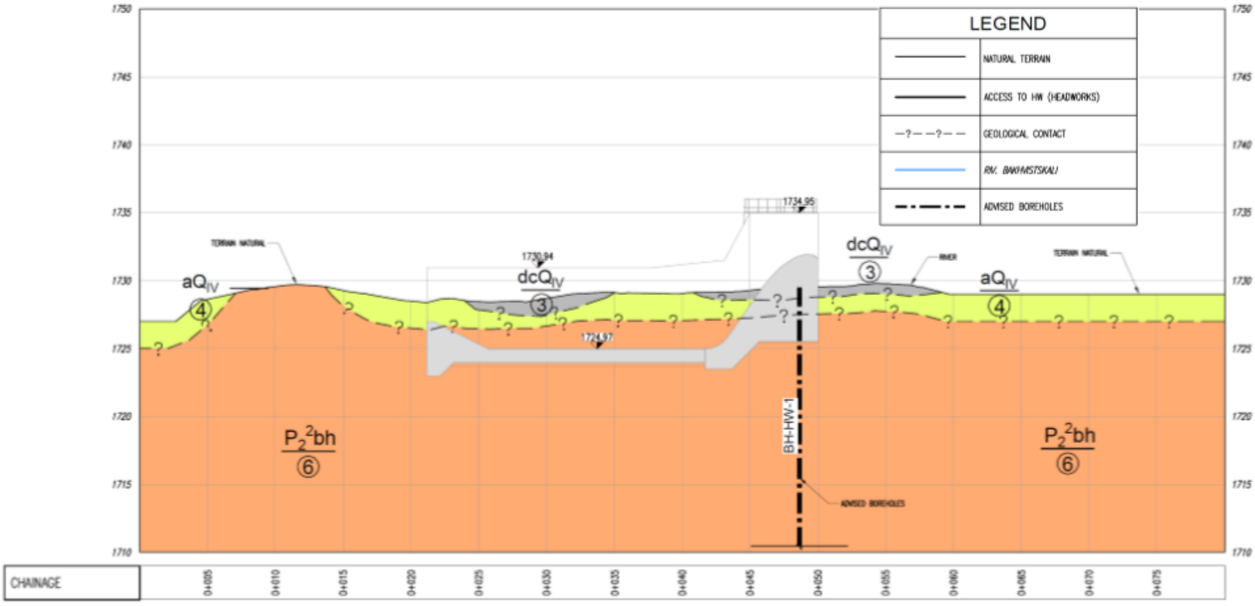
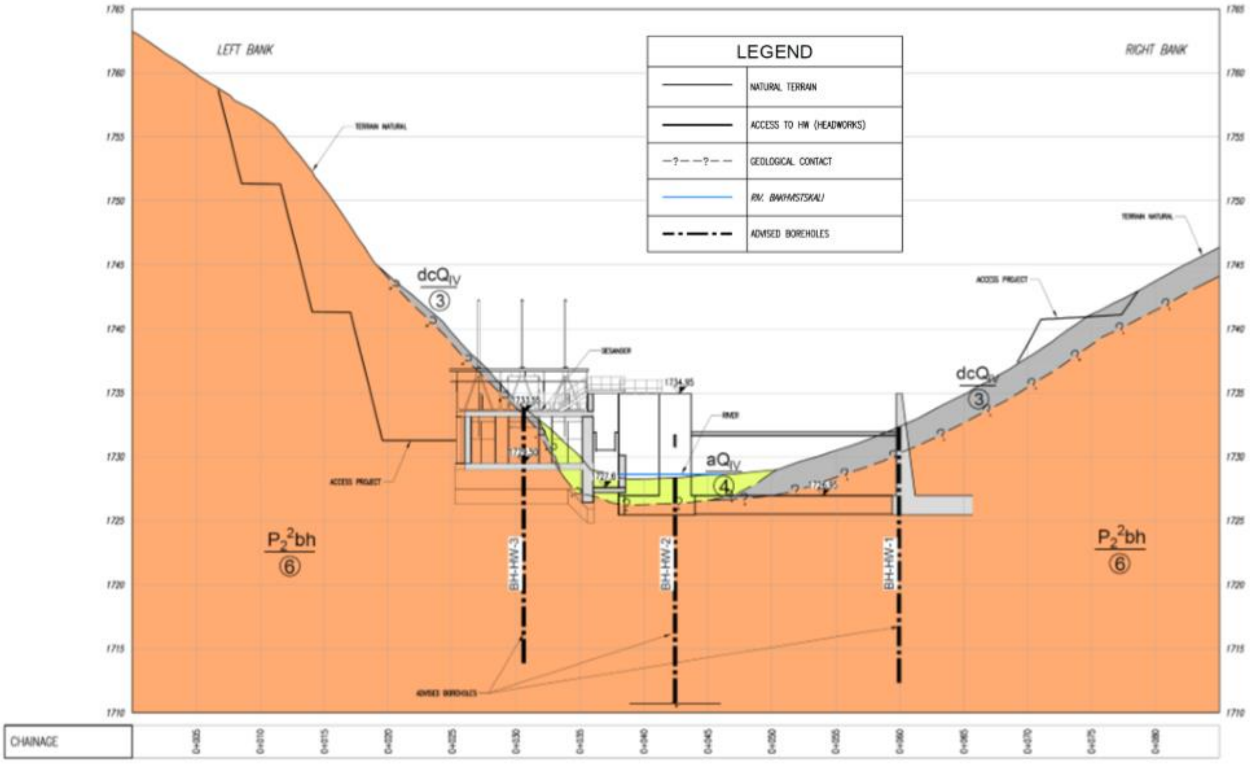
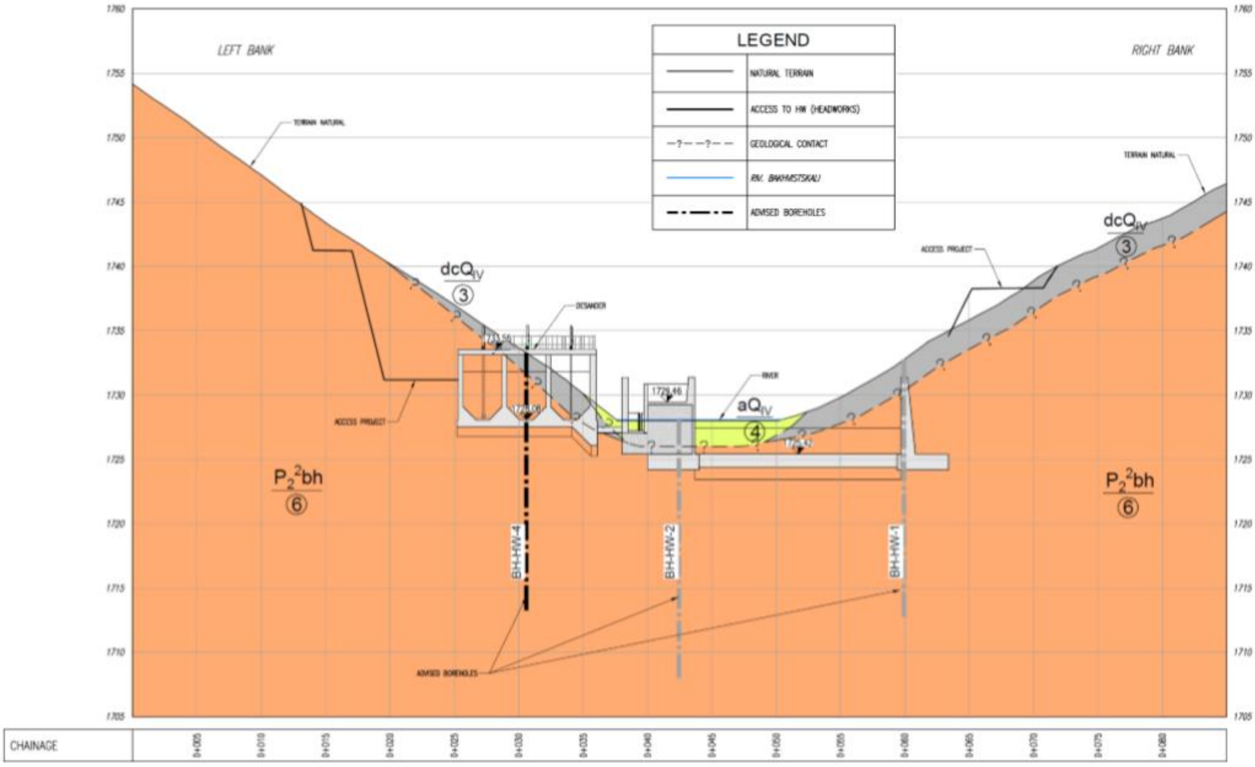


Figure 5.2.2.8.1.5. Headworks – Geological sections



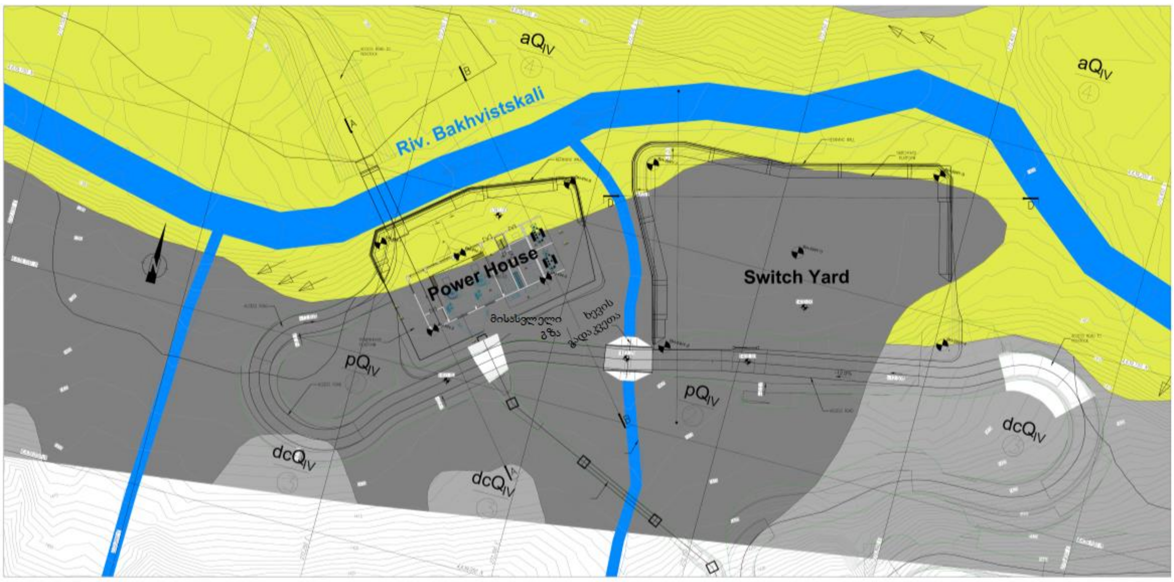




5.2.2.9 Powerhouse and Switchyard

The powerhouse building of Bakhvi-1 is planned to be located in the Bakhvistskali river valley, at the base of the left slope, in the floodplain at an altitude of about 1400 meters above sea level.

Figure 5.2.2.9.1. Location of the powerhouse and switchyard on the geological map



LEGEND - GEOLOGY		
2	pQ_{IV}	Crushedstones and gravel with sandy-clay infilling, boulder content.
3	dcQ_{IV}	Different size crushedstones with dark brown clay and clayloam infilling, 25 % boulder content.
4	aQ_{IV}	Gravel with sand and sandyclay infilling, up to 35 % cobbles content.
5	$P_2^2np_1$	Paleogene age volcanic breccias and trachybasalts (Chidila suits.Naphotskhvara sub-suit).
6	P_2^2bh	Paleogene age stratified tuffs with basalts, rarely volcanic breccias (Chidila suit.Bakhmaro sub-suit).

LEGEND GEOLOGY COMMON	
	River erosion
	Border between lithological-stratographic units
①	Layer Number Lithology
BH-	Drilling advised boreholes

The bottom of the valley is relatively wide, the floodplain is filled with clay-sand filler and large boulder inclusions. The powerhouse will be located between two wet ravines. At the river mouth, they have formed debris cones. Currently, the Bakhvistskali river is eroding the mentioned debris cone that leads to the formation and activation of landslides in the proluvial sediments. No other active geodynamic processes are observed in the vicinity of the HPP building at the time of the survey, however, since the HPP building is planned to be located close to the river floodplain, the mudrock flow character of the Bakhvistskali river and tributaries should be taken into account. This is reflected in the fact that during floods and flash floods, the river often changes its course, transporting a large amount of solid runoff, washing out the banks and flooding the adjacent. For the floodsave the powerhouse and switchyard will be located at a higher elevation and retaining walls will be built on the riverside.

Based on the surface geological map, it can be seen that a part of the powerhouse is located on aQ_{IV} (4) which is described as; Gravel with sand and sandy-clay infilling, up to 35% cobbles content. The rest of the powerhouse and switchyard is located on pQ_{IV} (2) which is described as; cruched stones and gravel with sandy-clay infilling and less boulder content. To understand the sediment thickness, boreholes has to be drilled before starting to detail design. Total 10 boreholes are recommended for the powerhouse area (5 boreholes) and switchyard area (5 boreholes). These boreholes have to be drilled with recovery on the corners of the building and the center (marked black circles in Figure 5.2.2.9.2.).

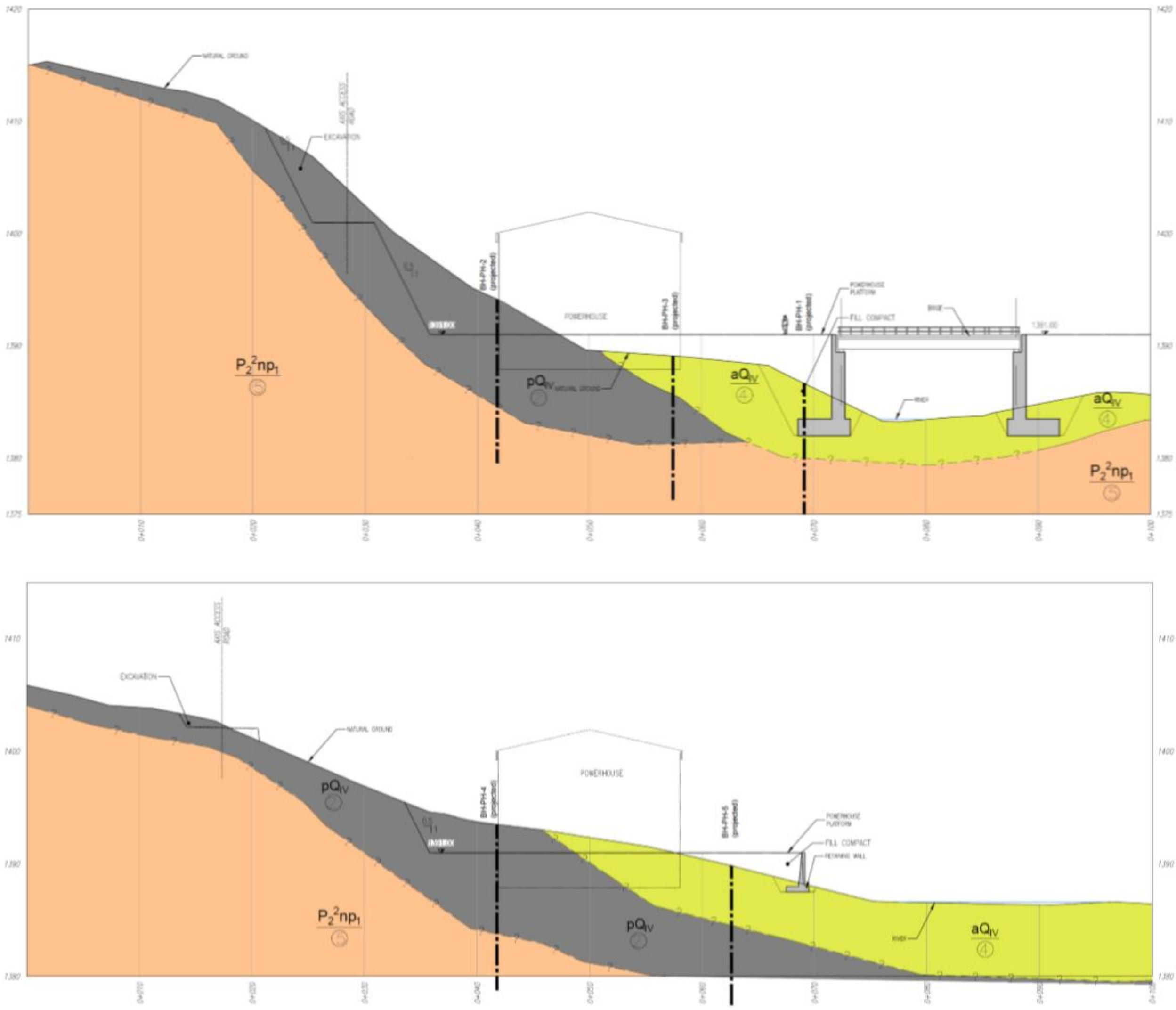
The client visited the new proposed Powerhouse and Switchyard location and stated that this area on the left bank of the river has the same shape and surface as the old location on the opposite side (right bank). The switchyard area is filled with big rounded stones, which leads to the conclusion that they have been transported by the river. These platforms seem to be suitable for construction.

Figure 5.2.2.9.2. View to the switchyard area on left bank

The Powerhouse is located in an area where the topography also forms a terrace shape. No big boulders were observed in this area.

Figure 5.2.2.9.3. View to the powerhouse area on left bank

Figure 5.2.2.9.4. Geological sections of power unit



5.2.2.10 Pipeline and Penstock Alignment

The slopes have medium and high angles of inclination and are built up of basaltic tuffs and volcanic breccias of Paleogene age. In most cases, these rocks are covered with Quaternary deluvial-colluvial and proluvial deposits of various thicknesses. However, due to the existing vegetation and difficult accessibility to this area, clear statements about the geological conditions could not be made at the alignment.

According to the accomplished research, engineering-geological survey, and field descriptions of the geological environment, 6 engineering-geological elements of not rocky and hard rock soils have been identified at the design site of “Bakhvi-1 HPP”.

- 1 - Large, medium to small boulders and rubble (cQIV);
- 2 - Detritus, rubble, and pebbles with clay-sand filler (pQIV);
- 3 - Rubble of different sizes with dark brown clay and loam filler, up to 25% boulder content (dcQIV);
- 4 - Shingle-bed with sand and clay-sand filler, containing up to 35% of boulders. Large size boulder (block) inclusions are observed (aQIV);
- 5 - Lava breccias and trachybasalts (P22np1);
- 6 – Layered tuffs of basaltic composition, rarely volcanic breccias (P22bh);

Based on the engineering-geological map of the study area prepared by [2] the expected surface geological condition on the actual pipeline and penstock alignment and the potential problematical areas are shown below in Figure 5.2.2.10.1.

Table 5.2.2.10.1. Expected geological conditions on the pipeline

Chainage from	Chainage to	Surface geology	Geo hazar risk
0+000	0+170	3	
0+170	0+180	6	
0+180	0+230	2	Tributary
0+230	0+250	6	
0+250	0+370	3	
0+370	0+420	6	
0+420	0+550	3	
0+550	0+570	6	
0+570	0+590	2	Tributary
0+590	0+630	6	
0+630	0+640		Fault zone
0+640	0+660	5	
0+660	0+750	3	
0+750	0+780	5	
0+780	0+790	2	Tributary
0+790	0+840	5	
0+840	1+010	3	
1+010	1+030	2	Tributary
1+030	1+070	3	
1+070	1+120	5	
1+120	1+150	3	
1+150	1+440	5	
1+440	1+540	1	Potential sliding hazard
1+540	1+740	5	
1+740	1+800	1	Potential sliding hazard
1+800	1+860	5	
1+860	1+910	1	Potential sliding hazard

1+910	2+630	5	
2+630	2+650	2	Tributary
2+650	2+910	5	
2+910	2+930	2	Tributary
2+930	3+650	2	
3+650	3+670	1	Tributary
3+670	3+750	2	

5.2.2.10.1 Estimation of Rock and Soil Types at the Pipeline Road Construction

The by estimated rock/soil distribution for the left scheme pipeline road construction are given in the figure below. Most parts of the slopes were not accessible during the site investigation and overall visibility in the densely vegetated mountain range was low, therefore it could be expected that these estimates differ. The riverbed and the surrounding area was the only accessible area.

Table 5.2.2.10.1.1. Estimation of ground condition for Pipeline road construction

Ground	Rock/soil mass characteristic (estimated) weathering degree / degree of fracturing / strength	Quantity in left scheme
Alluvial deposits (bed load in torrents, slope debris)	Medium to very coarse grained soils / debris, loose	5%
Mixed grained soils	Fine to mixed-grained soils (decayed tuffs etc.): non-cohesive (sandy) or cohesive (loam/clay) with boulders, stiff to firm	40% [1)]
Tuff, sandy (**weathered**)	Weathered / layered / jointed (5-100cm) / weak (10-50 MPa)	-
Tuff, sandy (**fresh**)	Fresh / layered / jointed (20-150cm) / medium hard (30-80 MPa)	-
Tuff, coarse (**weathered**)	Weathered / massive / weakly jointed (50-200cm) / weak to medium hard (10-70 MPa)	20%
Tuff, coarse (**fresh**)	Fresh / massive / compact (>150cm) / medium hard to hard (30-150 MPa)	30%
Basaltic lava / layers, dykes, lahars (**weathered**)	Weathered / layered or massive / jointed (50-200cm) / medium hard to hard (50-150 MPa)	- [2)]
Basaltic lava / layers, dykes, lahars (**fresh**)	Fresh / layered or massive / jointed to compact (>150cm) / hard to very hard (80-250 MPa)	- [2)]
Fractured rock	Tuff and lava rocks with high degree of fracturing / fault zones	5% [3)]

[1)] subsurface conditions in section between right tributary and powerhouse are hard to define
[2)] lava ridges possible occasionally
[3)] not directly detected

During the site visit the Sashuala project site was also visited and the observed conditions at this project can be a good indication for the expected rock/soil percentages in Bakhvi-1 project. The Sashuala project is located at a parallel river close to bahkviskali river (see Figure 5.2.2.10.1.1.).

Figure 5.2.2.10.1.1. Location of Sashuala HPP project

The project is in similar geological conditions like Bakhvi-1. Similarly, road construction was needed at the project area from the weir down to the Powerhouse. The water is transferred via a steel pipe. According to the gained information from the site personal; most of the road was constructed at rock conditions where approximately 20% of the excavation could only be done by blasting. The excavated material was mainly used for the road fillings or are deposited at the riverbed. At some steep ridges, they needed more time (2-3 months) to pass but generally, they had no big problems with the road constructions and no hazards are reported since completing the construction (approximately 2 years).

Photo 5.2.2.10.1.1. View to Sashuala weir and road construction (on the left side) to the upper project side

5.2.2.11 Recommended Geological Investigation

Within the area of Bakhvi-1 Headworks and Powerhouse, the valley slopes of Bakhvistskali river are mostly steep, forested, while above their grade decreases and they gradually transfer into an unforested zone at the highest level. The valley floor is narrow, V-shaped and its width is mainly 10-30 m. Generally, the existing thick forest on both banks is preventing the clear evidence of rock outcrops for better interpretation of the overall rock conditions. For Geological/geomorphological and geohazard maps prepared by

According to the geomorphological zoning scheme of the territory of Georgia, the research territory belongs to the medium height mountain-valley terrain subzone (of South Georgia highland zone) spread on volcanogenic folded structures of the Tertiary age. The mentioned subzone is a western termination of the Meskheti ridge, which is dissected with the ridges of meridional direction and river-gorges between them. The subzone is characterized by numerous denudation-erosion, landslide, mudflow, and snow avalanche processes.

The project area lies in the "fold-thrust belt" where rock formations inter-mingled during the compression tectonic processes in geologic time and the rock formations have been tectonically deformed in the fold-thrust belts of lesser Caucasus. For detailed geological, geomorphological, and geo-hazard maps by refer to the appendix.

Approximately parallel to the Bakviskali river bed, a strike-slip main fault (called Bakhvistskali fault) is observed. The headworks and the upper part of the pipeline of Bakhvi-1 project will be located close to this main fault and therefore it is advised to execute a detailed fault investigation at the intersection of the Fault – Pipeline at approximately chainage 0+630 of the pipeline.

Drillings were executed at the weir axis (previous design but close to the new design). Based on these boreholes and also observations during the site visit, it can be stated that the structures will be founded on strong rocks. The proposed weir axis is further on the downstream side compared to the previous design. Therefore it is recommended to execute 5 more boreholes on the headworks site; 3 on the weir axis (right bank, left bank, and riverbed) and 2 along the desander structure.

There are no investigations at the powerhouse and switchyard area to date. As this area is rather flat (platform) it might be that a thicker sediment layer, deposited by the river, might be present in this area. As soon as this area is accessible detailed geological mapping, investigation trenches and approx. 10 boreholes at this area (5 boreholes at the powerhouse area and 5 boreholes switchyard area) shall be executed. These boreholes have to be drilled with recovery and located at each corner of the building and one on the center.

The slopes of the left bank pipeline and penstock alignment are mostly built up of basaltic tuffs and volcanic breccias of Paleogene age. In most cases, these rocks are covered with Quaternary deluvial-colluvial and proluvial deposits of various thicknesses. Because of the present low slope inclination angle in some areas, it must be assumed that parts of the alignment can also be located in soil. However, due to the existing vegetation and difficult accessibility of this area, confident statement's about the geological conditions could not be made for the whole alignment. It is recommended that detailed geological mapping and geophysical investigation along the whole alignment (better to construct a footpath along the whole alignment before the investigation) shall be executed. Additionally drillings are recommended at the areas close to potential hazard zones and tributaries (approximately chainages 0+200, 0+580, 0+630, 0+780, 1+020, 1+500, 1+770, 1+900).

5.3 Hydrological Assessment

5.3.1 Objectives

The local hydrology constitutes one of the largest uncertainties for hydropower design. With the objective of reducing this uncertainty, hydro-meteorological information of the region from many different sources is collected, evaluated and analysed. The analyses performed in this FS comprise:

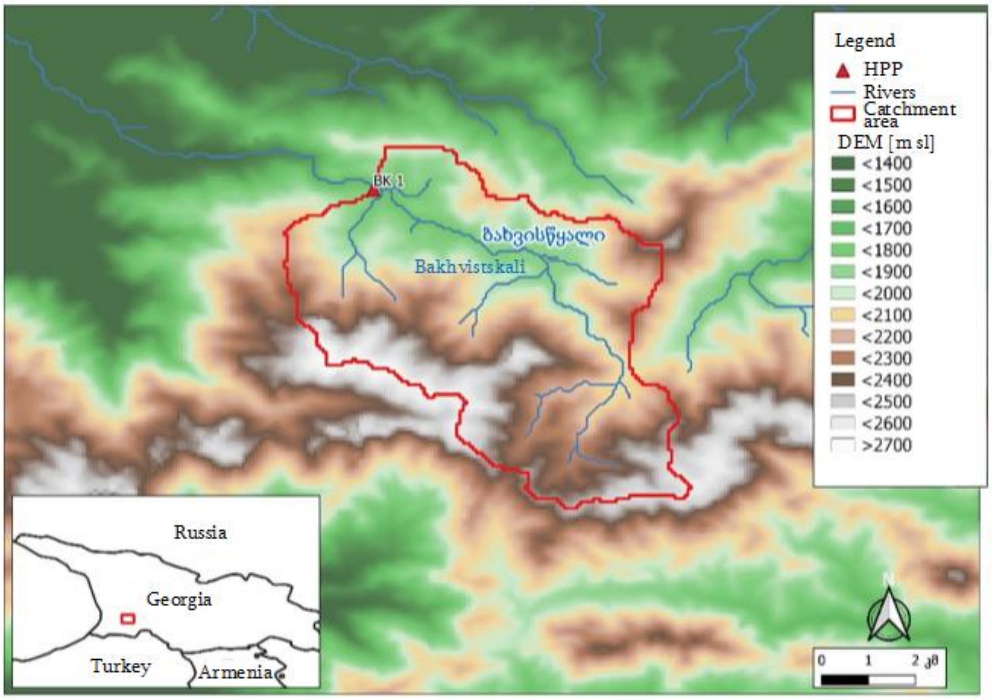
1. Data evaluation and comparison;
2. Review of previous hydrological assessments;

3. Estimation of long-term inflow characteristics, to provide information for the decision on the design discharge and for the calculation of energy generation;
4. Flood assessment

5.3.2 Catchment Area

The catchment area of the Upper Bakhvistskali River is located in south-western Georgia, about 40 km east of the Black Sea coast (Figure 5.3.2.1.). Elevations in the catchment area range from slightly over 2,700 m asl to 1,730 m asl at the BK1 intake, with a median elevation of 2,200 m asl. The catchment area at the BK1 intake, calculated based on the Hydrosheds 3s digital elevation model, is 52.1 km².

Figure 5.3.2.1. Bakhvistskali catchment area with intake locations of BK



Due to the high elevation, temperature in the catchment is below 0°C during long periods, from around December to March (depending on the elevation). Therefore, the catchment's runoff characteristics are strongly influenced by snow processes, with low discharge in winter, and a high snow melt peak between April and June.

Precipitation is mostly moving in from the west, and shows significant gradients both, from west to east, and with elevation. Mean annual precipitation measured at Bakhmaro meteorological station is around 1,500 mm, with higher precipitation between September and February (between 140 and 180 mm/month) and lower precipitation between March and August (between 80 and 120 mm/month).

5.3.3 Available Documents and Data

5.3.3.1 Overview of Documents and Data

The following documents that provide analyses of the inflow hydrology in the Bakhvi basin were used in an initial review of previous analyses:

1. "Bakhvi 1 Hydro Power Project Hydrological Report" by Temelsu, 2020 [1]
2. "HPP – Bakhvi 2 Hydrological Report – Water Economy - Energy Prodcuction" by Ingenieurbüro Dr. Sackl, 2019 [2]

3. "Bakhvi 3 HPP Technical Optimization Study" by ILF Consulting Engineers Georgia, 2018 [3]
4. "Baaduri Hydrology Report" provided with the ESIA study, undated [4]

Discharge observation data was available for the following locations (shown in the map in Figure 5.3.3.1.1.):

1. Daily discharge observations at the gauge Kveda-Bakhvi, downstream of the planned Bakhvi 1 intake and HPP, at an elevation of around 90 m asl, with a catchment area of 116 km², for the period 1937 1986 (with gaps);
2. Daily discharge observations at the gauge Bakhmaro, upstream of Bakhvi 1 intake and HPP, at an elevation of around 1,850 m asl, with a catchment area of 31.5 km² before 1964 and of 33.5 km² from 1964, for the period 1945-1978 (with gaps);
3. Daily discharge observations of the Gubazeuli River at Khidistavi village, in the adjacent basin east of Bakhvistskali River, at an elevation of around 140 m asl, with a catchment area of 337 km², for the period 1935-1991;
4. Daily discharge observations of the Bzhuzhi River at Gomi village, in a basin west of Bakhvistskali River, at an elevation of around 150 m asl, with a catchment area of 112 km², for the period 1950-1987;
5. Hourly inflow observations at Bakhvi 3 HPP, downstream of Bakhvi 1 intake and HPP, at an elevation of around 530 m asl, with a catchment area of 77.2 km², for the period 09/2015 - 08/2021.

In addition to these data sets with direct information on discharge, water level observations at two new gauges were available:

1. Hourly water level observations at the Bakhmaro location for the period 03/2021 06/2021;
2. Hourly water level observations at the Bakhvi 1 location for the period 03/2021 06/2021.

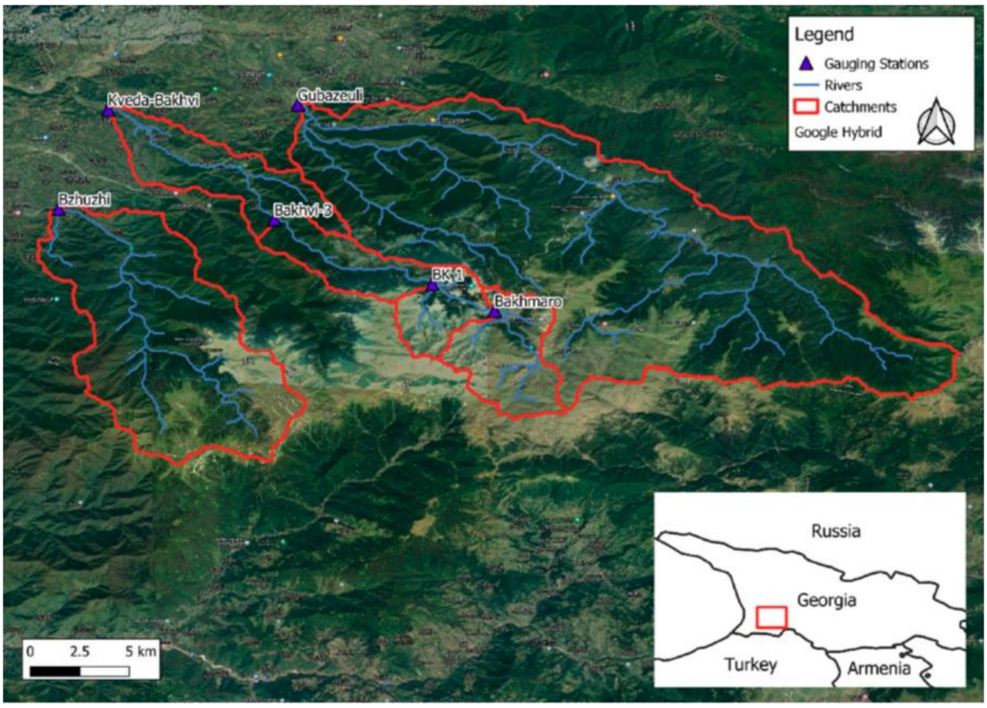
Due to the availability of discharge observations, meteorological data was not directly used for the estimation of inflow or flood values. A general overview of the regional long-term characteristics of rainfall and temperature was derived from the following data sets:

1. Publicly available gridded precipitation and temperature observation data set of the University of East Anglia, Climate Research Unit (CRU), for the period 1901-2019.
2. Daily Bakhmaro station precipitation and temperature data, for the period 1937 2010 (with gaps)

5.3.3.2 Data Evaluation

The available discharge records were evaluated with regard to completeness and reliability of the records, by comparison of the time series at different temporal scales and by comparison with precipitation records.

Figure 5.3.3.1.1. Locations of available streamflow observations in and around the Bakhvistskali catchment



5.3.3.2.1 Discharge at Kveda-Bakhvi

The daily record at Kveda-Bakhvi (Figure 5.3.3.2.1.1.) exhibits obvious inconsistencies, with a two distinct step changes (in 1963 and 1980). Before 1963, daily discharge values varied between 1 m³/s and 40 m³/s, with a few even higher events. Between 1963 and 1980, daily variations were in a range between 1 m³/s and mostly 20m³/s, in some events reaching around 30 m³/s. After 1980, low flow values were higher, at around 2 m³/s, but high flow did not exceed 15 m³/s anymore.

Such strong changes in the discharge characteristics typically can only be the result of human intervention (reservoirs, diversions, flood control structures), but none such intervention had taken place in the basin. An analysis of annual discharge values and precipitation sums (Figure 5.3.3.2.1.2.) shows that there also was no trend in precipitation that could explain the changing discharge observations.

It was therefore concluded that the record at Kveda-Bakhvi is not reliable and it was dismissed for further analyses. The use of only one part of the three-part observation series was also not considered as feasible, as it remained unknown if any of the three parts was more accurate than the other ones.

Figure 5.3.3.2.1.1. Daily discharge observation series at Kveda.Bakhvi

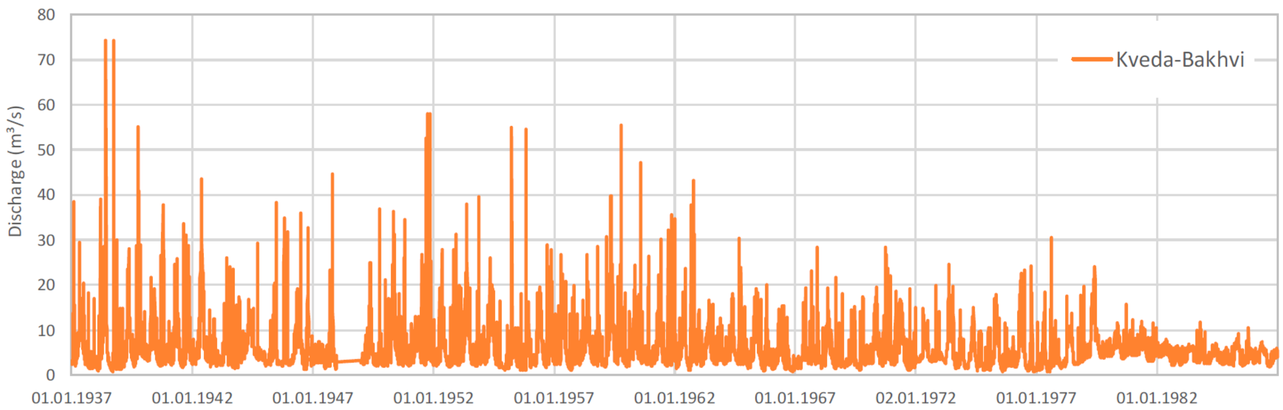
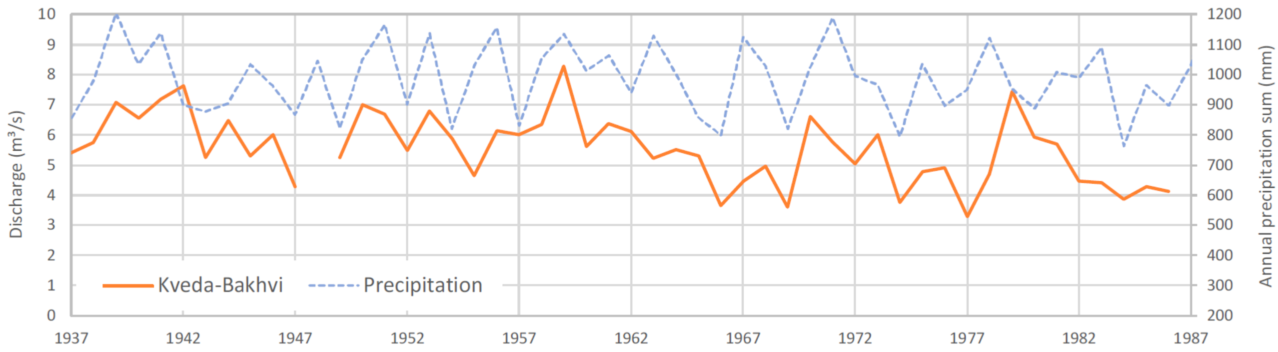


Figure 5.3.3.2.1.2. Annual discharge observation series at Kveda-Bakhvi and annual precipitation sums in the CRU precipitation data set



5.3.3.2.2 Discharge at Bakhmaro

The daily record at Bakhmaro (Figure 5.3.3.2.2.1.) exhibits several longer gaps before 1952 and many shorter gaps in the year 1952. The remaining series is almost complete and does not show any unusual trend as the record at Kveda-Bakhvi. Also the correlation of annual mean discharge and precipitation sum (Figure 5.3.3.2.2.2.), is generally good, suggesting higher reliability of this discharge data.

A visit to the location of Bakhmaro gauge (for which the record ends in 1978) showed a generally well defined cross-section (Figure 5.3.3.2.2.3.). Due to the high volume of sediments in this reach of the river, and indications of high sediment transport dynamics that lead to changes in the river bed, some uncertainty in the discharge record, especially for lower flow observations, can be expected.

For further analyses, the 25-year record of 1953-1977 was used, containing only years with very few gaps and omitting the last doubtful year.

Figure 5.3.3.2.2.1. Daily discharge observation series at Bakhmaro

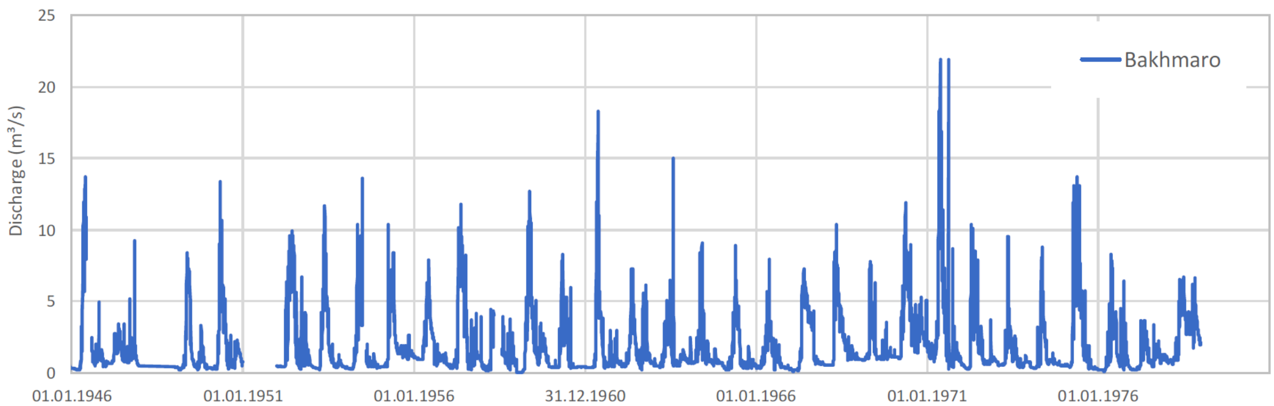


Figure 5.3.3.2.2.2. Annual discharge observation series at Bakhmaro and annual precipitation sums in the CRU precipitation data set

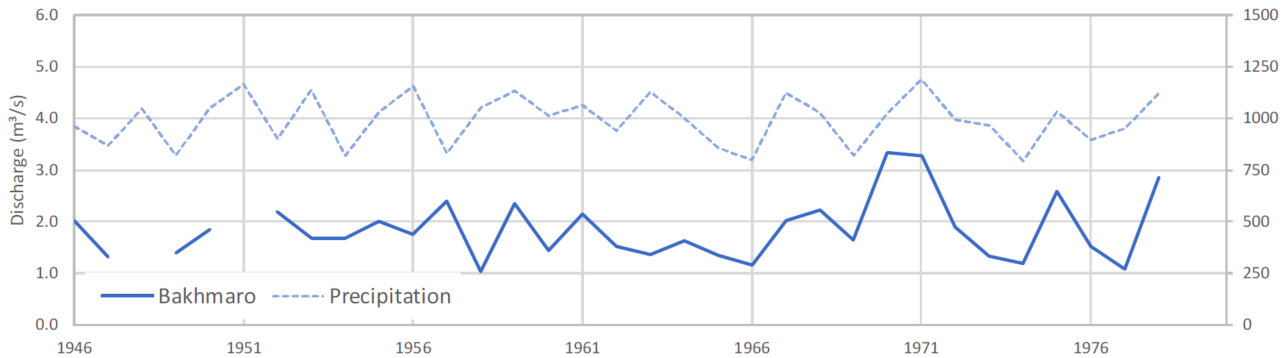
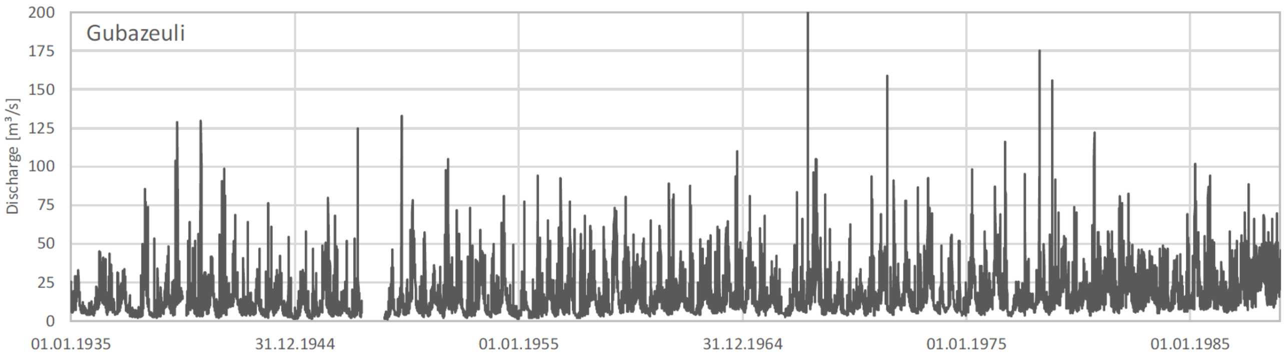


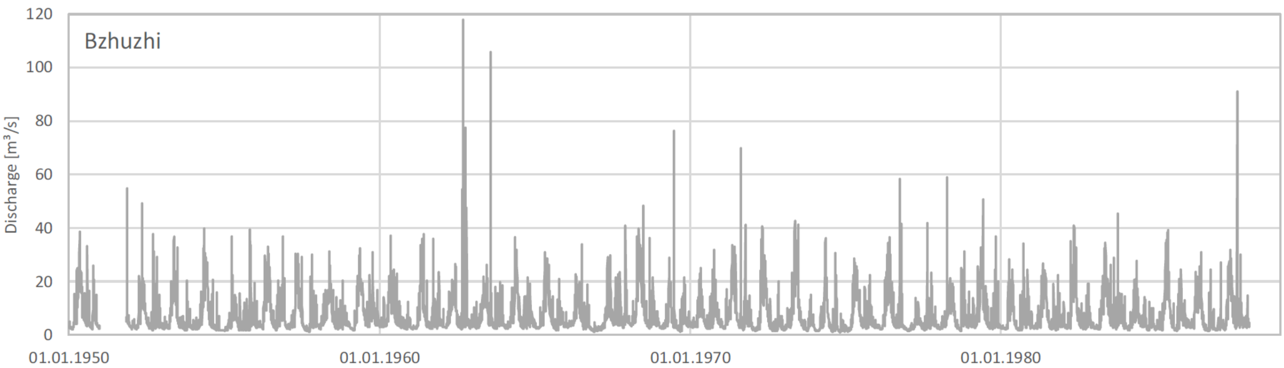
Figure 5.3.3.2.2.3. Location of Bakhmaro gauge (during site visit in July 2021)

5.3.3.2.3 Discharge in Neighbouring Catchments

The daily records of the neighbouring rivers Gubazeuli to the east and Bzhuzhi to the west are remarkably long series (Figure 5.3.3.2.3.1.). There are almost no gaps in both series, and the typical intra- and interannual variations are highly consistent within and across the two records.

Figure 5.3.3.2.3.1. Daily discharge observation series of the Gubazeuli (top) and Bzhuzhi (bottom) rivers





The Gubazeuli record, however, shows some deficiencies. After 1980, the Gubazeuli series exhibits stronger daily variations than during the previous decades, which again cannot be explained by human action in the basin. This is also reflected in the annual series (Figure 5.3.3.2.3.2.), with higher annual mean values after 1980 that do not correspond with the general level of the Bzhuzhi values of these years. The year-to-year correlation of both series, however, is very high.

An analysis of the specific mean monthly discharge at both gauges, and comparison with Bakhmaro, shows that the general seasonal behaviour is similar (Figure 5.3.3.2.3.3.), but that winter discharge is markedly higher at both neighbouring gauges. While it was acknowledged that lower flow observations at

Bakhmaro might be less reliable, this difference in winter discharge can well be explained by differences in the catchment characteristics. Both Gubazeuli and Bzhuzhi catchments have larger contributions from low-lying areas than Bakhmaro, with median elevations of 1,420 m asl in the Gubazeuli catchment and 1,490 m asl in the Bzhuzhi catchment. In the Bakhmaro catchment, with a median elevation of 2,280 m asl, there is less liquid precipitation and more snow during winter, leading to lower discharge. Such characteristics are also expected for Bakhvi 1, with a median catchment elevation of 2,200 m asl. Summer discharge is markedly higher in the Bzhuzhi River than in the Gubazeuli due to higher precipitation towards the Black Sea coast.

As the seasonality of inflow plays an important role for Bakhvi 1 HPP, the records of the neighbouring gauges were not used in further analyses for inflow estimates due to their different seasonal discharge characteristics. The record of Gubazeuli was used for comparison in the flood assessment, as it provides an exceptionally long discharge series in the region.

Figure 5.3.3.2.3.2. Annual discharge observation series of Gubazeuli and Bzhuzhi

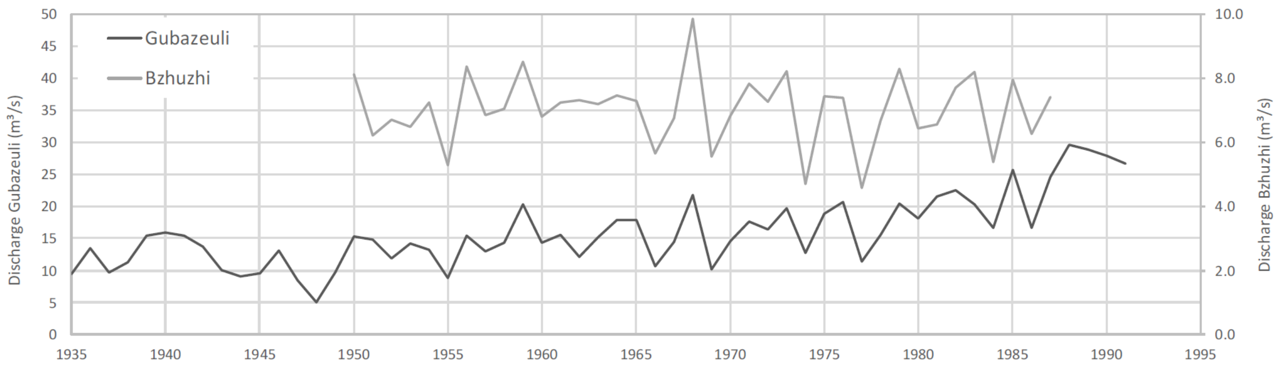
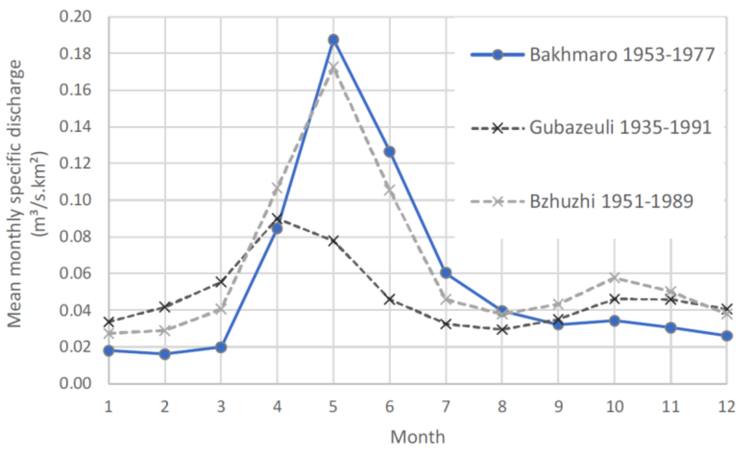


Figure 5.3.3.2.3.3. Specific mean monthly discharge of Gubazeuli and Bzhuzhi and of Bakhvistskali River at Bakhmaro

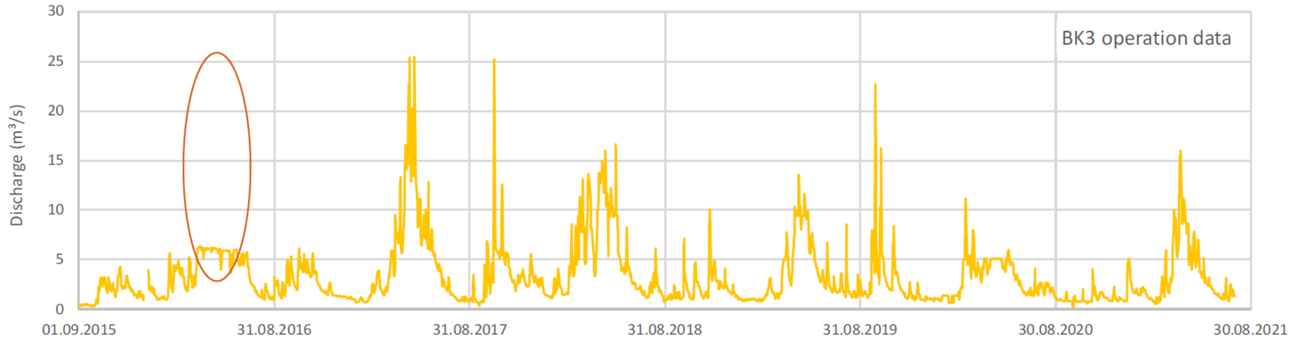


5.3.3.2.4 Inflow to Bakhvi 3

Hourly records of turbine discharge and spillway discharge at Bakhvi 3 HPP can be combined to a discharge series for the intake location (Figure 5.3.3.2.4.1 shows the daily series). As information on spillway discharge is available only from 2017 high flows are missing in the first year of the record, marked with a red circle in Figure 5.3.3.2.4.1.

The available record, from 09/2015 to 08/2021 is very short, but due to the good quality of the data and its high temporal resolution it was used as complementary information in both inflow and flood assessment for Bakhvi 1.

Figure 5.3.3.2.4.1. Daily discharge observation series at Bakhvi 3 intake

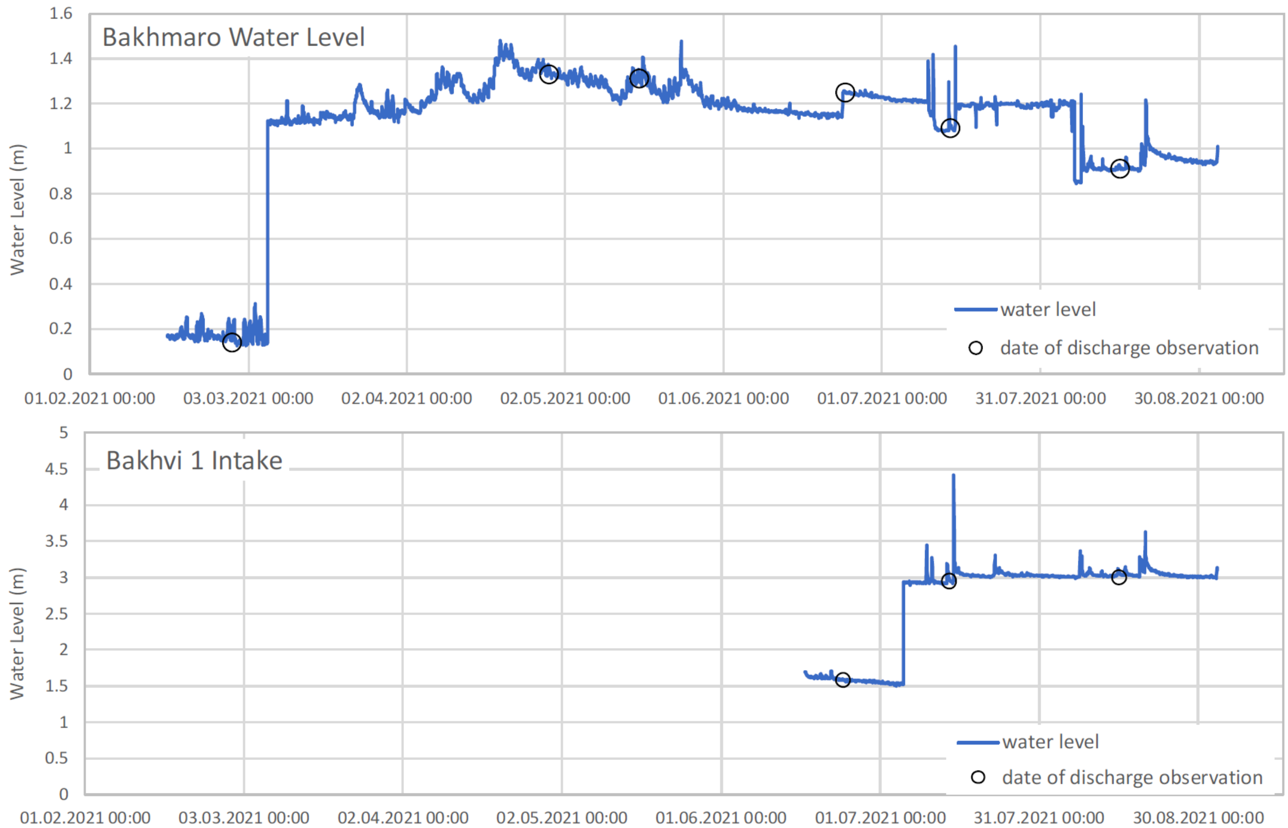


5.3.3.2.5 Water Level Observations at New Gauges

The record at Bakhmaro starts in February 2021, has a distinct step to higher water levels in March (probably related with a change in the station datum). The observations after this first step exhibit typical dynamics until July, when several unplausible smaller steps occur. A large step in early August confirms that the gauge does not provide consistent information after July 2021 anymore.

The record at Bakhvi 1 intake starts in June 2021, and also shows a high initial step in values in early July (change of datum). After that the record appears to be consistent, but the observation period is very short.

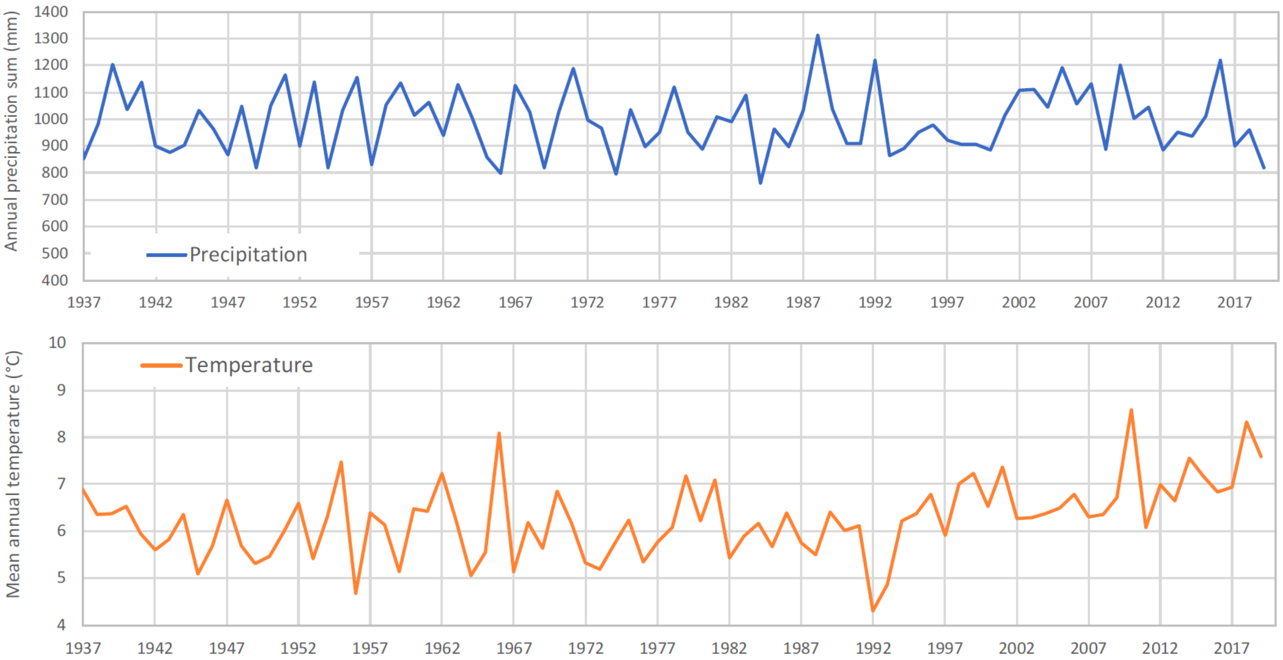
Figure 5.3.3.2.5.1. Hourly water level observation series at the new Bakhmaro gauge (top) and at the planned location of the Bakhvi 1 intake



5.3.3.2.6 Precipitation and Temperature Data

Global gridded observation data sets, as the analysed CRU data, typically rely on few high quality stations and apply regionalization methods to cover the entire land surface. For regions with scarce station data, as in the mountainous regions of Georgia, this implies that no direct local information is used for the derivation of the data in the specific grid cell. Furthermore, the grid cells are much larger than the investigated catchment. As a consequence, the absolute values of both precipitation and temperature (Figure 5.3.3.2.6.1.) do not reflect well the local characteristics. However, the inter-annual variations and long-term trends, which typically prevail in larger regions, are generally captured well in the CRU data set.

Figure 5.3.3.2.6.1. Annual precipitation sums (top) and mean annual temperature (bottom for the period 1937-2019, as provided in the CRU global data set for the grid cell over the Bakhvi 1 catchment

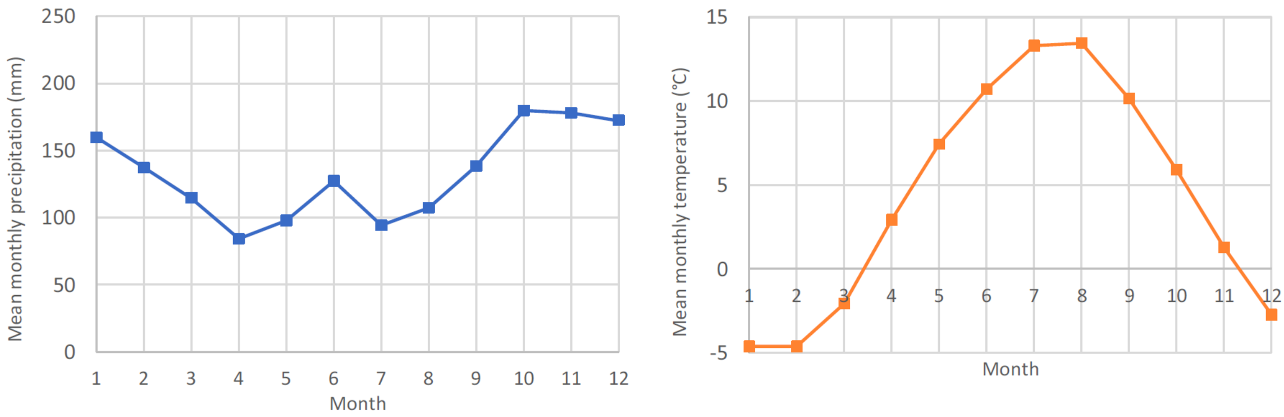


The long-term series of annual precipitation sums shows no relevant trend. This is important, as the available discharge observations used for further analysis of inflow and floods are from past decades, and can be regarded as representative only in the absence of precipitation trends.

For temperature, the global warming trend in the last two decades is clearly visible. Warmer temperatures typically have an impact on the seasonality of discharge, with slightly higher winter discharge due to higher contributions of liquid precipitation, and lower snow melt peaks due to less snow. Due to the very high elevations in the Bakhvi 1 catchment, however, these impacts will be relatively low, as winter precipitation will remain mainly snow. An impact of warming temperatures that is independent of the form of winter precipitation and that can be expected for the future inflow to Bakhvi 1 is an earlier start of the snow melt period. An exploration of these effects for Bakhmaro discharge observations is presented in Chapter 5.3.3.2.2.

Local information on precipitation and temperature was available for the meteorological station at Bakhmaro, at an elevation of around 1,850 m asl. Mean annual precipitation for the period 1953-1991 (which includes few gaps and appears to be homogeneous, while the available data from 1999 is consistently lower) amounts to 1,500 mm. Higher monthly precipitation is observed between September and February (between 140 and 180 mm/month) and lower precipitation between March and August (between 80 and 120 mm/month). Mean monthly temperature at Bakhmaro is below 0°C between December and March, and reaches a maximum of 13°C in July and August. Note that Bakhmaro station is located at a very low location within the Bakhvi 1 catchment (the planned intake is at 1,730 m asl), and that most parts of the catchment are at higher and therefore colder elevations. The mean annual temperature at Bakhmaro is around 4°C, and can be expected to be around -2° C at the highest locations around 2,700 m asl in the catchment area.

Figure 5.3.3.2.6.2. Mean monthly precipitation (left) and temperature (right) observed at Bakhmaro

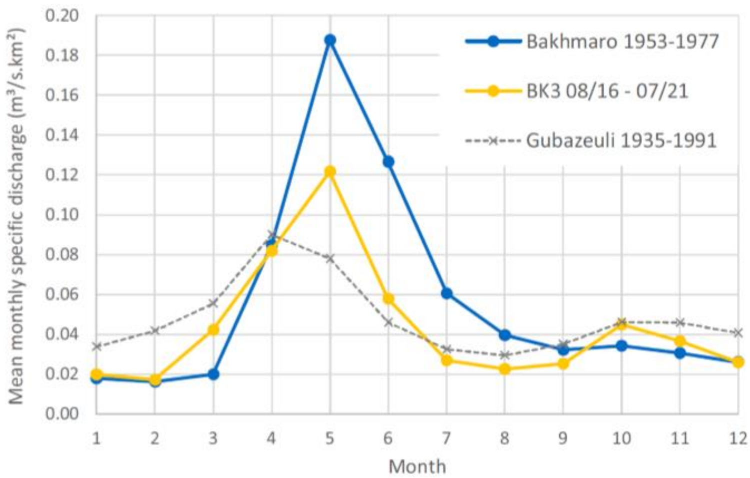


5.3.3.2.7 Long-Term Discharge Characteristics

As discussed above, a 25-years observation series for Bakhmaro gauge covering the period 1953-1977 was used for the inflow estimation. Earlier years of the available record included several gaps, and the last year shoed an inexplicably high level of discharge.

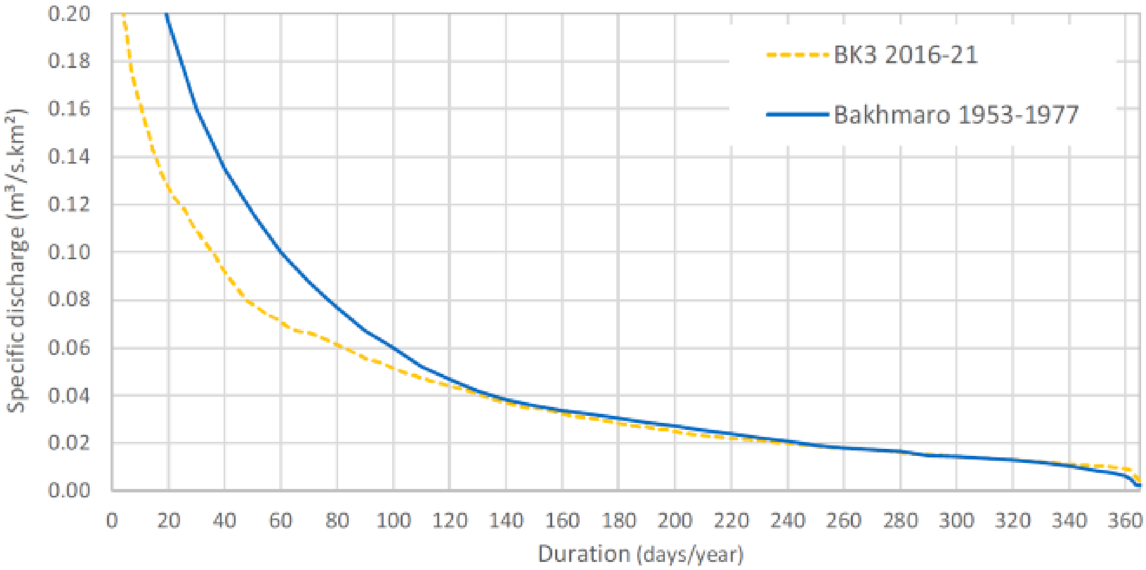
The planned Bakhvi 1 intake is located further downstream than the gauge at Bakhmaro (catchment area of 33.5 km² at an elevation of 1,845 m asl), with a catchment area of 52.1 km² at an elevation of 1,730 m asl. Further downstream, with a catchment area of 76.6 km² at an elevation of 530 m asl, operational data of Bakvhi 3 HPP provides inflow information for the recent years 2016-2021. Figure 5.3.3.2.7.1. compares the discharge information of the two different locations (and periods) by plotting the mean monthly specific discharge (discharge per km² of catchment area). Discharge in the winter half year is at a very similar level at both locations, but discharge in the summer half year is significantly lower in the Bakhvi 3 record, due to only dry and very dry years included in the record. Bakhvi 3 data also shows an earlier start of the snow melt discharge increase (already in March), which can partly be attributed to the contributions of parts of the catchment at lower elevations and partly to higher temperatures in recent years due to global warming. As the catchment of Bakhvi 1 intake does not extend to lower regions, the location of Bakhmaro gauge better captures the seasonal characteristics of the inflow to the intake.

Figure 5.3.3.2.7.1. Mean monthly specific discharge at Bakhmaro gauge (1953-1977) and Bakhvi 3 (2016-2021)



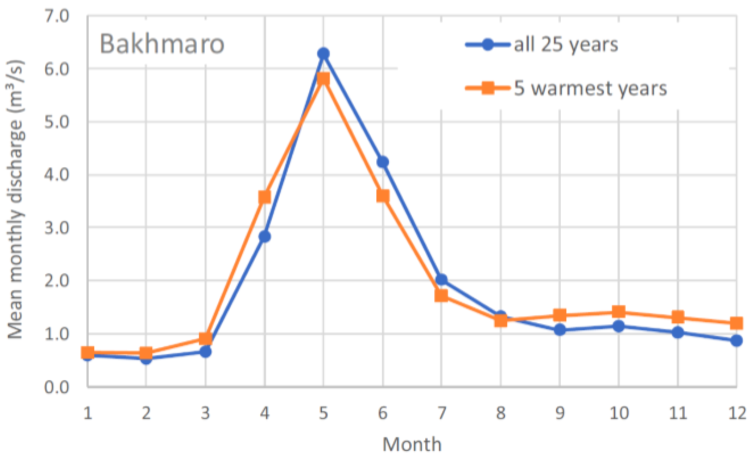
The differences between the two records are also presented in duration curves (Figure 5.3.3.2.7.2.), which show a very similar behaviour for durations up to around 120 days/year. For shorter durations, the higher observed values at Bakhmaro during normal and wet years are apparent.

Figure 5.3.3.2.7.2. Duration curves of specific discharge at Bakhmaro gauge (1953-1977) and Bakhvi 3 (2016-2021)



For an estimate of only the impact of increased temperatures on discharge, the observations of the five warmest years were compared with the full 25-year record at Bakhmaro (Figure 5.3.3.2.7.3). The difference in mean temperature between the 25-year period and the 5 warmest years is about 1°C, which is in the same range as the warming between the period of record 1953 1977 and the recent years. The typical impact of warmer temperatures on snow-dominated discharge are clearly visible, with higher discharge in winter, an earlier start of the snow melt and a lower snow melt peak (note that the precipitation was also slightly lower, by around 3%, in the five driest years than in the overall period). Figure 5.3.3.2.7.3. also shows that the impact of a 1° warming is not very significant, which probably can be attributed to the high elevation where many parts of the catchment remain dominated by snow in winter even with higher temperatures.

Figure 5.3.3.2.7.3. Mean monthly specific discharge at Bakhmaro gauge for the full 25-year record (1953-1977) and for the five warmest years in that period



Both presented analyses, the comparison of the historic record at Bakhmaro with recent operational observations at Bakhvi 3 and the comparison of the full 25-year Bakhmaro record with the five warmest years confirm that only small differences between the historic record at Bakhmaro and future inflow at Bakvhi 1 estimated from that record can be expected. The expected differences refer to a potentially slightly higher low flow discharge and an earlier start of the snow melt. For both parameters, an estimate that does not consider these changes can be considered more conservative. Therefore, the Bakhvi 1 inflow estimate is based on the long-term 25-year observation series at Bakhmaro for 1953-1977.

5.3.3.2.8 Inflow to Bakvhi 1 Intake

Inflow to Bakhvi 1 intake was calculated from the described Bakhmaro discharge observation series by applying the catchment area ratio. The resulting mean inflow is 2.9 m³/s.

Figure 5.3.3.2.8.1. shows the resulting duration curve, Figure 5.3.3.2.8.2. presents the mean monthly discharge. Figure 5.3.3.2.8.3. displays the series of 25 mean annual inflow values, which was used to calculate quantile values of annual inflow.

The values of mean monthly discharge are listed in Table 5.3.3.2.8.1., quantile values of mean annual discharge are listed in Table 5.3.3.2.8.2.

Figure 5.3.3.2.8.1. Annual mean inflow series for Bakhvi 1 intake for the years 1953-1977

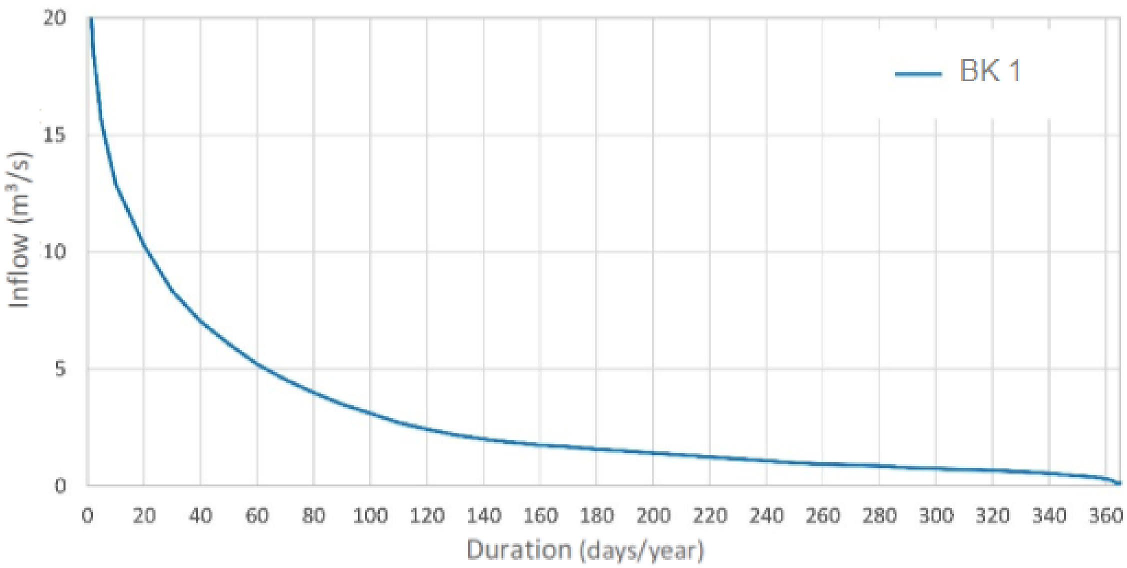


Figure 5.3.3.2.8.2. Annual mean inflow series for Bakhvi 1 intake for the years 1953-1977

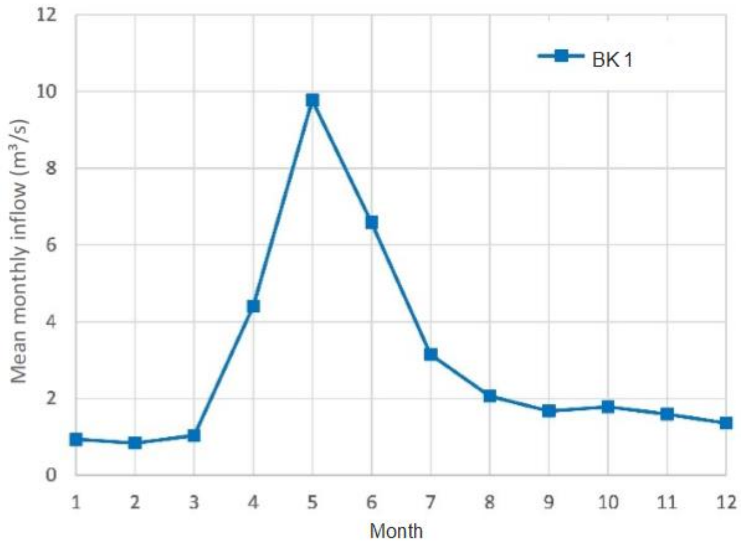


Figure 5.3.3.2.8.3. Annual mean inflow series for Bakhvi 1intake for the years 1953-1977

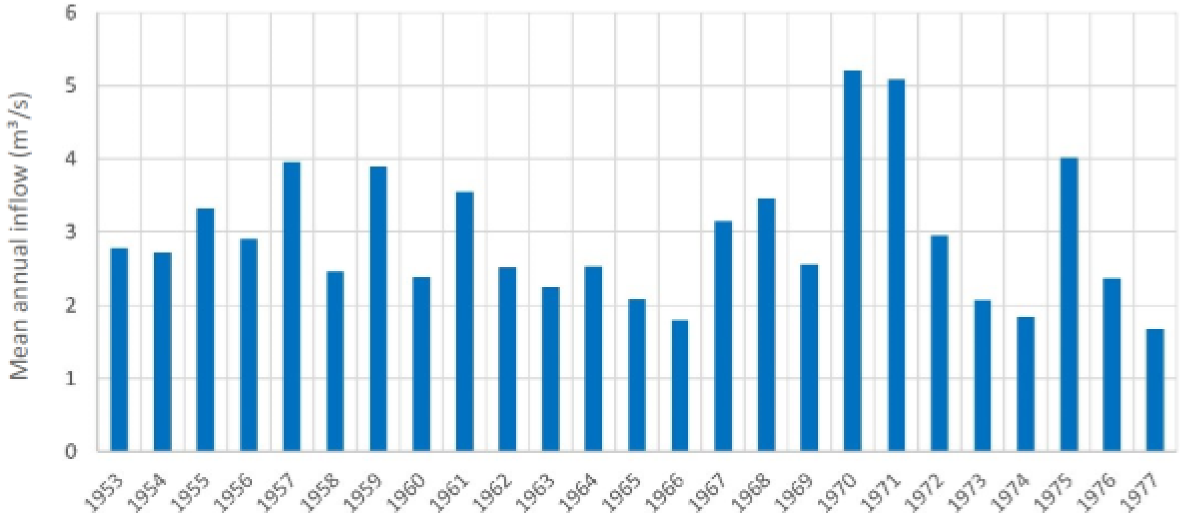


Table 5.3.3.2.8.1. Mean monthly inflow to Bakhvi 1

Month	1	2	3	4	5	6	7	8	9	10	11	12
Q (m^3/s)	0.9	0.8	1.0	4.4	9.8	6.6	3.2	2.1	1.7	1.8	1.6	1.4

Table 5.3.3.2.8.2. Distribution of mean annual inflow, based on the 25-year series of 1953-1977

%	Maximum	10	25	50	75	90	Minimum
Q (m^3/s)	5.2	4.0	3.5	2.7	2.4	1.9	1.7

Based on the daily time series of 25 years of inflow to Bakhvi 1 intake, minimum flow criteria were calculated. The values for absolute 10-day and 30-day minimum flows resulting from an analysis of this time series, 0.12 m^3/s, are resulting from one period of very low recorded flow at Bakhmaro gauge in Februar 1959, when the same value of discharge was recorded for more than one month. As this part of the record might be erroneous, an alternative value was calculated dimissing the low flow period of 1959. These values might be considered more realistic – but as it cannot be ruled out that the record during February 1959, or at least a part of it, is accurate, both sets of values are presented here.

Average annual flows were also determined for the tributary ravines at the diversion site of the project HPP. Due to the very small area of the catchment basin of these ravines, it is not possible to determine their average annual costs by analogous method according to the norms in force in Georgia. Therefore, the average multi-year costs of individual ravines at the confluence intersections are determined by the method given in the monograph "Water Balance of the Caucasus and its Geographical Regularity" (Science, 1991), developed at the Vakhushti Bagrationi Institute of Geography. According to the mentioned method, height of the runoff layer corresponding to the average height of the study river or ravine basin is determined based on the dependence curve between the mean heights of the basin and heights of runoff layer developed for the study area of the river or ravine basin after which the average multi-year flow of the river or ravine is calculated by the formula:

$$Q_0 = \frac{Fkm^2 \cdot hmm \cdot 1000}{tsek} \quad m^3/s$$

Where,

Fkm^2 – catchment area of the river in km^2;

hmm – height of the runoff layer in mm;

$tsek$ – number of seconds per year.

The average multi-year flows of those ravines at which the average height of the basin and the height of the runoff layer could not be calculated were determined by the method of modules well known in hydrology. The annual distribution of the average multi-year flows of the ravines in this case is also carried out at the intersection of the hydrological station Bakhmaro, synchronously with the annual distribution of the average multi-year flow of Bakhvistskali.

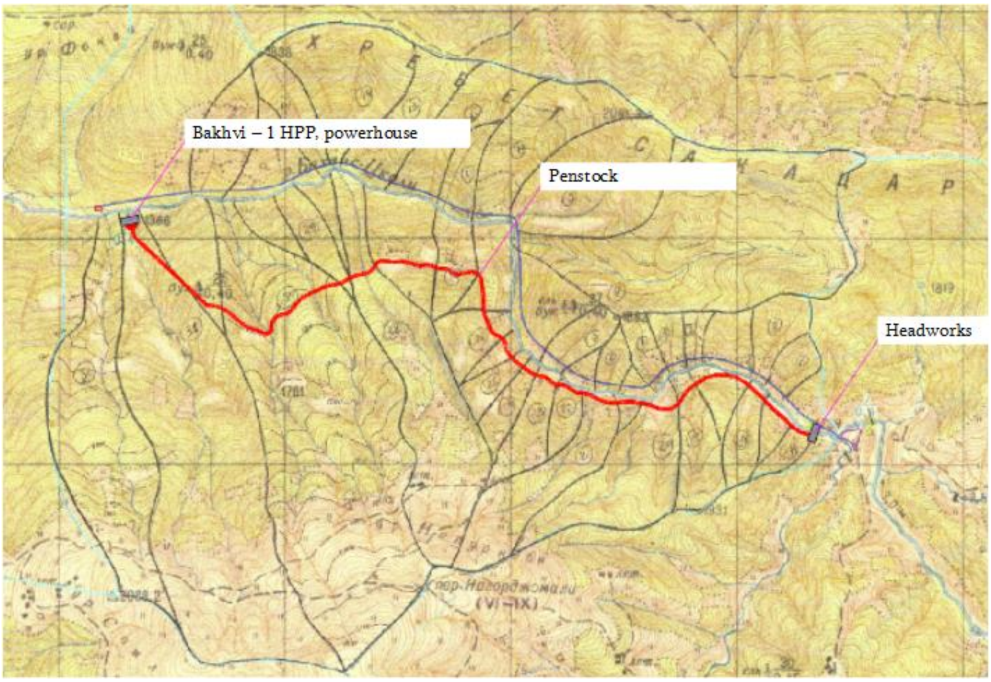
Table 5.3.3.2.8.3 below shows the intra-annual distribution of average multi-year flows of river tributaries at the project HPP diversion site.

Table 5.3.3.2.8.3. Intra-annual distribution of average multi-year flows of river tributaries at the project HPP diversion site in m^3/s

Ravine #	F km^2	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
1	0.042	0.001	0.001	0.001	0.003	0.007	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.002
2	0.068	0.001	0.001	0.002	0.006	0.014	0.009	0.004	0.003	0.002	0.003	0.002	0.001	0.004
3	0.026	-	-	0.001	0.002	0.004	0.003	0.001	-	-	0.001	-	-	0.001
4	0.031	0.001	0.001	0.001	0.003	0.007	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.002
5	0.038	0.001	0.001	0.001	0.003	0.007	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.002
6	0.032	0.001	0.001	0.001	0.003	0.007	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.002
7	0.055	0.001	0.001	0.001	0.004	0.011	0.006	0.003	0.002	0.002	0.002	0.002	0.001	0.003
8	0.721	0.012	0.011	0.014	0.058	0.133	0.087	0.044	0.028	0.024	0.027	0.024	0.018	0.040
9	0.268	0.004	0.004	0.005	0.021	0.052	0.033	0.016	0.011	0.009	0.010	0.009	0.006	0.015
10	0.199	0.003	0.003	0.004	0.015	0.038	0.024	0.012	0.008	0.007	0.007	0.007	0.004	0.011
11	0.058	0.001	0.001	0.001	0.004	0.011	0.006	0.003	0.002	0.002	0.002	0.002	0.001	0.003
12	0.142	0.002	0.002	0.003	0.011	0.027	0.017	0.009	0.006	0.005	0.006	0.005	0.003	0.008
13	0.139	0.002	0.002	0.003	0.011	0.027	0.017	0.009	0.006	0.005	0.006	0.005	0.003	0.008
14	0.229	0.003	0.003	0.004	0.016	0.041	0.026	0.013	0.009	0.008	0.009	0.008	0.004	0.012
15	0.081	0.001	0.001	0.002	0.006	0.014	0.009	0.004	0.003	0.002	0.003	0.002	0.001	0.004
16	0.114	0.002	0.002	0.002	0.008	0.020	0.013	0.007	0.004	0.004	0.004	0.004	0.002	0.006
17	0.029	0.001	0.001	0.001	0.003	0.007	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.002
18	0.055	0.001	0.001	0.001	0.004	0.011	0.006	0.003	0.002	0.002	0.002	0.002	0.001	0.003
19	0.091	0.001	0.001	0.002	0.007	0.017	0.011	0.006	0.004	0.003	0.004	0.003	0.001	0.005
20	0.220	0.003	0.003	0.004	0.016	0.041	0.026	0.013	0.009	0.008	0.009	0.008	0.004	0.012
21	0.185	0.002	0.002	0.003	0.013	0.034	0.022	0.011	0.008	0.007	0.008	0.007	0.003	0.010
22	0.039	0.001	0.001	0.001	0.003	0.007	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.002
23	0.076	0.001	0.001	0.002	0.006	0.014	0.009	0.004	0.003	0.002	0.003	0.002	0.001	0.004
24	0.047	0.001	0.001	0.001	0.004	0.011	0.006	0.003	0.002	0.002	0.002	0.002	0.001	0.003
25	0.033	0.001	0.001	0.001	0.003	0.007	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.002
26	0.066	0.001	0.001	0.002	0.006	0.014	0.009	0.004	0.003	0.002	0.003	0.002	0.001	0.004
27	0.067	0.001	0.001	0.002	0.006	0.014	0.009	0.004	0.003	0.002	0.003	0.002	0.001	0.004
28	0.411	0.006	0.006	0.007	0.031	0.076	0.048	0.024	0.016	0.013	0.015	0.013	0.009	0.022
29	0.055	0.001	0.001	0.001	0.004	0.011	0.006	0.003	0.002	0.002	0.002	0.002	0.001	0.003
30	1.062	0.018	0.016	0.020	0.085	0.198	0.128	0.064	0.042	0.035	0.040	0.035	0.027	0.059
31	0.898	0.015	0.014	0.017	0.072	0.168	0.108	0.054	0.036	0.030	0.034	0.030	0.022	0.050
Sum	_	**0.09**	**0.086**	**0.111**	**0.437**	**1.05**	**0.666**	**0.332**	**0.219**	**0.185**	**0.212**	**0.185**	**0.123**	**0.308**

The catchments of the ravines are marked with the appropriate numbering on the topographic map (Figure 5.3.3.2.8.4.).

Figure 5.3.3.2.8.4. Catchments of ravines in the project area



The minimum flow was calculated in accordance with 25-year period daily flow rates for Bakhvi 1 HPP intake area, as presented in Table 5.3.3.2.8.4. The absolute 10-day and 30-day minimum flow rates of 0.12 m^3 / s determined from the analysis of these time series are obtained from one period of the lowest flow rate recorded at the hydrological station Bakhmaro in February 1959, when the same flow rate was recorded for more than one month. Since this part of the record could have been erroneous, an alternative rate was calculated by reducing low water period in 1959. These figures should be considered more realistically, however, as the accuracy of the February 1959 records cannot be ruled out in whole or in part, both values are presented below.

Table 5.3.3.2.8.4 also presents more accurate low flow values obtained from the daily flow duration curve; These values are given in the form of flow with 10-day provision (97.3% provision) and also, 95% provision of flow.

Table 5.3.3.2.8.4. Minimum flow for Bakhvi 1 HPP alignment:

Value	10-day min (including 1959)	30-day min (including 1959)	10-day min (excluding 1959)	30-day min (excluding 1959)	$Q_{97.3}$ 10 day	Q_{95}
Q (m^3/s)	0.12	0.12	0.25	0.29	0.40	0.48

5.3.3.3 Floods

The flood estimation for Bakhvi 1 intake was based on available discharge data from the Bakhvistskali River, mainly using observations from Bakhmaro gauge, and additional information from the short series of operation observations at Bakhvi 3. For comparison, also the exceptionally long discharge series of Gubazeuli River was analysed.

The flood frequency estimates for the gauge locations were regionalized based on the index flood method.

5.3.3.3.1 Flood Peak Data

Flood discharge information was derived from the following sources:

1. Hourly discharge data of Bakhvi 3 for the period 2016-2021. While this series is too short to be used in a flood frequency analysis, it was used to estimate a relationship between daily mean discharge and hourly flood peak discharge.
2. Daily discharge observations of Bakhmaro gauge for the period 1952-1978 (it was assumed that the gaps and errors that lead to the elimination of the first and last years of this record for the inflow estimation did not significantly impact the flood peak values). Flood peak discharge for the selected peaks was estimated based on the relationship derived from hourly Bakhvi 3 data.
3. Flood peak discharge information for Bakhmaro gauge as provided in the report by Dr. Sackl [2]
4. Daily discharge observations of the gauge in the neighbouring Gubazeuli catchment for the period 1935-1991. Flood peak discharge for the selected peaks was estimated based on the relationship derived from hourly Bakhvi 3 data.

Figure 5.3.3.3.1.1. shows the daily discharge time series for Bakhvi 3 (for the part of the record with available information on spillway discharge) and the daily mean values and hourly peak values of ten selected peaks. Based on this data, a relationship between daily mean and peak discharge was established. The formula for this relationship is based on Sangal's approach, and considers the daily mean discharge on the day of the peak and on the previous and following day. Figure 5.3.3.3.1.1. shows a comparison of the observed hourly peaks with the peak discharge calculated from daily data with the Sangal-type formula.

Figure 5.3.3.3.1.1. Daily discharge and maxima and hourly peak discharge observed at Bakhvi 3

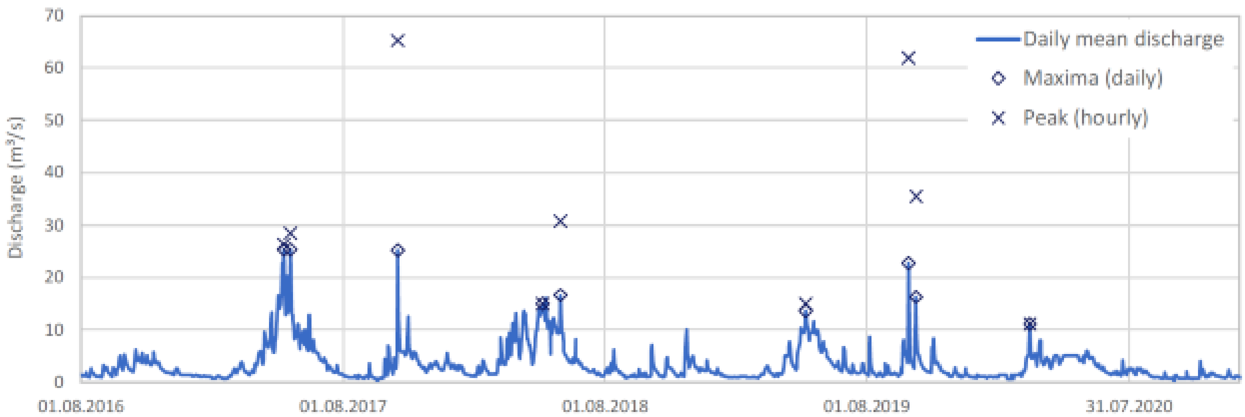
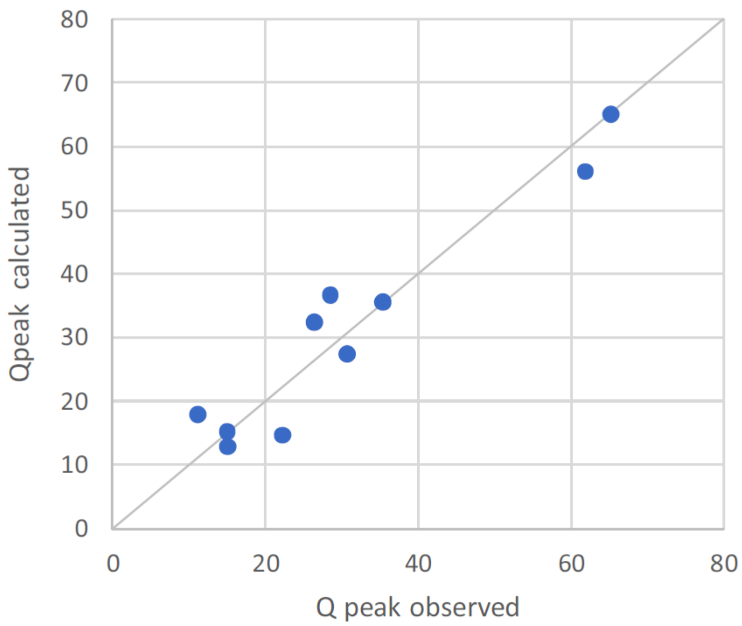


Figure 5.3.3.3.1.2. Observed peak and peak discharge calculated from daily mean data for Bakhvi 3 peaks



The calculation of peak discharge derived for Bakhvi 3 was then also applied to annual maxima series (AMS) determined from daily data of Bakhmaro (Figure 5.3.3.3.1.3.) and Gubazeuli (Figure 5.3.3.3.1.4.) gauges. As shown in the graphs, the estimated peaks vary from values that are very close to the daily mean value to peaks that are markedly higher, depending on the discharge dynamics estimated from the previous and following day daily discharge.

Figure 5.3.3.3.1.3. Daily discharge and maxima and estimated peak discharge at Bakhmaro

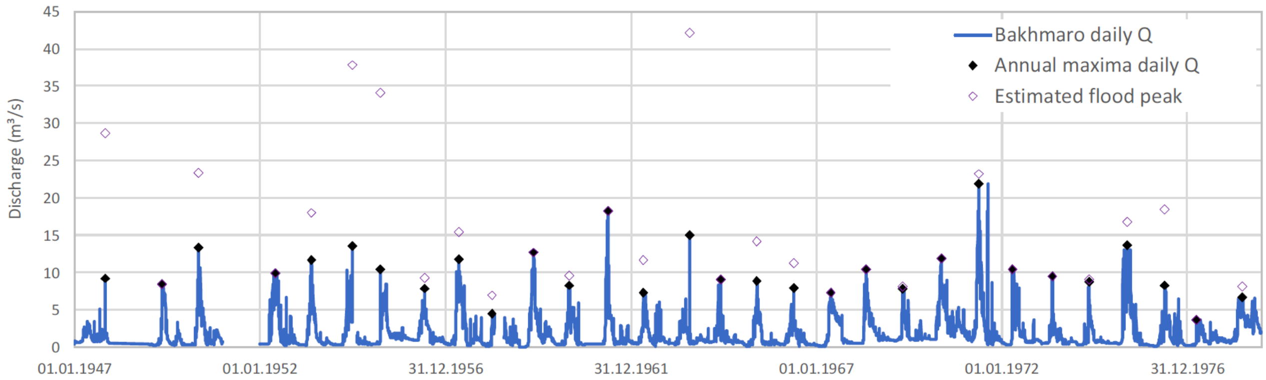
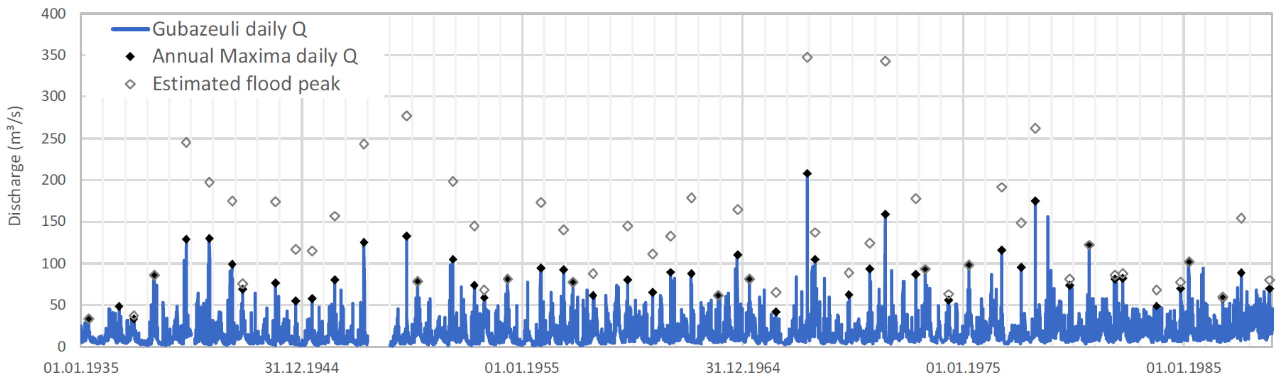


Figure 5.3.3.3.1.4. Daily discharge and maxima and estimated peak discharge at Gubazeuli



5.3.3.3.2 Flood Frequency Analyses

Flood frequency analyses for the three peak discharge series for Bakhmaro with the peaks estimated from daily data, Bakhmaro peak data from [2] and Gubazeuli with the peaks estimated from daily data were carried out using the software package HQ-Ex by DHI. With this tool, several extreme value distributions are fitted to the data, using three different methods of parameter estimation and providing a goodness-of-fit evaluation criterion based on three different evaluation procedures. Figure 5.3.3.3.2.1. exemplarily shows the results for seven extreme value distributions with an excepted goodness-of-fit, for Bakhmaro (estimated peaks).

For all three analysed data sets, the Log-Normal distribution with parameters estimated with probability weighted moments provided very good fit to the data (abbreviation LN3 WGM in the FFA graphs). Also, the results with this method were close to the mean of results with all acceptable distributions, as shown in the graphs below for Bakhmaro (estimated peaks, Figure 5.3.3.3.2.2.), Bakhmaro (peaks from [2], Figure 5.3.3.3.2.3.) and Gubazeuli (Figure 5.3.3.3.2.4.). Therefore, the results with this distribution was used for further calculation of the design flood inflow to Bakhvi 1 intake.

Figure 5.3.3.3.2.1. Flood frequency analysis for Bakhmaro (estimated peaks), results for different extreme value distributions fitted to the data

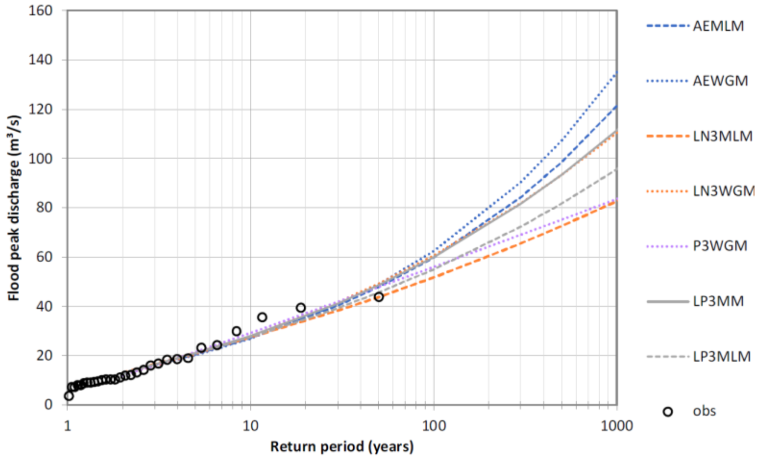


Figure 5.3.3.3.2.2. Flood frequency analysis for Bakhmaro (estimated peaks), results for Log-Normal 3 distribution (and mean of all acceptable distribution)

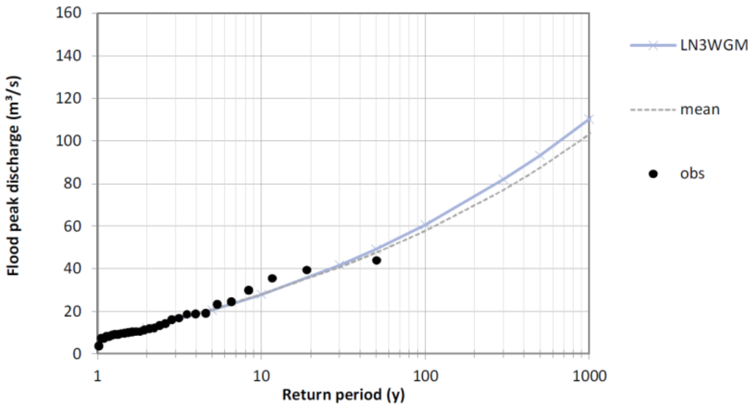


Figure 5.3.3.3.2.3. Flood frequency analysis for Bakhmaro (peaks from [2]), results for Log-Normal 3 distribution (and mean of all acceptable distribution)

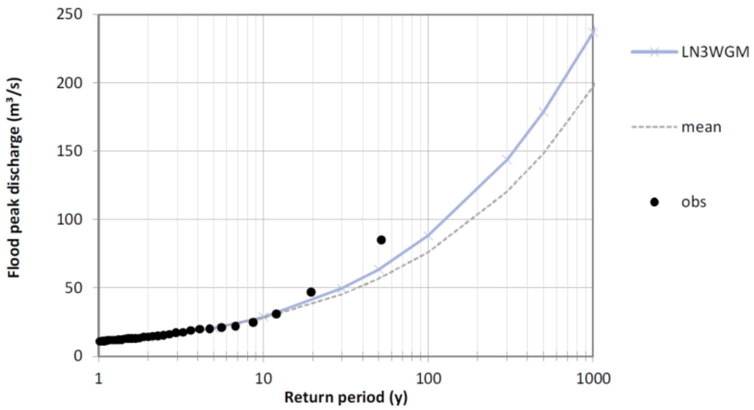
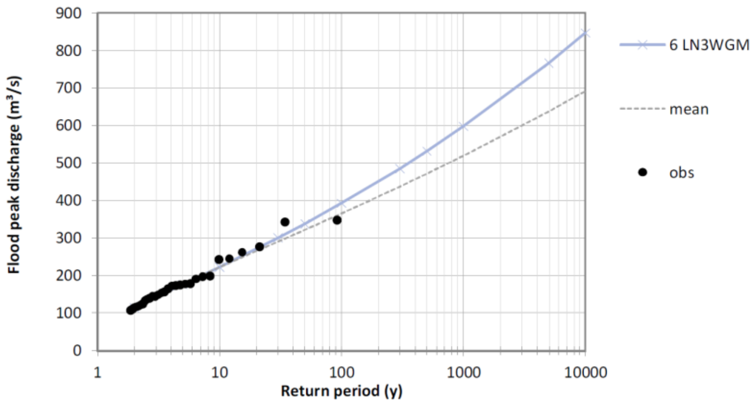


Figure 5.3.3.3.2.4. Flood frequency analysis for Gubazeuli (estimated peaks), results for Log-Normal 3 distribution (and mean of all acceptable distribution)



5.3.3.3.3 Flood Flow Calculation by Interpolation between Catchments

In the index flood approach, a so-called index flood (typically and also in this study the mean annual flood – MAF) is interpolated in space based on catchment characteristics (in this study only based on catchment area size). The values of floods with smaller probabilities are then estimated based on a growth curve that is assumed to behave consistently in a larger region. The growth curve can be estimated from analyses at single gauges or be interpolated from values at several locations.

Figure 5.3.3.3.3.1. displays the estimation of the index flood for Bakhvi 1 intake based on catchment area size and the four available flood observation records for Bakhmaro (2 values, for estimated peaks and peaks from [2]), Bakhvi 3 and Gubazeuli.

Figure 5.3.3.3.3.1 Index flood (MAF) values for four observation records and estimation for Bakhvi 1 intake

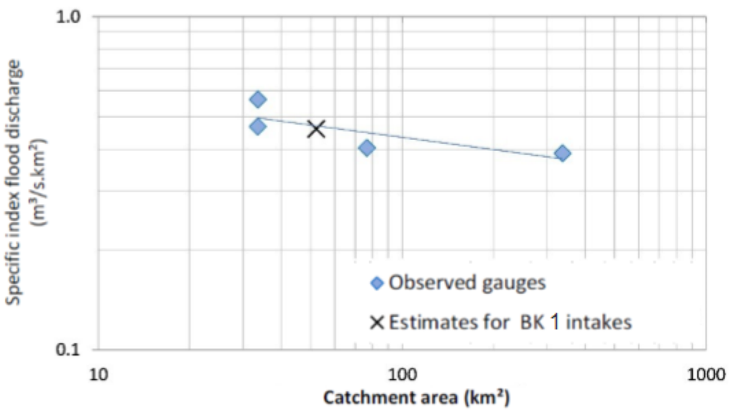
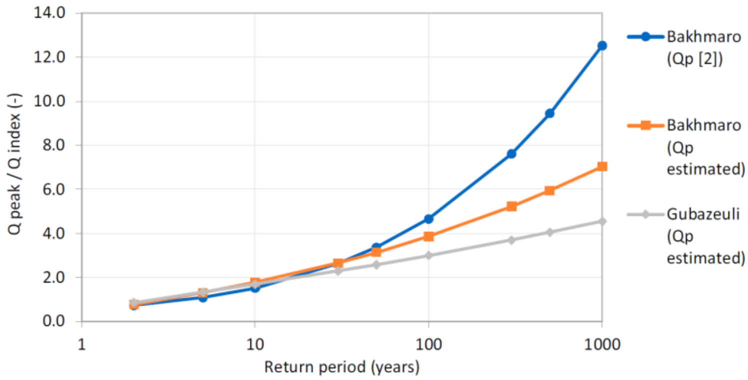


Figure 5.3.3.3.3.2. presents the three growth curves (flood peak relative to index flood) calculated from the flood peaks as derived from the FFA results presented in Figure 5.3.3.3.2.2 (Bakhmaro estimated peaks), Figure 5.3.3.3.2.3 (Bakhmaro peaks from [2]) and Figure 5.3.3.3.2.4 (Gubazeuli). Clearly, the results with Bakhmaro with the peaks from [2] provides the highest peaks for highest return periods. For a conservative flood assessment, this growth curve was therefore selected for the flood estimation for Bakhvi 1. Figure 5.3.3.3.3.2 also shows that for low return periods (between 5 and 10 years), this growth curve leads to slightly lower values than the other two curves. However, the differences are small and for design purposes these low return periods were not regarded as relevant. It was therefore regarded as sufficiently cautious to assume this curve for all return periods.

Figure 5.3.3.3.3.2. Growth curves based on FFA results for Bakhmaro (peaks from [2]), Bakhmaro (peaks estimated) and Gubazeuli (peaks estimated)



5.3.3.3.4 Flood Estimates for Bakhvi 1

Based on the index flood and growth curve as described above, design flood estimates for Bakhvi 1 intake were calculated, resulting in the values shown in Figure 5.3.3.3.4.1. and Table 5.3.3.3.4.1.

Figure5.3.3.3.4.1. Design flood estimates for Bakhvi 1 intake

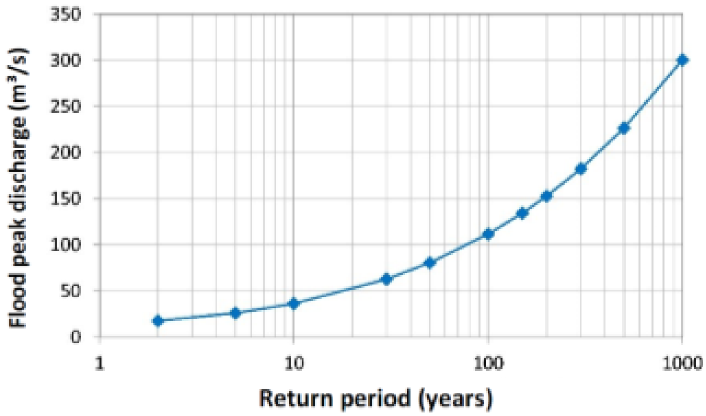


Table 5.3.3.3.4.1. Design flood estimates for Bakhvi 1 intake

Return period (a)	2	5	10	30	50	100	150	200	300	500	1000
Peak discharge (m^3/s)	18	26	37	63	81	112	135	153	183	227	300

5.3.3.4 Conclusions and Recommendations

The presented analyses provide the required hydrological information for the design of Bakhvi 1 HPP, and for analyses regarding its social and environmental impact. Due to the availability of discharge observations in the Bakhvistskali basin, these analyses mainly rely on the information provided by these records, and do not include substantial meteorological analyses. The main results of the studies on long-term inflow, including its seasonal and inter-annual variability, and on flood inflow are summarized in Table 5.3.3.4.1.

Table 5.3.3.4.1. Hydrology summary table for Bakhvi 1 HPP

General	
Catchment size at intake	52.1 km^2

Mean annual precipitation										1,500 mm		
Inflow												
Specific mean inflow										0.056 m³/s·km²		
Mean annual inflow										2.9 m³/s		
Mean monthly inflow [m³/s]												
Month	1	2	3	4	5	6	7	8	9	10	11	12
Q	0.9	0.8	1.0	4.4	9.8	6.6	3.2	2.1	1.7	1.8	1.6	1.4
Distribution of mean annual inflow [m³/s]												
%	10	25	50	75	90							
Q	4.0	3.5	2.7	2.4	1.9							
Floods Peak Discharges												
5-year flood									26 m³/s			
10-year flood									37 m³/s			
30-year flood									63 m³/s			
100-year flood									112 m³/s			
150-year flood									135 m³/s			
200-year flood									153 m³/s			
500-year flood									227 m³/s			

Annual distribution of 10%, 50%, 75% and 95% provision flows

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Aver.	0.9	0.8	1.0	4.4	9.8	6.6	3.1	2.1	1.7	1.8	1.6	1.4	2.9
Max.	2.3	2.2	2.0	10.3	20.3	12.3	6.3	5.3	3.9	5.1	4.4	4.8	5.2
Min. .	0.1	0.1	0.4	1.5	4.0	2.2	1.2	0.7	0.7	0.7	0.5	0.5	1.7
10%	1.7	1.5	1.6	7.6	15.3	9.8	5.3	3.5	2.7	3.0	2.1	1.9	4.0
50%	0.8	0.7	0.9	3.5	8.4	6.3	2.5	1.6	1.4	1.5	1.5	1.2	2.7
75%	0.7	0.5	0.7	2.6	7.0	4.8	2.1	1.3	1.1	1.1	1.1	0.8	2.4
95%	0.4	0.3	0.5	1.7	4.8	3.3	1.3	0.8	0.7	0.7	0.6	0.5	1.8

Main uncertainties in these estimates are related with the main source of information used for derivation of the values, historical Bakhmaro gauge records. The 25-year record ends in 1977, and therefore does not cover the most recent decades. As no relevant trend in precipitation in the catchment was found, it was considered to be representative also of current hydro-climatic conditions. However, temperature of course shows an increasing trend due to global warming, and has an impact on the seasonal discharge distribution. This influence was investigated and discussed, and is believed to have only small effect so far.

Due to the large bed load volumes deposited and transported in the river reach at the Bakhmaro bridge, there is also some uncertainty related with low flow observations in the historic record.

These uncertainties can be further reduced in future investigations at later stages of development by making use of the new observations collected operationally at Bakhvi 3 and at new gauges at Bakhmaro bridge and at the planned Bakhvi 1 intake.

Water level observations at the new gauges at Bakhmaro and Bakhvi 1 showed some inconsistencies, which also complicate the establishment of stage-discharge relationships. As additional information at these locations can bring very valuable information, especially on differences in streamflow along the course of the river, it is recommended to continue these observations. Caution should be increased regarding changes in the river bed or the position of the sensors that can lead to changes in the station datum. For the development of reliable stage-discharge relationships, all relevant parameters (cross section geometry, flow velocities, water level observations) need to be measured regularly, and also during (at least smaller) flood events. The application of a hydraulic model of the river reaches with the new gauges can further enhance the establishment of stage-discharge-curves.

5.3.3.5 Sediment Transport

5.3.3.5.1 Solid Runoff

Solid runoff of the river Bakhvistskali was studied only at the section of hydrological station Ukanavi in the 40s of the last century, for three years (1939,40-1942). It is known that in the practice of engineering hydrology it is not allowed to determine solid runoff values by the analogue method. The solid runoff of the river near the headworks area is ot studied. Therefore, its suspended solid sediment runoff at the headworks area is determined by the method given in the Hydrological Reference "USSR Surface Water Resources, Volume IX, Publication I". According to the mentioned method, the average river turbidity was initially determined from the schematic map of the small and medium river turbidity (gr / m3) of Georgia. According to the schematic map, the turbidity of Bakhvitskali river varies from 50 to 100 g / m^3. In our case, its average turbidity, taking into account the forest cover of a large area of the river basin, is taken to be equal to 70 g / m3. From here, the average annual value of the suspended solid sediment is calculated by the formula.

$$R_0 = \rho_{sash} \cdot Q_0 \ \text{kg/s}$$

Where,

Q_0 _ The average multi-year flow of the river at the project section.

The average multi-year runoff of the suspended solid sediment flow rate is calculated by formula:

$$W = R_0 \cdot T \ \text{tone/year}$$

Wherem

$T -$ number of seconds per year, which is equal to 31560000 seconds.

In the Bakhvitskali River basin, the bottom solid sediment flow rate can be taken equal to 20% of the suspended solid sediment flow rate.

The values of Bakhvitskali solid runoff determined by the calculations performed according to the above method at the headworks section are given in Table 5.3.3.5.1.1.

Table 5.3.3.5.1.1. Solid runoff of the river Bakhvitskali

Section	Q_0 m^3/s	ρ g/m^3	R_0 kg/s Suspend.	$R_0{}^{I}$ kg/s Bottom	$R_0 + R_0{}^{I}$ kg/s	W Suspend. tone/ year	W^{I} Bottom tone/ year	$W + W^{I}$ tone/ year
Headworks	2,9	75	0,21	0,04	0,26	6865	1372	8237

5.3.3.6 Depth of Expected Washout of Bakhvitskali River and its Left Tributary Gorge Bed

5.3.3.6.1 Bakhvitskali River

Bakhvitskali riverbed processes at the project HPP site are not studied. Therefore, the expected general washout depth of the left, largest tributary of the river gorge are determined by the method given in monograph “Forecasting the riverbed deformations in hydrosystem reaches” by V. Lapshenkov (Leningrad, 1979).

According to this method, the average general washout depth of the bed is initially determined by the following formula

$$H_{sash} = \left[\frac{Q_{p\%} \cdot n^{2/3}}{B} \cdot \left(\frac{10}{d_{sash}} \right)^{0,33} \right]^{\frac{1}{1+2/3 \cdot y}} \text{ m}$$

Where,

$Q_{p\%}$ - Maximum flow rate of 1% water supply in m³/s;

n - coefficient of bed roughness, which is determined by special calculations for each specific area;

B - width of a solid bed, the magnitude of which is determined for each specific site by the following formula

$$B = K \cdot \left(\frac{Q_{p\%}}{\sqrt{g \cdot i}}\right)^{0,4} \text{ m}$$

Here,

K - coefficient that takes into account the heterogeneity of water flow and suspended solid material. Its value, depending on the amount of suspended solid material (μ g / l) is taken from the relevant table. Its values are given in the table below;

i - Hydraulic slope of flow at each design site;

d_{SASH} - Average diameter of solid material deposited on the bottom of the riverbed. Its value is determined by the formula

$$d_{SASH} = K_1 \cdot i^{0,9} \cdot \left(\frac{Q_{10\%}}{\sqrt{g}} \right)^{0,4} \text{ m}$$

K_1 - coefficient that takes into account the heterogeneity of water flow and suspended solid material. Its value, depending on the amount of suspended solid material (μ g / l) is taken from other relevant table.

i - Hydraulic slope of flow at each design site;

$Q_{10\%}$ - maximum annual flow of 10% provision of Bakhvitskali river, which is determined for each project site;

g - acceleration of the force of gravity, in both formulas.

The amount of suspended solid material, according to which the values of K are determined for both cases, are calculated by the formula:

$$\mu = 7000 \cdot \left(\frac{H}{d_{dan}} \right)^{0,7} \cdot i^{2,2} \text{ g/l}$$

Where,

H - Average depth of flow in the project section;

y - The defining quality index of the chez Coefficient in Pavlovsky's formula. Its value is calculated by the formula.

$$y = 2,5 \cdot \sqrt{n} - 0,13 - 0,75 \cdot \sqrt{R} \cdot (\sqrt{} n - 0,1)$$

Where,

R - The hydraulic radius, which is equal to the average depth for rivers, $R = h$ m. In our case the average depth of the river;

n - coefficient of bed roughness.

The maximum depth of general washout of the bed is obtained by formua:

$$H_{\max} = 1,6 \cdot H_s \text{ meters}$$

The above parameters and self-washout depths required to calculate the expected general washout depth of the Bakhvitskali riverbed are given in Table 5.3.3.6.2.4 below.

5.3.3.6.2 Derivation Crossing Ravine

The ravines at the diversion site of the project HPP are unexplored from a hydrological point of view. The decision was made to determine the washout depth of the mentioned ravines by the analogous method, which means to obtain the washout depth of the largest ravine as a calculated value for all ravines.

For this purpose, the largest ravine was selected from the ravines crossing the diversion of the project HPP, which is connected to Bakhvitskali at an altitude of 1380 meters (geographical coordinates of the ravine crossing point: X = 272904, Y = 4638616). The maximum water flows of the gorge are determined by the method given in the "Technical reference for the calculation of maximum river runoff in the Caucasus".

It should be noted that the proposed method gives 10-12% higher values of maximum water flow than the intensity formula given in СНиПС2.01.14-83 ("Определение расчетных Гидролгических Характеристик"). The intensity formula does not take into account the current global climate change in recent decades and the associated increased rainfall intensity, which in turn reflects the lower values of flows obtained by the intensity formula. Given the increased rainfall intensity and consequently the maximum flows in the context of global climate change, a decision was made to determine the estimated values of maximum water flows by the method given in the technical reference. This method is well tested in Georgia and, based on practical experience, meets the modern conditions caused by climate change.

According to this method, the values of maximum water flows in the ravines, the catchment area of which does not exceed 400 km^2, are calculated by the formula:

$$Q = R \cdot \left[\frac{F^{2/3} \cdot K^{1,35} \cdot \tau^{0,38} \cdot \bar{i}^{\,0,125}}{(L+10)^{0,44}} \right] \cdot \Pi \cdot \lambda \cdot \delta \ \text{m}^3/\text{s}$$

Where,

R - district parameter. Its value in the conditions of western Georgia is equal to 1.35;

F - Catchment area, in the project section, in km^2;

K - climatic coefficient of the district, the value of which is taken from a special map and in our case is equal to 6.5;

τ - Recurrence over the years;

$\bar{i}$ - Balanced slope of the ravine, in units, from headworks to project section;

L - length of the ravine, from the headworks to the project section, in km;

Π - Characteristic coefficient of soil cover in the valley basin. Its value is taken from a special map and the corresponding table and in our case it is equal to 1;

λ - The coefficient of basin forestry, the value of which is calculated by the formula:

$$\lambda = \frac{1}{1 + 0,2 \cdot \frac{F_t}{F}}$$

Here,

F_t - The forest cover area of the basin in%, which is equal to 93%. From here λ = 0,84;

δ - coefficient of basin shape. Its value is calculated by formula:

$$\delta = 0,25 \cdot \frac{B_{\max}}{B_{sas}} + 0,75$$

Where,

$B_{\max}$ - Maximum width of the basin in km, which is equal to 0.50 km;

B_{sas} - average width of the basin in km. Its value is calculated by formula: $B_{sas} = \dfrac{F}{L}$

From here δ =1,04;

When calculating the maximum water flows of small ravines with catchment areas of less than 5 km², the formula discussed above additionally includes the coefficients corresponding to the catchment basin areas, specially processed below.

F km²	<1	1	2	3	4	5
K^I	0,70	0,80	0,83	0,87	0,93	1,00

Since the catchment area of the mentioned ravine is less than 1 km², K^I is equal to 0,70.

Table 5.3.3.6.2.1. Maximum water flows in large gorge crossed by the project HPP pipeline in m³ / s

Section	F km²	L km	i kal	λ	δ	K^I	Maximum flows			
							$\tau=100$ year	$\tau=33$ year	$\tau=20$ year	$\tau=10$ year
Derivation	0.898	2.05	0.393	0.84	1.04	0.70	15.8	10.4	8.57	6.59

In order to determine the values corresponding to the maximum water flow levels, a cross section of the gorge bed was removed from the 1: 500 scale topographic plan, according to which a correlation curve was developed between the maximum water flows and levels $Q = f(H)$

$$V = \frac{h^{2/3} \cdot i^{1/2}}{n}$$

Where:

- h - Average depth of flow at section, in m;
- i - hydraulic slope of flow taken from a topographic plan of the same scale;
- n - coefficient of riverbed roughness, the value of which depends on the slope of the ravine bed, by special calculations is equal to 0.111.

Table 5.3.3.6.2.2. Maximum levels of the pipeline crossing gorge

Section	Elevation of waterfront m. abs.	Lowest point of bottom m. abs.	Maximum water level			
			$\tau=100$ year, Q=15.8 m³/s	$\tau=33$ year Q=10.4 m³/s	$\tau=20$ year, Q=8.57ծ m³/s	$\tau=10$ year, Q=6,57 m³/s
Derivation	1400.50	1400,00	1401.10	1400.95	1400.90	1400.80

Table 5.3.3.6.2.3. Hydraulic elements of the diversion crossing ravine

Elevations m. abs.	Cross-elements	Sectin area ω m²	Flow width B m	Average depth H m	Flow slope i	Average celocity v m/s	Water flow Q m³/s
1400.50	Riverbed	0.67	5.00	0.13	0.280	1.21	0.81
1400.70	Riverbed	1.89	7.20	0.26	0.280	1.93	3.65
1401.00	Riverbed	4.48	10.1	0.44	0.280	2.75	12.3
1401.30	Riverbed	7.78	11.9	0.65	0.280	3.57	27.8
1401.60	Riverbed	11.6	13.3	0.87	0.280	4.34	50.3

The expected general washout depth of the said gorge bed is determined by the same method as discussed above. The parameters required for the calculation of the expected general washout depth of the bed of the unnamed ravine, parameters and self-washout depths are given in Table 5.3.3.6.2.4.

Table 5.3.3.6.2.4. Parameters required for the calculation of the general washing depth of the river Bakhvistskali and the unnamed ravine and the maximum washing depths

Section	$Q_{1\%}$ **m³/s**	$Q_{10\%}$ **m³/s**	i **riverbed**	n	B **m**	K	d_{sash} **m**	K_1	μ **g/l**	$R=h$ **m**	y	$\cdot H_s$ **m**	H_{max} **m**
River Bakhvistskali													
Source	112	37.0	0.0149	0.054	25.2	2.6	0.10	1.60	4.07	1.40	0.333	2.37	**3.80**
Upper bridge	112	37.0	0.0150	0.054	25.2	2.6	0.10	1.60	4.07	1.29	0.338	2.36	**3.78**
Building	126	41.6	0.0430	0.070	23.0	2.8	0.20	1.20	24.4	1.21	0.395	2.60	**4.16**
Lower bridge	126	41.6	0.0203	0.058	24.8	2.6	0.135	1.60	8.01	1.77	0.332	2.53	**4.05**
Nameless large ravine													
Penstock crossing	15.8	6.59	0.280	0.111	7.90	3.2	0.30	0.70	626	0.52	0.577	1.31	**2.10**

The maximum general washout depths in the last column of the given table 5.3.3.6.2.4 should be measured below the corresponding level values for the maximum 100-year recurrence water flow.

It should be noted here that, according to the above method, the general washout depth of the bed is calculated only when the maximum water flow is passing through the alluvial beds. The method does not provide for the determination of deep erosion parameters of rivers in rocks, where the development of deep erosion is a rather long process. Thus, if at the section of the building bedrocks are observed above the washing depth, the building should be based on the bedrocks.

5.4 Biological Environment

5.4.1 Flora

5.4.1.1 Introduction

The presented floristic environmental impact document contains the flora description of the construction project corridor of Bakhvi 1 HPP planned in Chokhatauri (adjacent territory of Bakhmaro borough) and Ozurgeti (adjacent territory of Askana village) municipalities and the threats for the local flora expected during the planned construction works.

This report includes the assessment of the biological environment in the study area, the analysis of impact caused by the construction of the water intake, diversion-penstock system, camp, spoil ground, headwork and the HPP powerhouse, as well as various recommendations for the implementation of which mitigation of the impact effect is achieved. This information is presented in different chapters of the document.

The fieldworks were conducted in August 2020 and in October 2021.

The report also contains information on sensitive habitats and plant communities and species of various conservation value – included in the Red List of Georgia or endemic, relict and other rare species.

It should also be noted that the planned project area falls within the Key Biodiversity Area (KBA) of "Bakhmaro" (Zazanashvili, N., Sanadiradze, G. et al. 2020), according to the plan of „ECOREGIONAL CONSERVATION PLAN FOR THE CAUCASUS 2020 EDITION“ developed in 2020. Based on the plan, the project territory is located within the conservation landscapes of the “Western Lesser Caucasus”. It should also be noted that the Key Biodiversity Area (KBA) of Bakhmaro is not presented by any of the plant species.

Taking into account the interests of various stakeholders involved at the Bakhvi 1 HPP project development stage, in particular – local population, local government, non-governmental and business sector and as well as the conditions of the Scoping Opinion, CCEH Hydro VI has decided to invite SLR, an international consulting company with high credibility and reputation, to prepare additional assessments in the biodiversity research process. The company operates across 6 continents, has more than 100 offices in 13 countries and is represented by more than 1800 experts, and the specifics of its work include experience in consulting in more than 30 different areas. The company's team working on environmental and social issues has in-depth experience to provide services in the hydropower and energy transmission sectors. International consulting company SLR has been operating in Georgia since 2014.

International consulting company SLR carried out both the desk and field works in 2021, detailed information on the surveys is provided in Annex N4 and N8. At the planning and implementation stages of these studies, the current legislation of Georgia, as well as international norms and requirements, such as the Performance Standard (PS) 6[1] of the International Financial Corporation (IFC) and the Environmental and Social Standards (ESS) 3[2] of the European Investment Bank (EIB) have been taken into account.

5.4.1.1.1 General Characterization of the Region

The project territory is located in Adjara-Guria geo-botanical region of the Lesser Caucasus geo-botanical zone, which comprises the western part of the Lesser Caucasus (Adjara, Guria, uttermost south-west part of Imereti; the east border passes on Meskheti Range – on the meridian of Mefistskaro Mountain).

Vegetation cover of Adjara-Guria geo-botanical region is distinguished by abundance, diversity and the high degree of relictness throughout Georgia. Natural variety of vegetation is clearly depicted as in horizontal direction (due to the distance from the sea), so in hypsometric direction (related to the sea level) within the region. Colchis type of vegetation zoning is represented by three zones: forest, subalpine and Alpine zones (subnival zone is not developed).

The forest zone includes the foothill line, lower and middle zones of mountain, up to 1800-1850 m above the sea level. Vegetation of this zone is the most abundance and diverse. In accordance with the dominated main (zonal) formations, following sub-zones are singled out within the forest zone:

- Sub-zone of mixed broadleaf forests;
- Sub-zone of the beech forests;
- Sub-zone of dark coniferous forests.

Sub-zone of mixed broadleaf forests comprises the foothill line and the mountain lower zone, up to 100-1100 m above the sea level. Polydominant mixed broadleaf forests dominate, which are represented by the diverse variations. The leading forest forming species are as follows: Sweet chestnut (*Castanea sativa*), Oriental beech (*Fagus orientalis*), common hornbeam (*Carpinus caucasica*), Strandzha oak (*Quercus hartwissiana*), Cornish oak (*Quercus dschorochensis*), Black alder (*Alnus barbata*). Following species mix the forest: Caucasian Linden (*Tilia caucasica*), Norway maple (*Acer platanoides*), Wych elm (*Ulmus glabra*) and others. There are also coniferous species in some groves - Caucasian pine (*Pinus kochiana*) and Oriental spruce (*Picea orientalis*). Besides polydominant broadleaf forests, monodominant and bidominant forests are also observed, namely: Sweet chestnut (*Castanea sativa*), Oriental beech (*Fagus orientalis*), common hornbeam (*Carpinus caucasica*), Cornish oak (*Quercus dschorochensis*) forests, beech-hornbeam, beech-chestnut and other forests. Majority of forests are relict type that is mainly stipulated by the evergreen Colchic underbrush well-developed in the forest groves. The underbrush is presented by cherry

[1]This document is available on the following page: Performance Standard 6 (ifc.org)
[2]This document is available on the following page: Environmental and Social Standards (eib.org)

laurel (*Laurocerasus officinalis*), common rhododendron (*Rhododendron ponticum*), Black Sea holly (*Ilex colchica*), Colchis ivy (*Hedera colchica*) and others. Following relict shrubs form the underbrush within the groves of broadleaf forests: Caucasian whortleberry (*Vaccinium arctostaphylos*), yellow azalea (*Rhododendron luteum*) and others. Except the above listed species, endemic and species of narrow area are also observed within the main forest and undergrowth, namely: Ungern's rhododendro (*Rhododendron ungernii*), Smirnow rhododendron (*Rhododendron smirnowii*), epigea (*Epigea gaulterioides*), date-plum (*Diospyros lotus*), common fig (*Ficus carica*), boxwood (*Buxus colchica*), (Caucasian bladdernu (*Staphylea colchica*) and others. On the area of the felled forests thickets of Rhododendrons (*Rhododendron ponticum, Rh. ungernii*) are developed in the inverted valleys. Mixed broadleaf forests of the region are rich in Liana vegetation, epiphytes are also observed.

Sub-zone of the beech forests is stretched from 100-1100 m to 1500-1550 m, a.s.l. (in the littoral part of Adjara – up the sub-alpine zone). Pure beech forest (*Fagus orientalis*) and mixed forests with domination of beech, hornbeam-beech, chestnut-beech, fir-beech and other forests are observed in the sub-zone. Majority of beech forests are presented with the relict Colchis undergrowth (*Rhododendron ponticum, Rh. ungernii*, cherry laurel -*Laurocerasus officinalis*, Black Sea holly -*Ilex colchica*, Colchis ivy -*Hedera colchica*, Caucasian whortleberry - *Vaccinium arctostaphylos*, yellow azalea –*Rhododendron luteum* and others.). Besides the beech forests, mixed broadleaf and coniferous forests also dominate within the mentioned sub-zone, in particular: Caucasian fir (*Abies nordmanniana*), Oriental spruce (*Picea orientalis*), pine (*Pinus sosnowskyi*) forests. Endemic Cornish oak (*Quercus dschorochensis*) forest is spread in Adjara, on the dry slopes of south exposition within the beech forest sub-zone. Rhododendron (*Rhododendron ponticum, Rh. ungernii*) undergrowth is developed in the inverted valleys, forestless areas.

Sub-zone of dark coniferous forests is stretched from 1500-1550 m to 1800-1850 m. It is well depicted on the most territory of the region (Adjaristskali River valley, north slope of Meskheti Range). Following tree species dominate there: Oriental spruce (*Picea orientalis*), Caucasian fir (*Abies nordmanniana*), spruce-fir, beech-spruce-fir formations. Pure beech forests and beech-dark coniferous forests with domination of beech are also observed within the sub-zone. Majority of forests are presented with relict Colchis (evergreen, deciduous) undergrowth. Dark coniferous forests (spruce, fir, spruce-fir forests) with common rhododendron (*Rhododendron ponticum*), cherry laurel (*Laurocerasus officinalis*) and Caucasian whortleberry undergrowth are widely spread as well. Crooked forests of endemic relicts - Transcaucasian birch (*Betula medwedewi*) and Pontine oak (*Quercus pontica*) (these forests deeply invade from the sub-alpine to the forest zone in case of the proper relief conditions) of Colchis and Colchis-Lazistan areas are spread within the boundaries of the sub-zone.

The sub-alpine zone comprises the line from 1800-1850 m to 2500 m above the sea level. Vegetation cover of sub-alpines of the region is quite prominent with its structural organization and genesis.

Highland variations of the mountain forest formations widely contribute to the sub-alpine forests creation. These forests are as follows: Oriental beech (*Fagus orientalis*), sub-alpine Caucasian fir (*abies nordmanniana*), sub-alpine Oriental spruce (*Picea orientalis*), sub-alpine Scots pine (*Pinus ksosnowskyi*). Distribution of birch (*Betula litwinowii*) and maple (*Acer trautvwttwri*) is relatively limited. Crooked forests of Pontine oak (*Quercus pontica*) and Transcaucasian birch (*Betula medwedewi*) are widely spread in sub-alpine areas, the upper distribution border of these forests sometimes reaches even 2300-2400 m above the sea level. Degree of relictness of the sub-alpine forests of the region is quite high (abundance of relict formations and associations).

Georgian Snow Rose (*Rhododendron caucasicum*) is widely distributed within the sub-alpine scrub of the region and observed on all exposition slopes, except the south slope. From other scrubs Junipers (*Juniperus pygmaea, J. depressa*) and Caucasian whortleberry (*Vaccinium arctostaphylos, V. Myrtillus)* can be found.

Sub-alpine tall herbaceous plants are distinguished by abundance of Colchis species (*Inula magnifica, Pyrethrum macrophyllum, Telekia apeciosa,* etc.). Polydominant tall herbaceous vegetation dominates on the area. Sub-alpine meadows occupy the vast areas in the region. The secondary colonial bent (*Agrostis capillaris*) and forb- colonial bent meadows prevail there. Polydominant grain-forb meadows are also widely distributed, which are represented by numerous versions. From monodominant meadows cranesbills (*Geranium gymnocaulon*), windflower (*Anemone fasciculata*), small parcels of matgrasses (*Nardus glabriculmis*) and others can be found.

The Alpine zone is expressed on certain peaks, altitude of which is more than 2500 m a.s.l (Sakornia, Khino, Sanislo, etc.). Among the alpine meadows, polydominant grain-forb meadow prevails. Grain and cranesbills (*Geranium gymnocaulon*) meadows occupy the vast areas. Alpine Georgian Snow Rose (*Rhododendron caucasicum*) formations are spread on the northern slope.

Within the eastern border of the region, namely, on Arsiani Range (environs of Goderdzi Pass) fossil remains of plants of the pre-glacier period and imprints within the volcanic tuffs can be found there.

5.4.1.1.2 Survey Methodology

Flora assessment comprised the description-identification of plant species occurring through the entire project corridor, especially making detailed lists of vegetation cover observed within the areas of planned headworks, penstocks and power houses.

Along with identification and making lists of plant species, danger and endemic statuses for appropriate species have been also determined. Information on distribution of such species was included in the lists of all sample points.

Plants species identification was conducted according to the "Flora of Georgia" (Ketskhoveli, Gagnidze, 1971-2001) and other floristic lists (Czerepanov, 1995; Gagnidze, 2005). Taxonomic data and validity of species nomenclature was rechecked in the International Database of Plant Taxonomies (The Plant List Vers. 1, 2010). Floristic and geo-botanical characteristics of species distribution in the habitats of the study area were specified by the sources about Georgian forests and vegetation cover (Ketskhoveli, 1960, Gigauri 2000, Akhalkatsi, Tarkhnishvili, 2012). Hazard categories for plant species were determined according to the Georgian Red List (Decree 190 of 2014).

Braun-Blanquet assessment system (Braun-Blanquet, 1965; Conklin & Meinzholt, 2004; Bonham, 2013; Peet & Roberts, 2013) and related percentage coverage scale have been used for determination of species coverage. In the plots sampled by Shannon-Wiener index, Evenness a widely used feature in plant ecology, such as spatial distribution of species in the community was determined based on the analysis of percentage coverage of plant species and their total number (See Table 5.4.1.1.2.1.). Species occurrence was determined for the red-listed and endemic species, which is calculated by correlation of that number of the plots, where a specific species is observed, with total number of sampled plots. For example, if a walnut is observed in two plots out of 20 ones, then the walnut occurrence index (F_i) equals to 2/20=0.1. The closer index is to 1 the higher is probability of a species occurrence (Elzinga et al., 1998; Hill et al., 2005).

Table 5.4.1.1.2.1. Interconnection of projection coverings determination scales of plant species and percentage ratio of the projection coverings: traditional "Braun-Blanquet" scale, conservative Domin scale, Domin's modified the so called "Krajina" scale and widely used Carolina and New Zealand scales (Peet & Roberts, 2013).

Covering area	Braun-Blanquet	Domin	Krajina	Carolina	New Zealand
One specimen	r	+	+	1	1

Minor, sparsely distributed	+	1	1	1	1
0–1%	1	2	1	2	1
1–2%	1	3	1	3	2
2–3%	1	3	1	4	2
3–5%	1	4	1	4	2
5–10%	2	4	4	5	3
10–25%	2	5	5	6	3
25–33%	3	6	6	7	4
33–50%	3	7	7	7	4
50–75%	4	8	8	8	5
75–90%	5	9	9	9	6
90–95%	5	10	9	9	6
95–100%	5	10	10	10	6

Habitat type typical for each points, along with coordinates was included in the flora lists of locations of the sample points. Type of a habitat was defined based on the European Nature Information System, according to the EUNIS habitats lists. It should be noted that the EUNIS habitats classification is not fully adapted to the Georgian habitats; however, there are the primary data using of which the given classification was performed. Identification of habitats distributed within the project territory based on the EUNIS habitats categories was carried out according to "Terrestrial Habitats of Georgia as to the EUNIS Habitats Classification" (Batsatsashvili, Abdaladze, 2017).

5.4.1.1.3 Characterization of Habitats and Vegetation Cover of the Project Corridor

Construction project corridor of Bakhvi 1 HPP crosses 5 habitats: they are: sparse spruce-fir woodlands, alder woodlands on the riverbank terraces, beech woodland with Colchis undergrowth, sub-alpine meadows and moist or wet eutrophic and mesotrophic grassland. These habitats are classified as follows based on the habitats list of the European Nature Information System (EUNIS) (see Figure 5.4.1.1.3.1.).

- **G3.1H Oriental Spruce (*Picea orientalis*) forests;**
- **G1.1 Riparian and gallery woodland, with dominant alder, birch, poplar or willow;**
- **G1.6E13 Western Pontic rhododendron-oriental beech forests;**
- **E4 Alpine and subalpine grasslands;**
- **E3.4 Moist or wet eutrophic and mesotrophic grassland**

Based on the project corridor and the habitats of Georgia, each of them can be described as follows:

G3.1H Oriental Spruce (*Picea orientalis*) forests - *Picea orientalis*-dominated forests of the Caucasus and of the eastern Pontic Range.

<u>Phytocenosis</u>

Geranio iberici-Pinion orientalis

<u>Species</u>

Picea orientalis

<u>The corresponding class in other classification schemes</u>

European forest types 6.3.2 sub-alpine and Montane spruce forest and Montane spruce-fir mixed forest.

<u>Annex I of the EU Directive on the habitats</u>

Not represented in the European Union.

Photo material of this habitat is provided in Picture 5.4.1.1.3.1., while the list of main plants species composition of this habitat identified in the project corridor is given in Table 5.4.1.1.3.1.

Picture 5.4.1.1.3.1. Spruce-fir forest

Table 5.4.1.1.3.1. The list of main plants species composition for **G3.1H habitat**			
Habitat: **G3.1H Oriental spruce (*Picea orientalis*) forests**			
Latin name	**English name**	**Latin name**	**English name**
Picea orientalis	Oriental spruce	*Carex pendula*	Weeping sedge
Abies nordmanniana	Caucasian fir	*Salvia glutinosa*	Glutinous sage
Pinus kochiana	Caucasian pine	*Phylitis scolopendrium*	Hart's Tongue Fern
Laurocerasus officinalis	Cherry laurel	*Athyrium filix-femina*	Lady fern
Alnus barbata	Common alder	*Urtica dioica*	Common nettle
Hedera colchica	Colchis ivy	*Actaea spicata*	Baneberry
Hedera helix	Common ivy	*Luzula sylvatica*	Greater Wood Rush
Matteuccia struthiopteris	Ostrich Fern	*Fragaria vesca*	Wild strawberry
Oxalis corniculata	Creeping woodsorrel	*Myosotis sylvatica*	Wood Forget-Me-Not
Petasites albus	White butterbur	*Rubus sp.*	Blackberry
Ilex colchica	Colchic holly	*Sambucus nigra*	Black elder
Geranium robertanum	Herb-Robert	*Hesperis matronalis*	Damask-violet

G1.1 Riparian and gallery woodland, with dominant alder, birch, poplar or willow – is mainly presented with the common alder (*Alnus glutinosa*). It is developed both in the forest zone, as well as in the forestless areas, where it follows the riverbed as a narrow stripe. Photo material of this habitat is provided in Picture5.4.1.1.3.2, while the list of main plants species composition of this habitat identified in the project corridor is given in Table 5.4.1.1.3.2.

Picture 5.4.1.1.3.2. Riparian alder forest

Table 5.4.1.1.3.2. The list of main plants species composition for **G1.1 habitat**			
Habitat: **G1.1 Riparian and gallery woodland, with dominant alder, birch, poplar or willow**			
Latin name	**English name**	**Latin name**	**English name**
Alnus barbata	Common alder	*Swertia iberica*	-
Picea orientalis	Oriental spruce	*Hedera colchica*	Colchis ivy
Eunymus latifolia	-	*Viola alba*	White violet
Acer campestre	Field maple	*Matteuccia struthiopteris*	Ostrich Fern
Fraxinus excelsior	Common ash	*Smilax excelsa*	Catbriers
Rhamnus imeretina	Imeretian buckthorn	*Veronica filiformis*	Slender Speedwell
Phyllitis scolopendrium	Hart's-tongue fern	*Ruscus colchicus*	Colchis butcher's broom
Corylus avellana	Common hazel	*Myosotis sylvatica*	Wood Forget-Me-Not
Sorbus aucuparia	Rowan	*Asplenium trichomanes*	Maidenhair spleenwort
Sorbus graeca	Greek whitebeam	*Hedera helix*	Common ivy
Carpinus betulus	Common hornbeam	*Petasites albus*	White butterbur
Campanula alliarifolia	Ivory bells	*Pteritdium tauricum*	Fern
Alchemilla rigida	-	*Mentha longifolia*	Horse mint
Inula magnifica	Giant fleabane	*Rumex alpinus*	Monk's-rhubarb
Globularia trichosantha	Blue Globe Daisy	*Prunella vulgaris*	Common self-heal

G1.6E13 Western Pontic rhododendron-oriental beech forests – such forests can be found throughout the western Pontic region with prevailing of Oriental beech (*Fagus orientalis*), where it is frequently observed together with the Georgian oak (*Quercus iberica*) and cappadocian maple (*Acer laetum*). The undergrowth is resented by the various Colchic type plants: common rhododendron (*Rhododendron ponticum*), yellow azalea (*Rhododendron luteum*), Colchic ivy (*Ilex colchica*), Colchis ivy (*Hedera colchica*), Catbriers (*Smilax excelsa*) et.al. Photo material of this habitat is provded in Picture 5.4.1.1.3.3, while the list of main plants species composition of this habitat identified in the project corridor is given in Table 5.4.1.1.3.3.

Picture 5.4.1.1.3.3 Rhododendron-oriental beech forest

Table 5.4.1.1.3.3. The list of main plants species composition for **G1.6E13 habitat**			
Habitat: **G1.6E13 Western Pontic rhododendron-oriental beech forests**			
Latin name	**English name**	**Latin name**	**English name**
Fagus orientalis	Oriental beech	*Rhododendron ponticum*	Common rhododendron
Castanea sativa	Sweet chestnut	*Rhododendron luteum*	Yellow azalea
Acer laetum	Cappadocian maple	*Ilex colchica*	Colchic ivy
Alnus barbata	Common alder	*Athyrium filix-femina*	Lady fern
Quercus iberica	Georgian oak	*Salvia glutinosa*	Glutinous sage
Picea orientalis	Caucasian spruce	*Rubus caucasicus*	Blackberry
Tilia begonifolia	Lime-tree	*Hedera colchica*	Colchis ivy
Rhamnus imeretina	Imeretian buckthorn	*Smilax excelsa*	Catbriers
Frangula alnus	Alder buckthorn	*Phyllitis scolopendrium*	Hart's-tongue fern
Corylus avellana	Common hazel	*Hedera helix*	Common ivy
Euonymus latifolius	Spindle Tree	*Matteuccia struthiopteris*	Ostrich Fern
Swida australis	Dogwood	*Fragaria vesca*	Wild strawberry
Ribes alpinum	Mountain currant	*Rosa canina*	Dog rose
Paris incompleta	-	*Sambucus ebulus*	Danewort
Ruscus colchicus	Colchis butcher's broom	*Viola alba*	White violet
Sorbus graeca	Greek whitebeam	*Rubus hirtus*	blackberry
Carpinus betulus	Common hornbeam	*Pteridium tauricum*	Bracken
Vaccinium arctostaphylos	Caucasian whortleberry	*Astrantia maxima*	Largest masterwort
Rumex alpinus	Monk's-rhubarb	*Prunella vulgaris*	Common self-heal
Ribes biebersteinii	Currant	*Vaccinium myrtillus*	European blueberry

E4 Alpine and subalpine grasslands – Sub-alpine meadows (1800-2700 m) are distinguished by great floristic and phytosociological diversity. Its sub-types are as follows:

- Grass meadows
- Herbaceous and grass-herbaceous meadows

Photo material of this habitat is provided in Picture 5.4.1.1.3.4, while the list of main plants species composition of this habitat identified in the project corridor is given in Table 5.4.1.1.3.4.

Picture 5.4.1.1.3.4. Sup-alpine meadows

Table 5.4.1.1.3.4. The list of main plants species composition for **E4 habitat**			
Habitat: **E4 Alpine and subalpine grasslands**			
Latin name	**English name**	**Latin name**	**English name**
Picea orientalis	Oriental spruce	*Globularia trichosantha*	Blue Globe Daisy
Geranium psilostemon	Armenian cranesbill	*Salvia glutinosa*	Glutinous sage
Astrantia maxima	Largest masterwort	*Prunella vulgaris*	Common self-heal
Hieracium umbellatum	Narrowleaf hawkweed	*Urtica dioica*	Common nettle
Inula magnifica	Giant fleabane	*Helichrysum graveolens*	Immortelle
Digitalis schischkinii	Rusty Foxglove	*Actaea spicata*	Herb Christopher
Mentha longifolia	Horse mint	*Luzula sylvatica*	Greater wood-rush
Petasites albus	White butterbur	*Rubus sp.*	Blackberry
Rumex alpinus	Monk's-rhubarb	*Swertia iberica*	-
Geranium robertanum	Herb-Robert	*Fragaria vesca*	Wild strawberry
Gentiana septemfida	Crested gentian	*Myosotis sylvatica*	Wood Forget-Me-Not
Origanum vulgare	Oregano	*Vaccinium arctostaphylos*	Caucasian whortleberry
Veratrum lobelianum	-	*Vaccinium myrtillus*	European blueberry
Pteridium tauricum	Bracken	*Campanula alliarifolia*	Ivory bells
Alchemilla rigida	-	*Rumex scutatus*	Buckler sorrel
Hesperis matronalis	Damask-violet		

E3.4 Moist or wet eutrophic and mesotrophic grassland - Wet eutrophic and mesotrophic grasslands and flood meadows of the boreal and nemoral zones, dominated by grasses *Poaceae, rushes Juncus spp.* or *club-rush Scirpus sylvaticus.*

phytocenosis

Glycyrrhizion glabrae, Calthion palustris, Deschampsion cespitosae, Juncion acutiflori, Cnidion venosi; Agropyro-Rumicion, Molinion caeruleae, Arrhenatherion, Alopecurion pratensis, Filipendulion.

Species

E3.41: *Caltha palustris, Cirsium palustre = C. simple,= Cirsium hygrophiloides, Telekia speciosa, Epilobium parviflorum, Mentha aquatica, Scirpus sylvaticus, Stachys palustris, Geum rivale, Polygonum bistorta, Trollius europaeus, Lotus palustris, Trifolium dubium, T. fontanum, Equisetum palustre, E. telmateia= E. variegatum, Myosotis palustris, M. caespitosa, M. lazica, Oenanthe silaifolia = Oe. abchasica, Gratiola officinalis, Inula salicina = I. britanica, Succisella inflexa, Dactylorhiza majali = Dactyloriza euxina, Alopecurus pratensis, Festuca gigantea, Juncus effusus, J. filiformis.* **E3.43**: *Deschampsia cespitosa,* *Iris sibirica, Oenanthe lachenali = Oe. abchasica, Gratiola officinalis, Juncus atratus, Leucojum aestivum, Lythrum virgatum.* **E3.44:** *Juncus effusus, J. inflexus, J. compressus, J. tenuis, Carex hirta, Festuca arundinacea, Rumex crispus, Mentha longifolia, M. pulegium, Potentilla anserina, P. reptans, Ranunculus repens.* **E3.46:** *Alopecurus pratensis, Festuca pratensis, Deschampsia cespitosa, Polygonum bistorta, Angelica sylvestris, Scirpus sylvaticus, Caltha palustris, Pedicularis limnogena = P. palustris, Ligularia sibirica, Telekia speciosa*

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Sub-type E3.43 = 6440: Alluvial meadows of Cnidion dubii on riparian lowlands.

Photo material of this habitat is provided in Picture 5.4.1.1.3.5., while the list of main plants species composition of this habitat identified in the project corridor is given in Table 5.4.1.1.3.5.

Picture 5.4.1.1.3.5. Moist or wet eutrophic and mesotrophic grassland

One of the typical species - *Caltha palustris* (marsh-marigold) for E3.4 habitat

Table 5.4.1.1.3.5. The list of main plants species composition for **E3.4 habitat**			
Habitat: **E3.4 Moist or wet eutrophic and mesotrophic grassland**			
Latin name	**English name**	**Latin name**	**English name**
Colchicum umbrosum	Steven	*Globularia trichosantha*	-
Alchemilla sericea	-	*Salvia glutinosa*	Glutinous sage
Betonica officinalis	Common hedgenettle	*Prunella vulgaris*	Common self-heal
Cardamine bulbifera	Coralroot	*Urtica dioica*	Common nettle
Inula magnifica	Giant fleabane	*Alchemilla rigida*	-
Clinopodium vulgare	Wild basil	*Rumex scutatus*	Buckler sorrel
Juncus effuses	Common rush	*Luzula sylvatica*	Greater wood-rush
Petasites albus	White butterbur	*Myosotis sylvatica*	Wood Forget-Me-Not
Rumex alpinus	Monk's-rhubarb	*Trifolium pratense*	Red clover
Plantago major	Broadleaf plantain	*Silene latifolia*	White campion
Poa pretensis	Kentucky bluegrass	*Caltha palustris*	Marsh-marigold

Figure 5.4.1.1.3.5. A map of habitats through the project corridor of the planned Bakhvi 1 HPP

In terms of flora point of view, the project area of the planned Bakhvi 1 HPP is not distinguished by abundance of plant species included in the Red List of Georgia, only one species – sweet chestnut (*Castanea sativa*) is observed adjacent to the project corridor. However, there are lots of endemic species of the Caucasus through the planned HPP project corridor (see sub-paragraph: The Red-Listed and Endemic Species through the Project Corridor).

Overall, the total project area can be assessed as a moderately sensitive area, given the level of diversity of habitats and endemic species.

The accounting results of specific sections are provided in the additional plant species lists below.

The plant species list of the camp area of the planned Bakhvi 1 HPP, which is the moist or wet grassland, is given in Table 5.4.1.1.3.6.

Table 5.4.1.1.3.6. Camp area of the planned Bakhvi 1 HPP

Projective coverage of plants: 15%

Habitat: E3.4 Moist or wet eutrophic and mesotrophic grassland

List of species / Percentage coverage (%)

Latin name	English name	% coverage	Latin name	English name	% coverage
Colchicum umbrosum	Steven	4	*Inula magnifica*	Giant fleabane	+
Rumex alpinus	Monk's-rhubarb	2	*Clinopodium vulgare*	Wild basil	1
Rumex scutatus	Buckler sorrel	1	*Juncus effuses*	Common rush	2
Alchemilla sericea	-	2	*Globularia trichosantha*	-	1
Betonica officinalis	Buckler sorrel	1	*Salvia glutinosa*	Glutinous sage	1
Cardamine bulbifera	Coralroot	1	*Prunella vulgaris*	Common self-heal	2
Mentha longifolia	Horse mint	1	*Petasites albus*	White butterbur	2
Plantago major	Broadleaf plantain	2	*Urtica dioica*	Common nettle	2
Poa pretensis	Kentucky bluegrass	1	*Alchemilla rigida*	-	2
Luzula sylvatica	Greater wood-rush	1	*Silene latifolia*	White campion	2
Myosotis sylvatica	Wood Forget-Me-Not	1	*Caltha palustris*	Marsh-marigold	2
Trifolium pratense	Red clover	2			

The list of plant species of the planned Bakhvi 1 HPP spoil ground area that is the sub-alpine grass meadow is provided in Table 5.4.1.1.3.7.

Table 5.4.1.1.3.7. The planned Bakhvi 1 HPP spoil ground area

Plants projective coverage: 15%

Habitat: E4 Alpine and subalpine grasslands

List of species / percentage coverage (%)

Latin name	English name	% coverage	Latin name	English name	% coverage
Rumex alpinus	Monk's-rhubarb	3	*Swertia iberica*	-	1
Rumex scutatus	Buckler sorrel	2	*Rhododendron caucasucum*	Caucasian rhododendron	1
Geranium psilostemon	Armenian cranesbill	2	*Salvia glutinosa*	Glutinous sage	1
Astrantia maxima	Largest masterwort	1	*Prunella vulgaris*	Common self-heal	2
Urtica dioica	Common nettle	2	*Hieracium umbellatum*	Narrowleaf hawkweed	1
Digitalis schischkinii	Rusty Foxglove	2	*Actaea spicata*	Herb Christopher	1
Myosotis sylvatica	Wood Forget-Me-Not	2	*Campanula alliarifolia*	Ivory bells	1
Veratrum lobelianum	-	2	*Rubus sp.*	Blackberry	1
Gentiana septemfida	Crested gentian	3	*Vaccinium myrtillus*	European blueberry	2
Alchemilla rigida	-	2	*Fragaria vesca*	Wild strawberry	1

The list of plant species of the neighboring territory of the planned Bakhvi 1 HPP flood zone is provided in Table 5.4.1.1.3.8. It represents the sub-alpine grass meadow, partly mixed with spruce-fir forest elements.

Table 5.4.1.1.3.8. Flood zone of the planned Bakhvi 1 HPP

Plants projective coverage: 25%

Habitato: E4 Alpine and subalpine grasslands + G3.1H Oriental spruce (*Picea orientalis*) forests

The list of species / percentage coverage (%)

Latin name	English name	% coverage	Latin name	English name	% coverage
Picea orientalis	Oriental spruce	1	*Helichrysum graveolens*	Immortelle	2
Abies normanniana	Caucasian fir	1	*Rumex alpinus*	Monk's-rhubarb	3
Rhododendron ponticum	Common rhododendron	1	*Swertia iberica*	-	1
Rumex scutatus	Buckler sorrel	2	*Rhododendron caucasucum*	Caucasian rhododendron	1
Geranium psilostemon	Armenian cranesbill	2	*Globularia trichosantha*	-	1
Inula magnifica	Giant fleabane	1	*Salvia glutinosa*	Glutinous sage	1
Astrantia maxima	Largest masterwort	1	*Prunella vulgaris*	Common self-heal	2
Hieracium umbellatum	Narrowleaf hawkweed	1	*Urtica dioica*	Common nettle	2
Petasites albus	White butterbur	2	*Geranium robertanum*	Herb-Robert	2
Digitalis schischkinii	Rusty Foxglove	2	*Actaea spicata*	Herb Christopher	1
Mentha longifolia	Horse mint	1	*Luzula sylvatica*	Greater wood-rush	1
Veratrum lobelianum	-	2	*Rubus sp.*	Blackberry	1
Gentiana septemfida	Crested gentian	3	*Vaccinium myrtillus*	European blueberry	2
Alchemilla rigida	-	2	*Fragaria vesca*	Wild strawberry	1
Myosotis sylvatica	Wood Forget-Me-Not	2	*Campanula alliarifolia*	Ivory bells	1
Origanum vulgare	Oregano	1	*Fagus orientalis*	Oriental beech	+

The list of on-site observed plants of the riverbank alder woodland is given in Table 5.4.1.1.3.9. This habitat falls within the planned penstock corridor, where the vegetation is mixed with common alder (*Alnus barbata*) and oriental spruce (*Picea orientalis*); Imeretian buckthorn (*Rhamnus imeretina*) is a codominant species. The combination of the given communities is a low-sensitive habitat.

Table 5.4.1.1.3.9. The list of vegetation cover of one of the sections of the planned penstock area

Plants projective coverage: 45%

Habitat: G1.1 Riparian and gallery woodland, with dominant alder, birch, poplar or willow

The list of species / percentage coverage (%)

Latin name	English name	% coverage	Latin name	English name	% coverage
Alnus barbata	Common alder	4	*Swertia iberica*	-	2
Picea orientalis	Oriental spruce	1	*Alchemilla rigida*	-	2
Carpinus betulus	Common hornbeam	1	*Matteuccia struthiopteris*	Ostrich Fern	2
Acer laetum	Cappadocian maple	1	*Rumex alpinus*	Monk's-rhubarb	3
Rhamnus imeretina	Imeretian buckthorn	2	*Prunella vulgaris*	Common self-heal	2
Sorbus graeca	Greek whitebeam	1	*Pteridium tauricum*	Bracken	3
Corylus avellana	Common hazel	1	*Rumex scutatus*	Buckler sorrel	1
Vaccinium myrtillus	European blueberry	2	*Veratrum lobelianum*	-	2
Sorbus aucuparia	Rowan	1	*Gentiana septemfida*	Crested gentian	2
Laurocerasus officinalis	Cherry laurel	1	*Campanula alliarifolia*	Ivory bells	2
Rhododendron ponticum	Common rhododendron	1	*Urtica dioica*	Common nettle	2
Ilex colchica	Colchic holly	+	*Salvia verticillata*	Whorled clary	2

Ruscus colchicus	Colchis butcher's broom	1	*Oplismenus undulatifolius*	Wavyleaf basketgrass	2
Petasites albus	White butterbur	2	*Hesperis matronalis*	Damask-violet	1
Hypericum perforatum	Perforate St John's-wort	2	*Geranium psilostemon*	Armenian cranesbill	2
Astrantia maxima	Largest masterwort	2	*Hieracium umbellatum*	Narrowleaf hawkweed	2
Inula magnifica	Giant fleabane	2	*Mentha aquatica*	Water mint	1
Trifolium ambiguum	Caucasian clover	2	*Helleborus caucasica*	Hellebores	1

Table 5.4.1.1.3.10. provides the list of plant species of the beech-common rhododendron forest through the section of the penstock planned within the corridor of Bakhvistskali River. It should be noted that the penstock area partly (for details see Figure N2 – the map of habitats) falls within this habitat (beech-common rhododendron). In the mentioned forest, the plants' species composition does not vary dramatically, only a decrease or increase (according to sections) in the total projection coverage of plants of a particular species is observed. Therefore, a single list was compiled for the entire area of this penstock that crosses the beech-common rhododendron forest. The territory is a medium sensitive area, where the Colchis type evergreen shrubs are developed, there are lots of sweet chestnut (*Castanea sativa*) – the species included in the Red List of Georgia.

Table 5.4.1.1.3.10. The list of plant species through the penstock area planned within the corridor of Bakhvistskali River

Plants projective coverage: 70%

Habitat: G1.6E13 Western Pontic rhododendron-oriental beech forests

The list of species / percentage coverage (%)

Latin name	English name	% coverage	Latin name	English name	% coverage
Fagus orientalis	Oriental beech	5	*Petasites albus*	White butterbur	1
Castanea sativa	Sweet chestnut	1	*Hedera colchica*	Colchis ivy	2
Picea orientalis	Oriental spruce	1	*Smilax excelsa*	Catbriers	2
Rhododendron ponticum	Common rhododendron	4	*Urtica dioica*	Common nettle	2
Alnus barbata	Common alder	2	*Hesperis matronalis*	Damask-violet	1
Carpinus betulus	Common hornbeam	1	*Pteridium tauricum*	Bracken	3
Quercus iberica	Georgian oak	1	*Prunella vulgaris*	Common self-heal	2

Acer laetum	Cappadocian maple	1	*Campanula alliarifolia*	Ivory bells	2
Frangula alnus	Alder buckthorn	1	*Hedera helix*	Common ivy	2
Tilia begonifolia	Lime-tree	1	*Phyllitis scolopendrium*	Hart's-tongue fern	3
Laurocerasus officinalis	Cherry laurel	1	*Matteuccia struthiopteris*	Ostrich Fern	2
Ilex colchica	Colchic holly	2	*Athyrium filix-femina*	Lady fern	2
Frangula alnus	Alder buckthorn	1	*Rubus caucasicus*	Blackberry	2
Corylus avellana	Common hazel	1	*Sambucus ebulus*	Danewort	1
Euonymus latifolius	Spindle Tree	1	*Salvia glutinosa*	Glutinous sage	2
Swida australis	Dogwood	1	*Rosa canina*	Dogrose	1
Ribes alpinum	Mountain currant	2	*Rubus hirtus*	Blackberry	1
Paris incompleta	-	2	*Astrantia maxima*	Largest masterwort	2
Ruscus colchicus	Colchis butcher's broom	2	*Vaccinium myrtillus*	European blueberry	2
Sorbus graeca	Greek whitebeam	2	*Viola alba*	White violet	2
Vaccinium arctostaphylos	Caucasian whortleberry	2	*Fragaria vesca*	Wild strawberry	2
Rumex alpinus	Monk's-rhubarb	3	*Ribes biebersteinii*	Currant	1

Table 5.4.1.1.3.11. provides the list of plants' species of the spruce-fir forest habitat through the penstock area planned within the Bakhvistskali River corridor. It should be noted that the part of the penstock will pass through this habitat (spruce-fir). In the mentioned forest, the plants' species composition does not vary dramatically, only a decrease or increase (according to sections) in the total projection coverage of plants of a particular species is observed. Therefore, a single list was compiled for the entire area of this penstock that crosses the spruce-fir forest.

Table 5.4.1.1.3.11. The list of plant species through the penstock area planned on the left bank of Bakhvistskali River

Plants projective coverage: 70% HAbitat: G3.1H Oriental spruce (*Picea orientalis*) forests	
The list of species / percentage coverage (%)	

					
Latin name	**English name**	**% coverage**	**Latin name**	**English name**	**% coverage**
Picea orientalis	Oriental spruce	5	*Carex pendula*	Weeping sedge	2
Abies nordmanniana	Caucasian fir	3	*Salvia glutinosa*	Glutinous sage	2
Pinus kochiana	Caucasian pine	2	*Phylitis scolopendrium*	Hart's Tongue Fern	2
Laurocerasus officinalis	Cherry laurel	2	*Athyrium filix-femina*	Lady fern	2
Alnus barbata	Common alder	1	*Urtica dioica*	Common nettle	2
Hedera colchica	Colchis ivy	4	*Actaea spicata*	Herb Christopher	1
Hedera helix	Common ivy	4	*Luzula sylvatica*	Greater wood-rush	3
Matteuccia struthiopteris	Ostrich Fern	2	*Fragaria vesca*	Wild strawberry	2
Oxalis corniculata	Creeping woodsorrel	1	*Myosotis sylvatica*	Wood Forget-Me-Not	2
Petasites albus	White butterbur	3	*Rubus sp.*	Blackberry	2
Ilex colchica	Colchic holly	2	*Sambucus nigra*	Black elder	1
Geranium robertanum	Herb-Robert	2	*Hesperis matronalis*	Damask-violet	2

Table 5.4.1.1.3.12. provides the list of plant species through the power house area of Bakhvi 1 HPP. This territory is a beech forest habitat mixed with the riverbank alder (*Alnus barbata*) habitat, where the oriental spruce (*Picea orientalis*) is also observed. The combination of these communities represents the medium sensitive habitat.

Table 5.4.1.1.3.12. Vegetation of the planned Bakhvi 1 HPP power house area	
Plants projective coverage: 40% Habitat: G1.6E13 Western Pontic rhododendron-oriental beech forests + G1.1 Riparian and gallery woodland, with dominant alder, birch, poplar or willow	

The list of species / percentage coverage (%)					
Latin name	**English name**	**% coverage**	**Latin name**	**English name**	**% coverage**
Alnus barbata	Common alder	2	*Pteridium tauricum*	Bracken	3
Fagus orientalis	Oriental beech	3	*Phyllitis scolopendrium*	Hart's-tongue fern	2
Tilia begonifolia	Lime-tree	+	*Matteuccia struthiopteris*	Ostrich Fern	2
Picea orientalis	Oriental spruce	+	*Urtica dioica*	Common nettle	2
Acer laetum	Cappadocian maple	1	*Trachystemon orientalis*	Early-flowering borage	2
Laurocerasus officinalis	Cherry laurel	1	*Campanula alliarifolia*	Ivory bells	2
Rhododendron ponticum	Common rhododendron	2	*Oplismenus undulatifolius*	Wavyleaf basketgrass	2
Ilex colchica	Colchic holly	1	*Heracleum sosnowskyi*	Sosnowsky's hogweed	2
Hedera colchica	Colchis ivy	2	*Prunella vulgaris*	Common self-heal	1
Hedera helix	Common ivy	3	*Smilax excelsa*	Catbriers	2
Petasites albus	White butterbur	2	*Paris incompleta*	-	2
Polypodium vulgare	Common polypody	2	*Rumex acetosa*	Garden sorrel	1
Salvia glutinosa	Glutinous sage	2	*Senecio rhombifolius*	groundsel	2

5.4.1.2 Red-Listed and Endemic Species of the Project Area

Latin name	English name	Red List of Georgia	Endemism/Relictness	IUCN
Castanea sativa	**Sweet chestnut**	VU	-	LC
Laurocerasus officinalis	**Cherry laurel**	-	Flora relict species of the tertiary period	-
Rhododendron ponticum	**Common rhododendron**	-	Flora relict species of the tertiary period	-

Rhododendron caucasicum	**Georgian Snow Rose**		Endemic species of the Caucasus	-
Hedera colchica	**Colchis ivy**	-	Sub-endemic species of the Caucasus	-
Ilex colchica	**Colchic holly**	-	Registered from Kolkheti. Besides the Caucasus is grows in Stranja (Bulgaria) and Chaneti (Asia Minor).	-
Geranium psilostemon	**Armenian cranesbill**	-	Endemic species of the Caucasus	-
Paris Incompleta	-	-	Endemic species of the Caucasus	-
Ruscus colchicus	**Colchis butcher's broom**	-	Endemic species of the Caucasus	-
Astrantia maxima	**Largest masterwort**	-	Endemic species of the Caucasus	-
Hieratium umbellatum	**Canadian hawkweed**	-	Endemic species of the Caucasus	-
Inula magnifica	**Giant fleabane**	-	Endemic species of the Caucasus	-
Digitalis schischkinii	Rusty Foxglove	-	Endemic species of the Caucasus	-
Rhamnus imeretina	**Imeretian buckthorn**	-	Endemic species of the Caucasus	-
Helleborus caucasica	**Hellebores**	-	Endemic species of the Caucasus	-

The impact on plant species found within the Bakhvi 1 HPP project area can be assessed as a medium degree.

The international consulting company – SLR has also studied the habitat.

The survey included the desk studies implemented based on the review of various available documentation and the obtainment the data from open sources on the internet, in this phase of the survey, the following documents were reviewed:

- Gamma (2012): The Environmental Impact Assessment Report on the construction and operation of 9.8MW Bakhvi 3 HPP planned on Bakhvistskali River in Ozurgeti municipality. Author – Gamma Consulting Ltd;
- Gamma (2019): The Environmental Impact Assessment Report on the construction and operation of Bakhvi 2 HPP planned on Bakhvistskali River in Ozurgeti municipality. Author – Gamma Consulting Ltd;
- AquaGE (2018): Bakhvi 3 HPP, the report on the monitoring of the aquatic environment, zoological and aquatic biodiversity during the period of the HPP's commissioning, 2018;
- AquaGE (2019): Bakhvi 3 HPP, the report on the monitoring of the aquatic environment, zoological and aquatic biodiversity after the HPP's commissioning. Annual report 2019;
- AquaGE (2020): Bakhvi 3 HPP, the report on the monitoring of the aquatic environment, fish fauna and wildlife during the operation period. Annual report 2020;
- CCEH (2021): Scoping study of Bakhvi 1 HPP;
- SLR, 2019. The projects of development of the electricity transmission network of Georgia. Environmental and Social Impact Assessment (ESIA) report, Vol 3, Biodiversity. Tbilisi: SLR Consulting LLC, on behalf of the Georgian State Electrosystem (GSE).

Information on visual detection of species, as well as, the data of the previous survey in Bakhmaro/Ukanava territory are provided in the report.

As for open source data search via the Internet, the table below lists the websites from where the data was used in the research process; relevant data are present in the appropriate sub-paragraph of the report.

Provider/source	**Link**	**Use or type of provided information**
European Environment Agency	https://emerald.eea.europa.eu/	**Emerald Network –** Information on the area and species
BirdLife International - Datazone	http://datazone.birdlife.org	**KBA and IBA sites** – Information on the area and species
Global forest watch	https://www.globalforestwatch.org/map/	Information on the soil cover and forest types is provided
IBAT	https://www.ibat-alliance.org/	Information on **protected areas and species** is provided
IUCN Red List	https://www.iucnredlist.org/	Data on the **protected species**
GBIF	https://www.gbif.org/	**Biodiversity data portal**
Protected Planet	https://www.protectedplanet.net/en	Information on **protected areas**
Alliance for Zero Extinction (AZE)	https://zeroextinction.org/	Information on **AZE territories** and their species
Amphibian web	https://amphibiaweb.org/index.html	Information on reduction of amphibians, natural history, conservation and taxonomy.
Fish Base	http://www.fishbase.org/	Information on fish species.
Global 200 Ecoregions WWF	https://www.worldwildlife.org/publications/global-200	Data on eco-regions.
IUCN Ecosystems	https://iucnrle.org/assessments/	Information on the status of various ecosystems.
Georgia: Government	https://apa.gov.ge/en/protected-areas/managedReserve	Information on the protected areas of Georgia.
Special Protection Areas (SPA) for birds in Georgia	http://aves.biodiversity-georgia.net/	Information on the Special Protection Areas (SPA) for birds in Georgia

Habitat mapping and fauna surveys were conducted in the area. As for the study of fish fauna, it was mostly carried out on Bakhvistskali River in the study area, although the territory was slightly expanded from Bakhvi 3 HPP to the lower reaches, as it was considered to fill the data obtained through the study area.

The survey was conducted beyond the main study area, in 15 km radius from the existing infrastructure for the assessment of the protected areas.

Besides the assessment of the project area, the study area of the habitats of the specified project corridor has been increased, for instance, the study of species having the conservation status (Critically Endangered (CR), Endangered (EN) and Vulnerable (VU)) was conducted via iBAT over a 50 km radius. European Nature Information System (EUNIS) have been used for the habitats' mapping. The EUNIS Habitat Classification is a comprehensive, Pan-European system for habitat identification. The classification is hierarchical and includes all types of habitats, from natural to artificial and from freshwater to the sea. The types of habitats are identified by a specific code, name, and description that is fully published online

(EAA, 2021). The EUNIS classification system may also be used to identify conservation habitats, as listed in the Revised Annex of Resolution 4 (1996) of the Bern Convention on endangered natural habitats types using the EUNIS habitat classification (year of revision 2014) and which is signed by Georgia as well.

In each habitat that was deemed to exist within the study area, 10x10 m plot has been allocated to confirm the various types of habitats. Vegetation cover of each plant species was identified and accounted according to the Braun-Blanquet scale (Braun-Blanquet, 1972), which is summarized in the table below. The change of a habitat change was carried out by a manual GPS (Garmin 62S), where the initial and final points of each habitat were marked and mapped. Species recorded in each plot were used for inventory of species in the study area, as well as to determine whether there were any conversion species (according to IUCN and Georgian Red Lists) or not there. Invasive species were also recorded, both during the inventory and when moving through the study area. Invasive species were identified in the textbook – "The Alien Flora of Georgia" (Kikodze, 2010).

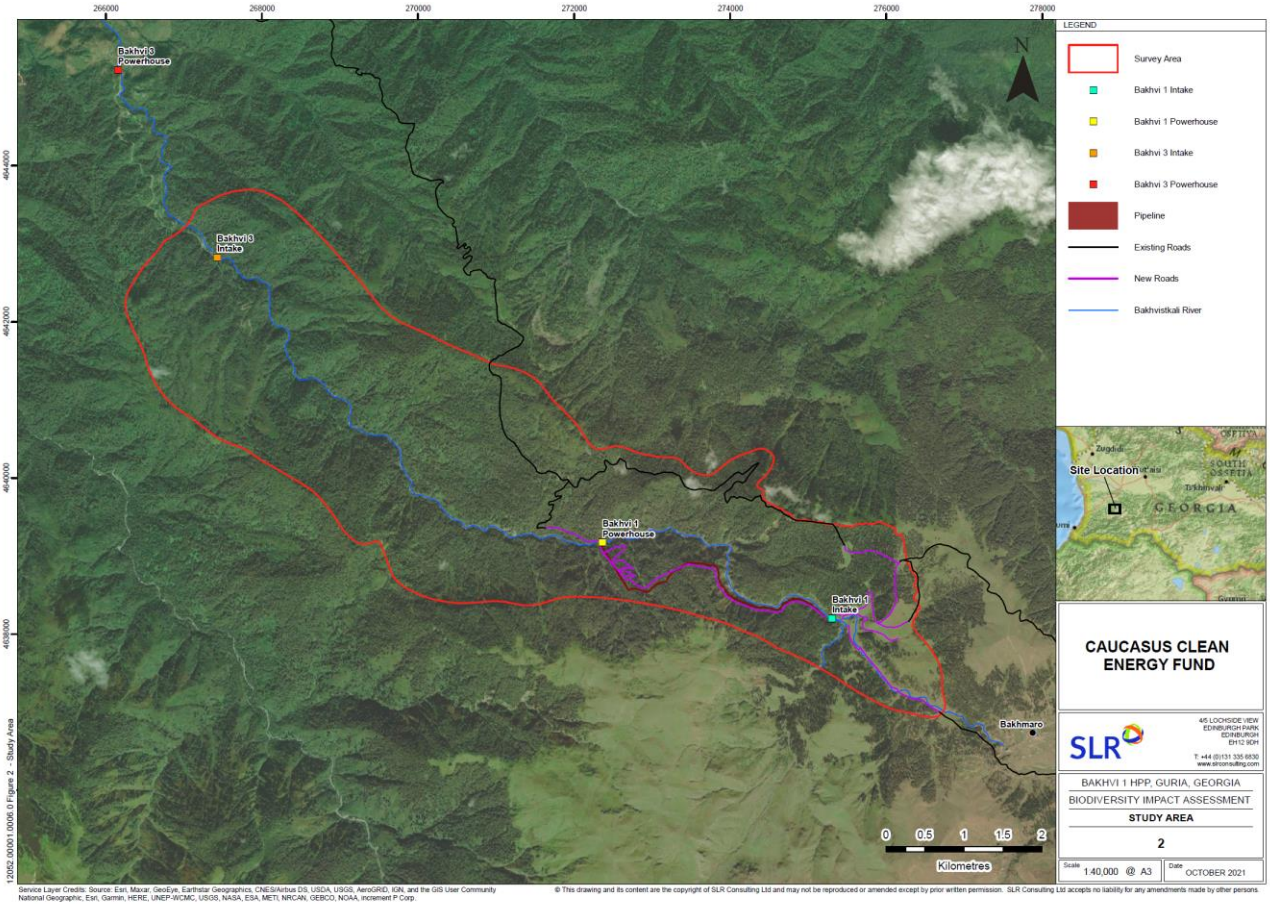
Since the field survey was completed, the EUNIS Habitat Classification Key for Georgia (Abdaladze O., 2019) was used to identify the habitat in the study area. Mapping was initially done with open source spatial data, then ESRI ARC GIS software was used. The smallest unit used in compiling the map was 1 ha; if an interesting feature covered the less area than the marked one, then a symbol was used to mark this area.

Symbol	Description
r	Rare, as a rule one individual plant
+	2 – 5 units, cover < 5%
1	6 – 50 units, cover < 5%
2	Infinite quantity, 5-15% cover
3	Infinite quantity, 15-25% cover
4	Infinite quantity, 50-75% cover
5	Infinite quantity, 75-100% cover

Habitat types were also given colored codes to simplify the visualization of their location to make it easier to perceive.

In frames of the desk survey, the iBAT survey, which covered a radius of 50 km, gave us the information about a relatively rare fungus that is recorded in the nearby area and therefore, it could have been potentially present in the study area as well. Hence, if it is observed during the vegetation survey process, the found fungi were registered and detected.

Within the study of baseline condition, 11 tree species and 11 shrub species were identified. Totally, 81 grass species were recorded in various habitats. Only one species with the conservation status was detected – sweet chestnut *Castanea sativa,* which is Vulnerable (VU) according to the Red List of Georgia. The trees of sweet chestnut are generally observed in the *Castanea sativa* forest (G1.7D), which is additionally described in the table below.



Tree species	Shrub species	Grass species	Grass species	Grass species
Alnus barbata *Common alder* *Abies nordmaniana* *Caucasian fir* *Acer platanoides* *Norway maple* *Alnus incana* *grey alder* *Carpinus caucasica* *Caucasian Hornbeam* *"Castanea sativa sweet chestnut"* *Fagus orientalis* *oriental beech* *Sorbus torminalis* *wild service tree* *Tilia begoniifolia* *Linden*	*Hedera colchica* *Colchis ivy* *Ilex colchica* *Colchic holly* *Lauricerasus officinalis common laurel cherry* *Rhododendron luteum Yellow azalea* *Rhododendron ponticum Common rhododendron* *Rhuscus colchicus -* *Rosa sp. dog rose* *Rubus sp. blackberry* *Ruscus hypoglossum spineless butcher's-broom* *Vaccinium arctostaphylos Caucasian whortleberry*	*Alchemilla mollis* *garden lady's-mantle* *Alchemilla sericata Gold Strike* *Anthoxanthum odoratum sweet vernal grass* *Aslpenium trichomanes maidenhair spleenwort* *Asplenium scolopendrium hart's-tongue fern* *Athyrium filix-femina Lady fern* *Betonica officinalis Buckler sorrel* *"Campanula latifolia giant bellflower "* *Campanula sylvatica -* *Cardamine bulbifera* *Coralroot* *Carum caucasicum -* *Cerastium hollosteoides Common Mouse-Ear Chickweed*	*Geranium robertianum herb-Robert* *Heracleum mantegazzianum* *giant hogweed* *Hesperis matronalis damask-violet* *Hydrocotyle ramiflora -* *Hypericum linnaeroides St. John's wort* *Impatiens noli-tangere touch-me-not balsam* *Inula salicina Irish fleabane* *Juncus effusus common rush* *Lotus cornicullatus bird's-foot trefoil* *Luzula sp. wood-rush* *Menthalongifolia wild mint* *Myosotis scorpioides water forget-me-not* *Oxalis acetosella wood sorrel*	*Polystichumbraunii* *Braun's Holly Fern* *Potentila indicia* *mock strawberry* *Primula aldiga* *Primrose* *Prunella vulgaris common self-heal* *Pteridium album* *fern* *Pteridum teucrium* *Germanders* *Ranunculus sp.* *Buttercup* *Rumex acetosella* *red sorrel* *Salvia glutinosa glutinous sage* *Sedum album white stonecrop* *Sibbaldia parviflora -* *Silene latifolia* *white campion*

Tree species	Shrub species	Grass species	Grass species	Grass species
		Clinopodium nepeta lesser calamint *Cruciata laevipes crossword* *Dactylis glomerata cock's-foot,* *Dactylorhiza euxina spotted orchid* *Epilobium angustifolium Blooming Sally* *Epilobium montanum Broad-leaved Willowherb* *Equisetum palustre* *marsh horsetail* *Erigeron annuus* *annual fleabane* *Erigeron canadensis horseweed* *Euphorbia sp. spurge* *Filipendula ulmaria meadowsweet* *Fragaria vesca wild strawberry* *Fragaria vesca* *wild strawberry*	*Paris incompleta -* *Petasitesalbus white butterbur* *Petasiteshybridus butterbur* *Phleumphleoides Boehmer's cat's-tail* *Plantago lanceolatta ribwort plantain* *Plantago major broadleaf plantain* *Poa pratense Kentucky bluegrass* *Polygala vulgaris common milkwort* *Polygonum carneum knotweed* *Polygonum persicaria lady's thumb* *Polygonum thumbergii(invasive) knotweed* *Polypodium vulgare common polypody*	*Stachys machrantha big betony* *Stachys sylvatica hedge woundwort* *Symphytum officinale common comfrey* *Taraxacum officinale common dandelion* *Trifolium ambiguum Caucasian clover* *Trifolium medium* *zigzag clover ১* *Trifolium pratense* *red clover* *Trifolium repens* *white clove* *Urtica diocia* *common nettle* *Valerianatiliifolia* - *Veratrum lobelianum* - *Verbascum lychnitis white mullein* *Veronica serpyllifolia thyme-leaved speedwell*

Based on EUNIS classification system, 14 types of habitats were registered through the study area. They are summarized below and then described in more detail. The number in parentheses is the EUNIS code. There is a map below, where the location of these habitats is provided.

1. Permanent mesotrophic lakes, ponds and pools (C1.2)
2. Permanent non-tidal, fast, turbulent watercourses (C2.2)
3. Trampled mesophilous grasslands with annuals (E2.8)
4. Moist or wet eutrophic and mesotrophic grassland(E3.4)
5. Pontic alpenrose heaths (F2.226)
6. Riparian and gallery woodland, with dominant alder (G1.1)
7. Beech forests (parent category of G1.6E and G1.6H)
8. Pontic beech forests (G1.6E)
9. Caucasian beech forests (G1.6H)
10. Chestnut woodland (G1.7D)
11. Chestnut forests G1.7DA
12. Balkano-Pontic fir forests (G3.17)
13. Mixed fir - spruce - beech woodland (G4.6)
14. Arable land and market gardens (I1)

Information about the above listed habitats' types is given in more detail below.

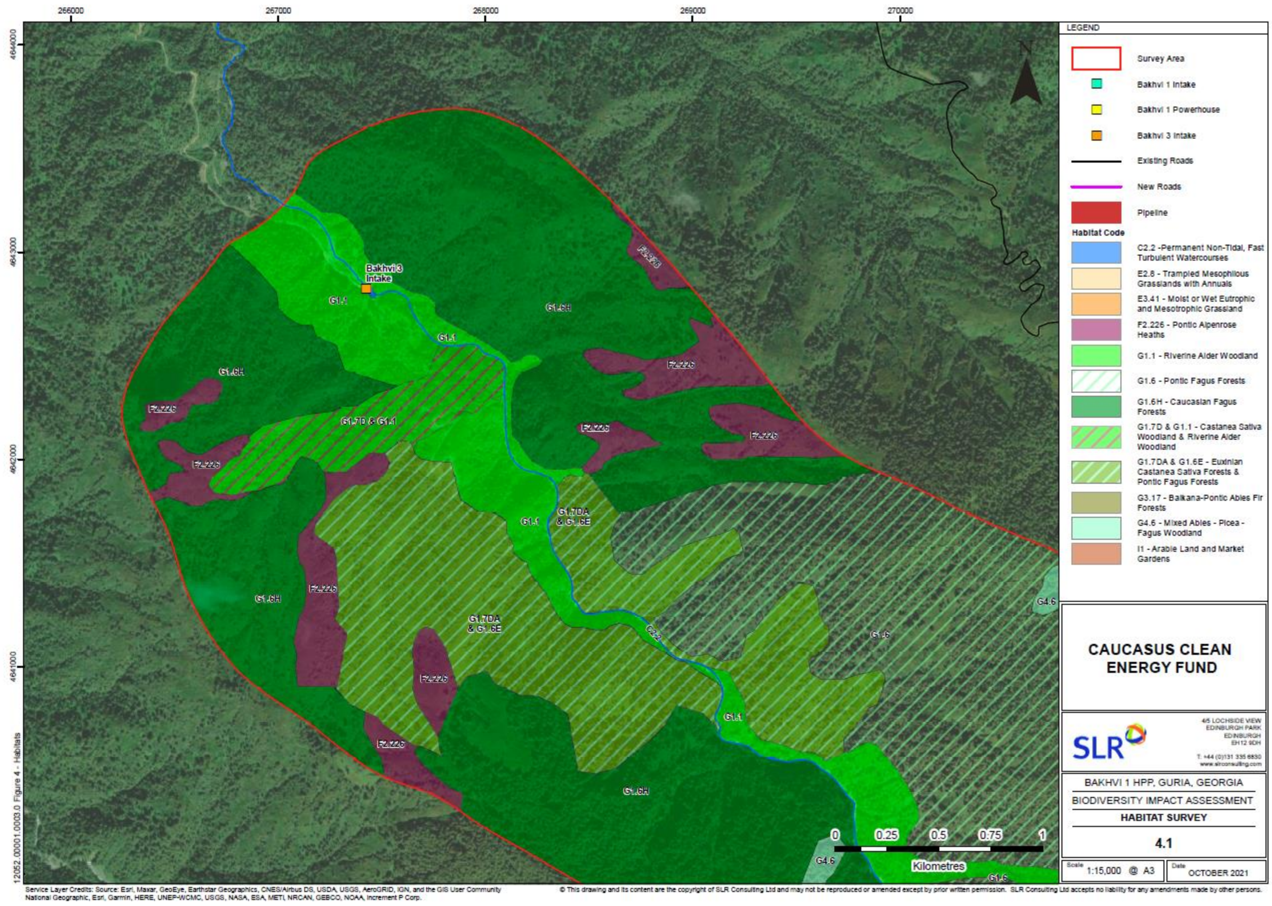
Permanent mesotrophic lakes, ponds and pools (C1.2) – this category merges with E3.4 and covers the area above the river Bakhvistskali, where brooks and water seepage are observed; water comes out of the surface of the earth and initially forms moist hollows, which are then transformed into small streams.

Several similar streams were observed near the site of water withdrawal, where the Caucasian salamander was observed. Due to the limited area of these habitats they are not shown on Map 5.

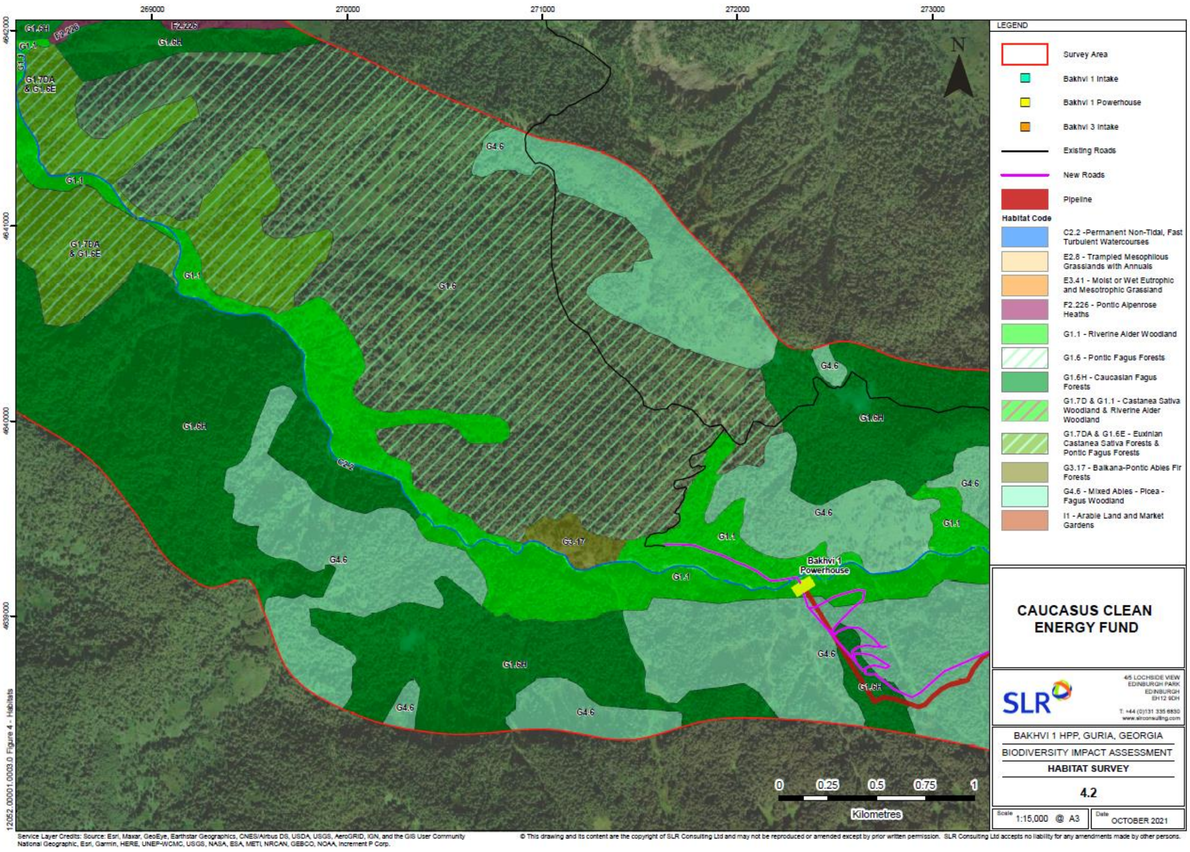
Permanent non-tidal, fast, turbulent watercourses (C2.2) – this category was used to describe the river Bakhvistskali and its tributaries. Water flows over rocks and boulders and rapids and riffles are formed, with small amount of sections, if any, where the water course flows without splashes and white water

Trampled mesophilous grasslands with annuals (E2.8)– mesophilous grasslands with annuals are developed along the river Bakhvistskali, on stony-sandy soil. It includes low annuals, such as the meadow grasses *Poa pratensis, Veronica serpyllifolia, Achillea sericea (syn. Achillea coarctata), Alchemilla sericata* and *Alchemilla mollis Polygala vulgaris*, *Lotus corniculatus.*

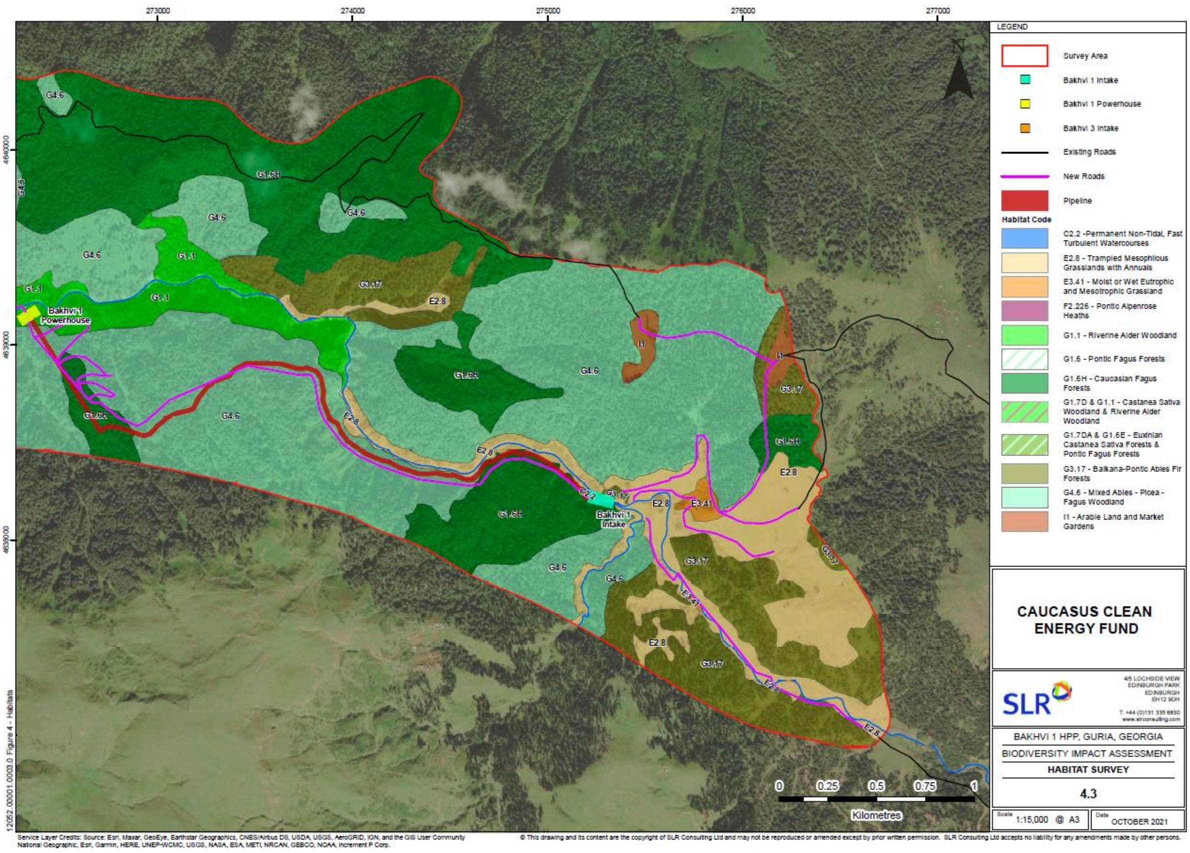
Survey of habitats (EUNIS)



Survey of habitats (EUNIS)



Survey of habitats (EUNIS)



Trampled mesophilous grasslands with annuals

Moist or wet eutrophic and mesotrophic grassland (E3.4)– it is a pasture with dominant grasses, such as *Poa pratensis* and rush species, e.g. *Juncus effusus.* Although the area of this habitat is limited, but is it quite favorable for the Caucasian salamander. As for the plant species, this habitat is favorable for spotted orchid *Dactylorhiza euxina,* which is a Near Threatened taxon, according to the IUCN Red List.

Moist or wet eutrophic and mesotrophic grassland

Pontic alpenrose heaths (F2.226) – through the project area, this habitat forms the heaths above the tree line, such as exposed ridges with a thin layer of soil. Rhododendron species *Rhododendron caucasicum, Rhododendron luteum,* and *Rhododendron ponticum* have been observed in this area.

Riparian and gallery woodland, with dominant alder (G1.1) – common alder *Alnus barbata* is dominant within the riparian alder forest massif through the study area. This habitat is located along the floodplain of the river Bakhvistskali and its tributaries. In some areas this habitat has been experienced and is still experiencing the strong anthropogenic impact due to the activities such as the logging. Oriental beech *Fagus orientalis* and Caucasian hornbeam *Carpinus caucasicus* are also present in small densities in those sections, where this habitat is formed. Frequently, the Rhododendron species - *Rhododendron ponticum* and butterbur *Petasites hybridus* are distributed in the lower storey of the forest.

Riparian alder forest massif

Beech forests (G1.6) – this is a parent category of G1.6E and G1.6H. The parent category was used when it was impossible to classify the forest as a more detailed category, or they are the Pontic or the Caucasian beech forests.

Pontic beech forests (G1.6E)– in the study area, the best description of this category would be the alder-chestnut forest with Colchic undergrowth, where the sweet chestnut *Castanea sativa* (included in the Red List of Georgia) and common alder are dominant. The most chestnut trees are medium and large in size, while the undergrowth is dominated by the endemic Colchis species, such as Colchis ivy *Hedera colchica* and Cherry laurel *Laurocerasus officinalis (c.f. Prunus laurocerasus)*. *Rhododendron ponticum* is distinguished by the highest density in this habitat.

Caucasian beech forests (G1.6H)– Oriental beech *Fagus orientalis* and oriental hornbeam *Carpinus orientalis* mixed with alder *A.barbata* and Norway maple *Acer platanoides* is observed in the beech-hornbeam forests. The undergrowth of this forest includes various Rhododendrons - rhododendron*R.caucasucum, R.luteum,* Cherry laurel *Laurocerasus officinalis* and blackberry *Rubus sp.* Persian ivy *Hedera colchica*is is also distributed, which is lying the forest soil. Beech-hornbeam forest occupies the largest area in the study area. It is also noteworthy that some adult specimens have rotten roots and are damaged by parasites, and in some places the forest is felled.

Caucasian beech forests, beech and hornbeam

Chestnut woodlands (G1.7D) – Pontic beech and chestnut forests are present in the study area, where the following tree species are observed – sweet chestnut *Castanea sativa* (included in the Red List of Georgia, VU), oriental beech *Fagus orientalis,* Caucasian hornbeam *Carpinus caucasicus,* common alder *Alnus barbata,* lime-tree *Tiliabegonifolia* and Norway maple *Acer platanoides.* The undergrowth is dominated by Common rhododendron *Rhododendron ponticum,* Yellow azalea *Rhododendron luteum,* Colchic holly *Ilex colchica,* common laurel cherry *Lauricerasus officinalis, Rubus sp. Ruscushypoglossum.* The composition of trees trees forming each habitats is variable due to the deforestation, for instance, Rhododendron species are observed in the open groundl, where the deforestation took place.

Chestnut forests (G1.7DA) – Sweet chestnut *Castanea sativa* is dominant in these forests. In the study area, the forests include both natural forest and naturalized, artificial plantations. When surveying the valley, it is possible to easily see the white chestnut flowers in May/June.

Balkano-Pontic fir forests (G3.17) – mostly fir forests can be found in such habitat; as a rule Caucasian fir *Abies nordmanniana* is dominant there and is a relatively common habitat in the study area. It has the evergreen or deciduous undergrowth, where the following species can be found: rhododendron *R.ponticum,* yellow azalea *R.luteum*or Caucasian whortleberry *Vaccinium actostaphylos and Rubus sp.*

Balkano-Pontic fir forest

Mixed fir - spruce - beech woodland (G4.6) – this type of forest is detected, when beech forests (G1.6) and its sub-categories are associated with Caucasian fir *Abies nordmanniana* in the study area.

Arable land and market gardens (I1) – this is quite a broad categoriy, it includes the arable lands, which are annually sown and harvested, this habitat does not include trees or shrubs. This type of habitat is mostly associated with farms and villages.

In frames of the fieldworks, only common and widespread fungus species were detected. The iBAT data survey confirmed that only one species, *Hygrocybe citrinovirens* is common in Georgia, all records are registered in the eastern part of Georgia, near Tskhratskaro and Tsalka districts. Therefore, it was considered that this species is not common in the study area.

Other species identified by the study of iBAT data: *Arrhenia discorosea, Flammulina ononidis, Hygrocybe ovina* and *Hygrocybe punicea* have not been observed in Georgia (Zvyagina, et al., 2015). It should be noted that the lack of survey data does not prove their absence, however, there is no suitable habitat for these species in the study area.

The following invasive species were observed during the survey:

- *Erigeron annuus* - grows along paths, roads and degraded habitats.
- *Erigeron(Conyza) canadensis* - grows along paths, roads and degraded habitats.
- *Polygonum thumbergii* - grows near rivers and wetlands

It should be noted that although the giant hogweed *Heracleum mantegazzianum* was observed in the study area, this species is indigenous for Georgia and is not considered as an invasive species, as in most parts of Europe.

Assessment of Critical Habitats

Critical Habitat Assessment (CHA) was conducted in compliance with the relevant international guidelines ((IFC, 2012),(IFC, 2019), and (EIB, 2018)) based on the basic survey results of biodiversity by the international consulting company SLR. The purpose of the assessment was to identify the areas of high biodiversity value and as well as, the areas that can be sensitive to the proposed project. The reason for identifying critical habitat areas is that PS6 and ESS3 require that in frames of the project, no activities should be implemented in the critical habitat area unless all of the following issues are demonstrated (excerpt from PS6):

- No other viable alternatives within the region exist for development of the project on modified or natural habitats that are not critical;
- The project does not lead to measurable adverse impacts on those biodiversity values for which the critical habitat was designated, and on the ecological processes supporting those biodiversity values;
- The project does not lead to a net reduction (net loss) in the global and/or national/regional population of any Critically Endangered or Endangered species over a reasonable period of time;
- A robust, appropriately designed, and long-term biodiversity monitoring and evaluation program is integrated into the client's management program

To demonstrate that this project meets the above requirements, the project's mitigation strategy (according to the hierarchy of mitigation measures) will be described in a Biodiversity Action Plan that involves the implementation of measures and appropriate guidelines to achieve net gains of those biodiversity values for which the critical habitat was designated.

Terms Used in Critical Habitat Assessment

Ecologically Appropriate Area of Analysis (EAAA) is a geographical area considered within the assessment of the critical habitat. This area is specific for each characteristic considered in the assessment. The approximate area of the project and its impact area are taken into account when determining the ecological area of analysis.

Area of Influence ((AOI)) is the minimum geographical area that is considered within the assessment of the identified characteristics and risks. In addition, Area of Influence ((AOI)) considers the project-expected impacts, such as the loss of habitat (temporary or permanent), hydrological changes and disturbance of the balance.

The Study area – this is the area of distribution that was surveyed during the flora and fauna study in 2021. It covers the presumable Area of Influence (AOI) determined for the period of the survey.

Ecologically Appropriate Areas of Analysis (EAAA) used for each characteristic are provided on a map.

Critical Habitat is any area of the utmost importance and priority for the planet in terms of biodiversity conservation. It considers priority systems both globally and nationwide, and is based on conservation biological principles such as "vulnerability" (degree of threat) and "irreplaceability" (rarity or uniqueness).

Critical habitat definition is based on the priority quantitative thresholds of biodiversity, which are substantially based on the globally accepted precedents, such as, the Criteria of the Red List of International Union for Conservation of Nature (IUCN) (updated in 2020) and the thresholds of the Key Biodiversity Areas KBA). The Red List of Georgia has been also considered for this project.

The identification of critical habitats is based on the five common criteria of PS6 and ESS3 [3] and is related to the quantitative thresholds of some of these criteria, which are summarized below:

- C1: Critically Endangered and/or Endangered Species; its thresholds are:
  a) Areas of globally important concentrations of EN or CR species included in the IUCN Red List (≥ 0.5% of the global population and ≥ 5% of reproductive units of CR or EN species).
  b) Areas of globally important concentrations of Vulnerable (VU) species included in the IUCN Red List, the loss of which will result in the change of status to EN or CR in the IUCN Red List and meets the above listed thresholds (see subparagraph "a" above).
  c) As appropriate, habitat containing nationally/regionally important concentrations of an EN, CR or equivalent national/regional listing.
- C2: Endemic and/or Restricted-Range Species, where the restricted area means Extent of Occurrence ((EOO)). It has the following thresholds:
  a) For terrestrial vertebrates and plants, restricted-range species is defined as those species, which have an extent of occurrence (EOO) of 50 000 km^2 or less.
  b) For marine systems, restricted-range species are provisionally being considered those with an extent of occurrence (EOO) of 100 000 km^2 or less.
  c) For coastal, river and other aquatic species, habitats with a width not exceeding 200 km at any point (eg rivers), a restricted-range area is defined as a global area equal to or less than 500 km geographical section (or, the distance between the furthest distribution sites).
- C3: Migratory and Congregatory Species:
  a) Areas known to sustain, on a cyclical or otherwise regular basis, the inhabiting environment for ≥ 1 % migratory or congregatory species at any point of the species' lifecycle.
  b) Areas kown to sustain the inhabiting environment for approximate ≥10 % of the global population during the period of the ecological stress.
- C4: Highly Threatened and/or Unique Ecosystems. Their thresholds are:
  a) Areas globally representing ≥5% of the ecosystem type that meet the IUCN CR or EN status criteria.
  b) Other areas not yet assessed by the IUCN but according to regional or national systemic conservation planning, considered to have a high priority for conservation.
- C5: Key Evolutionary Processes. Quantitative thresholds are not established for this criterion, however, the consultation document (IFC, 2019) provides examples of the range of areas associated with major evolutionary processes.

[3] There are no quantitative limits required for definition in ESS3.

Together with these five criteria provided in PS6 of IFC (C1 – C5), the sixth criterion will be also taken into consideration as it is a part of all the six factors in ESS3 used to determine a critical habitat:

- C6: Biodiversity or/and ecosystem having the significant social, economic or cultural importance for local communities and indigenous groups.

The IFC PS6 guidelines also require that if a project is located within or near the internationally and/or nationally recognized areas of high biodiversity value, such as Key Biodiversity Areas (KBAs), which encompass Important Bird and Biodiversity Areas (IBAs), it is necessary to be mapped these areas and to be considered within the assessment of a critical habitat. In this report, each characteristic of Key Biodiversity Areas and Important Bird and Biodiversity Areas have been considered in frames of the assessment of a critical habitat.

All the above-listed six criteria were assessed in relation to the project baseline condition and conservation characteristics. Each characteristic (or their combination) was assessed to determine if it was a critical habitat.

Natural and Modified Habitats

According to the requirements of PS6 and ESS3, Chapter 5 also includes the mapping of modified, natural or/and critical habitats identified within the project Area of Influence ((AOI)), as part of the risk and impact determination process. ESS3 recognizes that there is continuity between the modified and natural habitats given in PS6, so it provides an additional category - semi-natural habitats that is discussed below.

- **Modified habitats** (PS6), similar to urban habitats (ESS3), are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition. For this given project, such habitats are minimum, although it covers the hazel plantations or gardens.
- **Semi-natural habitats** have an ecological complex that is significantly modified by human activities in terms of structure, balance or function point of view. They could be formed as a result of traditional agricultural or other human activities and their existence depends on the preservation of their typical composition, structure and function. Although they are not natural habitats, but these habitats and ecosystems often have the high conservation value in terms of biodiversity and services. The grasslands near the Bakhvi 1 HPP water intake belong to the similar habitat.
- **Natural habitats** are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition. For this project, certain forested habitats, where deforestation has not historically been carried out, may have similar characteristics.

Critical habitat may be modified or natural habitats.

Impact Assessment

The impact assessment has been carried out by using the following guidelines:

- (IFC, 2019) International Finance Corporation's Guidance Notes: Performance Standards on Environmental and Social Sustainability, Guidance Document 6.
- (CIEEM, 2018) The Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine, version 1.1. Chartered Institute of Ecology and Environmental Management, Winchester.
- (EIB, 2018) European Investment Bank, Environmental and Social Standards. Environment, Climate and Social Office, Project Directorate. Determine the value of the characteristic.

Within the assessment of any impact, the initial step is to determine which characteristics need to be investigated in more detail – the assessment of critical habitat. Ecological recipients to be subject to a more detailed, risk-based assessment, must have a sufficient value that will influence them and may be significant in terms of the requirements of legislation, policy or IFC/EIB point of view. These recipients must also have the potential of vulnerability to the significant impact resulting from the development, or they should be located (fully or partly) within the Area of Influence ((AOI)). Species and characteristics subject to further assessment were determined as follows based on the conservation value:

- **Conservation status species** are those species included in the IUCN Red List (IUCN, 2021) or the Red List of Georgia as Vulnerable, Endangered or Critically Endangered. Conservation status species can also be those included in Annex II or IV of the EU Habitat Directive (European_Commission, 2021), in Annex I of the EU Birds Directive or/and in the 6th Resolution of Bern Convention (1998), which lists the species needed specific measure to protect a habitat (Europe, 2021)
- **Habitats of conservation importance** are areas, which provide a habitat for the significant populations of rare, endangered or endemic flora species, or/and areas that provide a relevant habitat for the conservation status species. Conservation importance of a habitat will be greater, if it is reflected in Annex I of the Habitats' Directive or in Resolution 4 of Bern Convention (1996), which lists endangered natural habitats that require specific protection measures.

Mitigation Strategy

Mitigation measures have been proposed for each evaluated characteristic, according to potential risks and impact assessment. If the impact is expected, it is recommended to avoid the impact on the conservation characteristics in compliance with the hierarchy of mitigation measures. However, it is not always available, therefore, the implementation of various mitigation measures is needed. Mitigation measures are summarized below; more detailed information is provided in the Biodiversity Management Plan. The mitigation strategy aims at preventing no net loss of biodiversity when net gain is required.

Biodiversity - No Net Loss/Net Gain

According to PR6 and ESS3, the project will seek to achieve no net loss of biodiversity. No net loss is defined as the point at which project-related impacts on biodiversity are balanced by measures taken to avoid and minimize the project's impacts. Based on PR6, mitigation measures will be carried out within the area of a natural habitat to achieve no net loss of biodiversity, where feasible.

If a project is implemented within the area of a critical habitat and the project activity results in the impact risk on a critical habitat, then, according to PR6, it is required to achieve net gain of biodiversity. Net gains are additional conservation outcomes that can be achieved for the biodiversity values for which the critical habitat was designated. Net gains may be achieved through the development of a biodiversity offset and/or, in instances where the client could meet the requirements of paragraph 17 of this Performance Standard (IFC, 2012) without a biodiversity offset, the client should achieve net gains through the implementation of programs that could be implemented in situ (on-the-ground) to enhance habitat, and protect and conserve biodiversity.

Determining and Evaluating Critical Habitat

The key steps in the process of identifying critical habitats and the impact assessment are as follows:

1. Consultation with stakeholders and the initial review of literature;
2. Collect field data and confirm available information;
3. Determine Ecologically Appropriate Areas of Analysis (EAAA);

4. Confirm which characteristics meet the critical habitat criteria;
5. Assess the potential impact of project activities;
6. Implement prevention measures;
7. Implement mitigation measures
8. Assess the possibility of achieving no net loss or net gain.

Based on desk studies of the preliminary field data (given in Section 3.1.), the list of those characteristics of biodiversity, which can meet the critical habitat criteria of IFC PS6/ESS3, have been compiled and all critical habitat triggers are discussed in this section.

Assessment of Critical Habitats

C1: Globally or nationwide Critically Endangered and/or Endangered Species

None of the plant species observed through the study area is Endangered or Critical. One observed species – sweet chestnut is included in the Red List of Georgia as Vulnerable. Therefore, no other plant species are additionally reviewed here.

In the terrestrial Ecologically Appropriate Areas of Analysis (EAAA), six potentially present fauna species are included in the Red List of Georgia or IUCN Red List as Endangered or Critically Endangered. Two additional Vulnerable species (IUCN Red List and/or Red List of Georgia (GRL)) – Caucasian Salamander and brook trout have been added to this list. Species, which have been confirmed or are likely to exist within the study area and those included in Annex I of the EU Birds Directive or Annex II of the Habitats' Directive, have also been considered with regard to Criterion C1 for compliance with the ESS3 requirements. And finally, the assessment also considers the species deemed to meet the criteria of Key Biodiversity Areas (KBAs) or Important Bird and Biodiversity Areas (IBAs) and are not reflected in previous categories. The list of species considered in this section is provided in the table below.

Key Biodiversity Areas (KBAs), which encompass Important Bird and Biodiversity Areas (IBAs).

Species considered in the assessment of critical habitat

Species	**IUCN status**	**Georgian status**	**European status**
Caucasian viper *Vipera kaznakovi*	EN	EN	
Rosalia longicorn *Rosalia alpine*	VU	EN	HD AII
African death's-head hawkmoth *Acherontia atropos*		EN	
Brown bear *Ursus Arctos*	LC	EN	AII/AIV
Lynx *Lynx lynx*	LC	CR	AII/AIV
Caucasian Salamander *Mertensiella caucasica*	VU	VU	N/A
Species protected in Europe (Annex 1 Birds and Annex II and IV Terrestrial Fauna) for ESS3			
Western Barbastelle *Barbastella Barbastellus*	NT	VU	AII/AIV
Bats – order of species			
Grey wolf *Canis lupus*	LC	-	AII/AIV
Otter *Lutra lutra*	NT	VU	AII/AIV

Species	IUCN status	Georgian status	European status
Caucasian squirrel *Sciurus anomalus*	LC	VU	AIV
Long-legged buzzard *Buteo rufinis*	LC	VU	AI
Griffon vulture Gyps fulvus	LC	VU	AI
Golden eagle *Aquila chrysaetos*	LC	VU	AI
Eastern imperial eagle *Aquila heliaca*	VU	VU	AI
Greater spotted eagle *Aquila clanga*	VU	VU	AI
European Nightjar *Caprimulgus europaeus*	LC		AI
European honey buzzard *Pernis apivorus*	LC	-	AI
Short-toed snake eagle Circaetus gallicus	LC		AI
European roller Coracias garrulous	LC		AI
Lesser spotted eagle*Clangapo marina*	LC	VU	AI
White stork Ciconia ciconia	LC	VU	AI
Black stork *Ciconia nigra*	LC	VU	AI
Woodlark *Lullula arborea*	LC	-	AI
Red-backed shrike *Lanius collurio*	LC	-	AI
Species determined within the biodiversity area not listed above			
Caucasian parsley frog *Pelodytes caucasicus*	NT		
Sedges *Carex carex*	LC		A1
Great snipe *Gallinago media*	NT		A1
Caucasian black grouse *Lyrurusmlo kosiewiczi*	NT		
Caspian snowcock *Tetraogallus caspius*	LC	VU	
Bechstein's Myotis *Myotis bechstenii*	NT	VU	AII/AIV
Geoffroy's bat *Myotis emarginatus*	LC		AII/AIV
Lesser horseshoe bat *Rhinolophus hipposideros*	LC		AII/AIV

- C1: Habitat that is important for Critically Endangered and/or Endangered Species; its thresholds are:
  a) Areas that support globally important concentrations of EN or CR species included in the IUCN Red List (≥ 0.5% of the global population and ≥ 5% of reproductive units of CR or EN species).
  b) Areas of globally important concentrations of Vulnerable (VU) species included in the IUCN Red List, the loss of which will result in the change of status to EN or CR in the IUCN Red List and meets the above listed thresholds (see subparagraph "a" above).

c) As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species.

Caucasian Viper *Vipera kaznakovi*

Information on the species

According to IUCN web page (IUCN, 2021), it is an endemic species of the Caucasus and Endangered. The area of its occupancy is along the Black Sea coast, Caucasus forested slopes up to 900 m above the sea level, starting from Turkey to Georgia, to Surami Pass in the east, in Kolkheti and ending in Mikhailovsky Pass in the west. From here this species spread to the northern slope of the Greater Caucasus. In general, its area of occupancy is divided into two parts, Adjara-Lazeti (Turkey and Adjara) and northern Kolkheti (western Georgia, Abkhazia and Krasnodar Territory in Russia). It is noteworthy that the Extent of Occurrence (EOO) defined by the IUCN does not include the study area.

Determine of Ecologically Appropriate Area of Analysis

Ecologically Appropriate Area of Analysis of this species is determined as an appropriate habitat (As explained by the open-source modelling and information provided on the IUCN website) located in the Key Biodiversity Area of Adjara-Imereti range, Map 8. Altitude is about 900 meters above sea level for this species, which means that the study area is not included in the EAAA. Map 8 also shows the Extent of Occurrence (EOO) defined for this species by the IUCN that only includes the western part of KBA.

Critical Habitat Assessment

Ecologically Appropriate Area of Analysis (EAAA) of this species does not belong to the study area, consequently, there is no critical habitat for the Caucasian viper in the study area.

Risk

In the project Area of Influence (AOI), presence of habitat relevant for this species is less expected, accordingly, there is no risk for this species.

Prevention

Removal of vegetation cover and earth works will start beyond the hibernation period (October-April/May) in forested and cleared areas. This will generally allow the reptiles to leave the construction area naturally.

Stone or earth/boulder piles formed in summer as a result of clearing works of working sites will not be removed/cleared until April/May, when reptiles emerge from hibernation and become active again.

A vehicle speed limit will be set in the project area to reduce the likelihood of killing the specimens lying under the sun while driving on the road.

Every morning, before the start of the work, ESG team will carry out the first field visit by the electric mountain bike, the ESG team or the relevant expert will be trained on how to remove the reptiles from the project corridor. Environmental officer or relevant expert find reptiles (amphibians and reptiles) in the RoW and remove from the dangerous area by taking appropriate measures. When it is considered that the RoW is free from reptiles, trucks and cars will be allowed to use the road. The team will also inspect the excavation site and trenches before starting work to check if reptiles and animals have fallen into the trenches and they will be safely removed if found.

Before starting work in the project, all workers will be instructed on the nature conservation issues. They will be instructed that if they find reptiles, they should not even harm or catch them, but should inform the environmental officer about it.

Mitigation

In frames of construction the power house, road and water intake, it is expected to extract boulders and remove trees. To compensate for the potential loss of a certain part of the reptiles' habitat, 10 winter hibernation sites for reptiles will be created in frames of the project. These winter hibernation sites will be made from wood, stones and other plants. The specification for its creation will be given in the Biodiversity Management Plan and they will be located on the southern or south-western slopes.

It should also be noted that fencing, which is proposed as a mitigation measure, will be useful for reptiles in general as access to the work area will be limited, which will further reduce the potential risk of crushing the specimens.

Compensation

In frames of the project, the program to raise awareness of wildlife in schools will be funded. This will be a program that includes training on reptiles. Raising awareness through teaching and learning will further reduce the killing of reptiles.

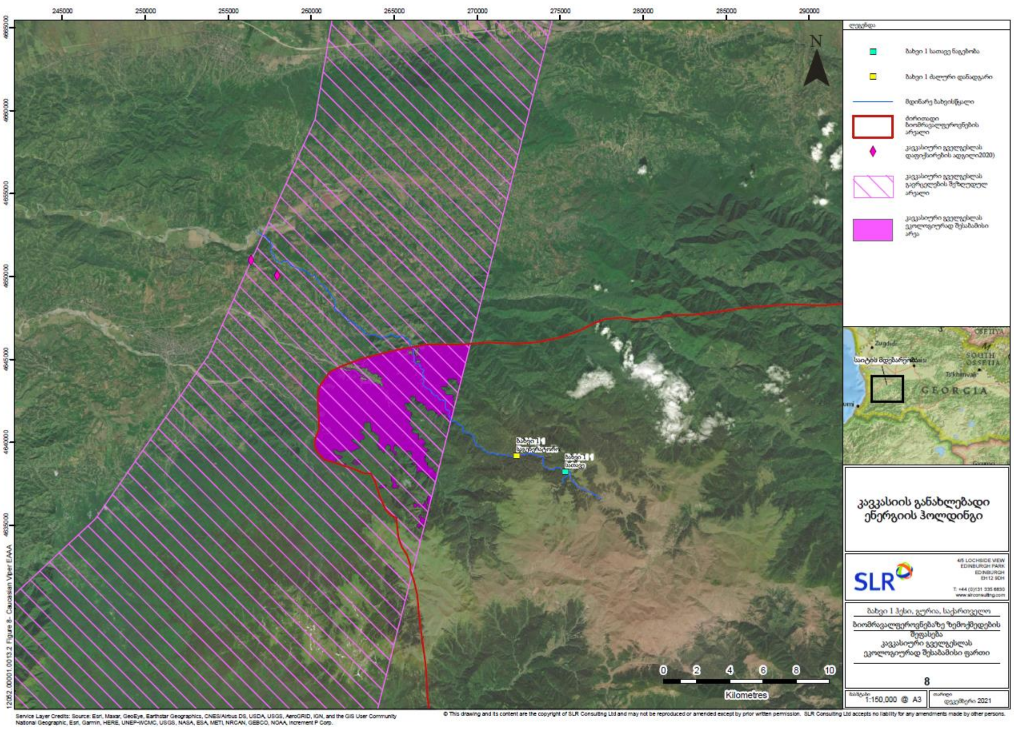
Monitoring

Considering the fact that this species forms a critical habitat there, the monitoring for this species is not proposed, but ESG team will record the reptiles observed during the inspection of the RoW and excavations, this information will be annually collected and attached to the report.

Final result

Caucasian viper has not been observed in the study area. Despite this, a number of mitigation measures will be implemented for reptiles and amphibians. It is estimated that no net loss of biodiversity will be achieved with regard to reptiles and amphibians by the implementation of preventive and mitigation measures. Through the awareness-raising campaign, which is a compensation measure, it is expected that even small net gain will be possible in the future.

Ecologically Appropriate Area of Analysis of the Caucasian viper



Rosalia longicorn Rosalia Alpina

Information about the species

It is widespread species in Europe, it is found in Germany and Poland, France and North Spain to Greece, in Turkey and Georgia in the west (Reissmann, 2010). In Central Europe *Rosalia alpina* prefers sparse, natural beech forests on the south or west slopes, from mountainous to sub-alpine region, up to 1500 m above the see level, it selects areas from 600 to 1000 m a.s.l. Rosalia longicorns emerge from the end of June to the beginning of September, they are maximum active in mid-July and mid-August. In southern Europe (probably including Georgia) this species uses dead or rotten trees for their lifecycle, such as beech *Fagus* and sycamore *Acer*but, as well as elm *Ulmus*, willow *Salix*, chestnut *Castane*a, ash *Fraxinus*, walnut *Juglans*, linden *Tilia*, oak *Quercus,* alder *Alnus* and hawthorn *Crataegus.* Dried or rotten trees, broken tree branches or damaged areas of otherwise healthy wood are suitable for their cycle of development.

Determine of Ecologically Appropriate Area of Analysis

Ecologically Appropriate Area of Analysis were determined as the "continuous" massifs of beech and other deciduous forests on the southern or southwestern slopes, at an altitude of 600-1,500 m, which is within the boundaries of this important biodiversity area, Map 9.

Critical Habitat Assessment

Due to the widespread of this beetle, a suitable habitat for this species, which includes the Ecologically Appropriate Area of Analysis (19.60 km^2), is not considered to be sufficient to provide 0.5% of its global population with a living environment. Especially when there are about 11,640 km^2 area of beech forests in Georgia (Global Forest Coalition, 2008), part of which, probably, beech forest sections that are more optimum for this species, are located on the south/south-west slopes and lower elevations above the sea level. Thus, it is not considered that this species contributes to the critical habitat in the given Ecologically Appropriate Area of Analysis.

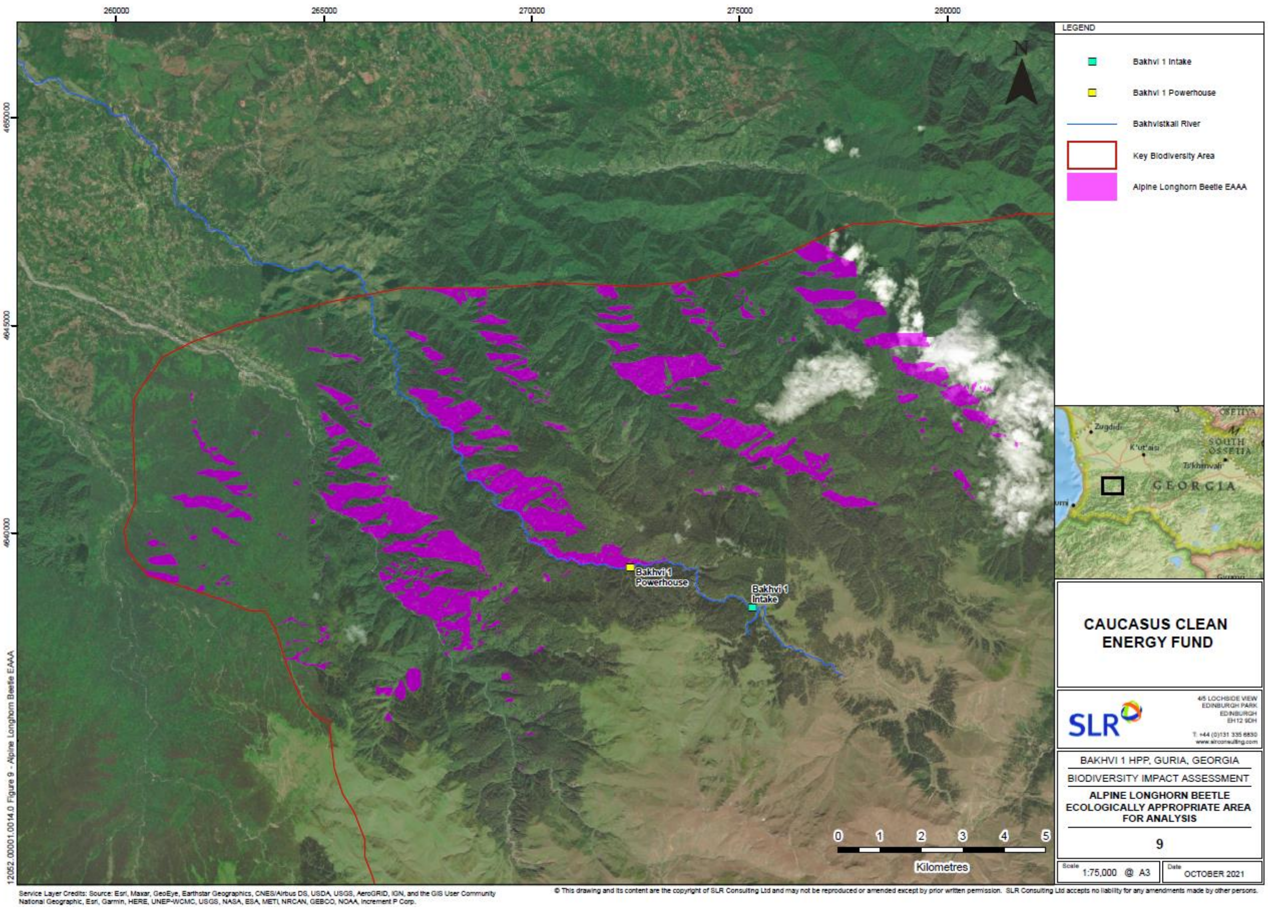
Risk

The risk of this character is too low in terms of project point of view, as its presence is not expected throughout the project Are of Influence (AOI). Thus, the implementation of any additional measure regarding this species is not required. However, the compensation measure is proposed in favor of this species.

Compensation

Since trees are cut, a pile of logs will be arranged, they will be placed on the south/south-west slope, downstream of the design power house, along on the other side.

Ecologically Appropriate Area of Analysis of Rosalia longicorn



African death's-head hawkmoth Acherontia atropos

Information about the species

This species is relatively widespread, found throughout Europe and most of Africa. As a species, it feeds on nectar and sugar. Adults feed on honey, they produce bee-like odor that allows them to enter the bee hive and eat honey. They also suck nectar from flowers, which in turn helps to reproduce certain species, such as petunia and orchid species (Animal Spot, 2021).

Determine of Ecologically Appropriate Area of Analysis

Information on the distribution altitude of this species or its better habitat is extremely poor, as it is spread over a very large area. Considering the fact that this species needs nectar and visits hives, it was determined that EAA includes the habitats within the Important Biodiversity Areas, where the sweet chestnut forests (which produce large amounts of pollen) and relatively lower areas (agricultural lands) are observed, where, for instance, potato is grown, as well as chrysanths and Atropa can be found, as this species feeds on these plants, Map 10.

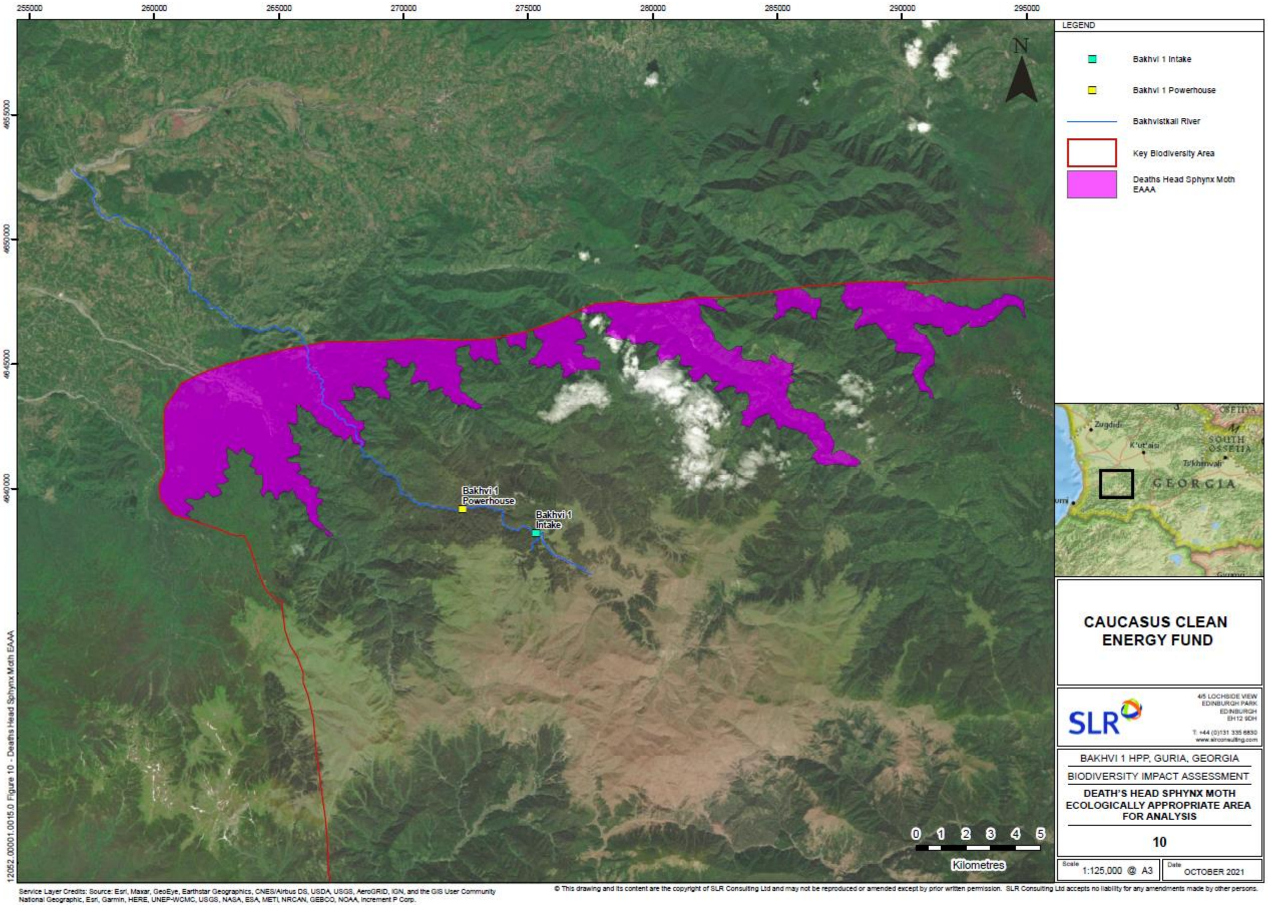
Critical Habitat Assessment

Due to the widespread – entire Europe, Africa and partly Asia of this species, the given Ecologically Appropriate Area of Analysis (78.33 km^2) is not sufficient for providing the living environment for 0.5% of its global population. Therefore, this species contributes to the critical habitat.

Risk

The project Area of Influence (AOI) is beyond the Ecologically Appropriate Area of Analysis of this species, so the project activities will not pose any risks to this species. The implementation of additional measures regarding this species is not proposed.

Ecologically Appropriate Area of Analysis of African death's-head hawkmoth



Group of species – large predators

Information about species

Brown bear *Ursus arctos*: According to the IUCN, this geographically widespread species is a Least Concern taxon. However, in Georgia, where this species is preserved, it is included as Endangered in the Red List of Georgia; At same time, one of the main causes of mortality of brown bears in Georgia is illegal hunting (Lortkipanidze, 2010), which is still practiced by the local population in Georgia.

The forest habitats and subalpine pastures in the study area provide a habitat for this species, as confirmed by the field surveys conducted in 2021, as well as by local residents. Average area of female brown bear is 100 – 1 000 km^2, while the area of female brown bear is larger (Pop , et al., 2018)(Zlatanova, et al., 2015). According to the data obtained from the database of the Emerald Network of Georgia (Council of Europe, 2015), based on the study (2012-2013) of the population of brown bear conducted by the order of the government, the number of individuals of brown bear is 1 643 in Georgia.

Lynx *Lynx lynx*: - Similar to the brown bear, lynx is also the widespread species in Eurasia, it is assessed as a Least Concern taxon by the IUCN. In Georgia, where this species has been regularly hunted or is being hunted, its population level is considered to be significantly reduced, so it is included in the Georgian Red List as a Critically Endangered. According to one population estimate (Species Survival Commission, 2021), its number is 160 in Georgia, the source of this estimate is unknown. As a rule, the lynx is observed in forested areas, which cover 43 % of the territory of Georgia. Based on this, the average area of one lynx is about 187 km^2.

The main food of the lynx includes ungulates such as, tur, chamois and roe deer. This species is found in the sub-alpine zone, forested areas and the territories that are not anthropogenic impacted, e.g. grasslands or dense forests.

Grey wolf *Canis lupus*: is a widespread species throughout the world from North America and Greenland, throughout Europe and Siberia, and south to India. Globally, this species is a Least Concern taxon. It is not included in the Red List of Georgia. Although no signs of presence of a wolf were found within the survey of 2021, but this species is expected to inhabit within the given Ecologically Appropriate Area of Analysis, according to the forestry service personnel. The area of a wolf is quite large (100 – 500 km^2) and depends on the availability of the food. Prey of a wolf is diverse, including deer, wild boar, domestic cattle, carrion and waste.

Determine of Ecologically Appropriate Area of Analysis

As all the above listed species are large predators, it is assumed that they have a shared Ecologically Appropriate Area of Analysis, area of which was defined by the threshold of the Key Biodiversity Area, Map 11 and includes 2 618.31 km^2 area. One of the defining characteristics of this area is the lynx.

Critical Habitat Assessment

Extent of occurrence of the above listed three species is quite large, close to the polar (wolf and brown bear) or for the lynx – to the west, from France and Norway to Siberia and north Pakistan/China to the east. This Ecologically Appropriate Area of Analysis is less than 0.01% of the most limited extent of occurrence (lynx) of the three species. Therefore, it is considered that this Ecologically Appropriate Area of Analysis is not a critical habitat for these species, as it will not be able to create a living environment for more than 0.5% of the global population of any of these three species.

Risk

The construction of the project infrastructure will lead to affect approximately 39.05 ha habitat, as a whole, out of which 9.09 ha area will be permanently lost, while 29.96 ha will be available for reclamation after completion the construction. The habitats that will be lost are widespread through this territory and cover only a small part of area of these three species. The direct loss of habitat due to the project is likely to have a less significant impact on the conservation status of these three species.

Due to the increased transport movement, noise and dust, the migration may take place within the construction period. Therefore, the brown bear/lynx/wolf are expected to migrate temporarily from the construction territory due to noise and project activities. However, it is considered that sufficient alternative areas will be available to obtain food and hibernate outside the project impact area, especially if this is only required temporarily during the construction phase (approximately 24 months).

There is also a risk during the construction process that unorganized wastes can attract the brown bear, lynx or wolf and encourage them to come into conflict with humans.

As expected, these species will return to their habitats after completion of the construction process, especially, after restoration of the temporary damaged territories. The temporary migration will not be significant as alternative areas with abundant food are available outside the project area.

Human activity of the construction area can impact on the populations of brown bear, wolf and lynx due to their curiosity. For instance, without mitigation measures, if reclamation works are not carried out after the excavation, curious animals may be trapped, which may result in injury and/or death, which has a significant impact. The same can be said about a vehicle collision to the brown bear. The death of the brown bear, lynx or wolf may not be significant in terms of conservation status of these species, but it does have significant negative impacts on them.

If construction works are started in winter upstream of the power house proposed area, in the forested territory, then the disturbance or injury of brown bear being in a winter hibernation can take place. The injury or death of the brown bear is a considerable adverse impact on this species providing a critical habitat.

For the other two hydropower projects, hunting pressures on the population of large predators were taken into account during the construction phase (SLR, 2017). However, there, in Bakhvistskali valley, where the populations of brown bear, lynx and wolf are relatively small (in frames of the survey of 2021, limited sign of presence of the brown bear were found, the signs of vitality of the other two species were not detected) the hunting culture is not so active as in other regions of Georgia. Thus, the additional hunting pressure is less expected on these three species from the workers during the construction period, even without the mitigation measures. However, as a precaution, common preventive measures will be taken and environmental training will be conducted.

Since the construction is complete, the impoundment will not affect the migration of brown bear, wolf or lynx, as this impoundment will be too small (0.24 ha) and even the change of flow velocity in Bakhvistskali River will not affect the migration of these species, as crossing the river will still be possible and the environmental flow release will enable the appropriate habitat to exist for drinking /bathing the brown bear. According to the signs of vitality of brown bear, it currently moves freely through the territory of Bakhvi 3 HPP and the powerhouse and upstream, so the free migration will continue during the operation of Bakhvi 1 HPP that is expected for all the three species.

Prevention

The following measures will be carried out to prevent the impact on these species (brown bear, wolf and lynx):

Trenches will be arranged during the construction and deep excavations will be carried out. As it is mentioned above, wandering mammals, such as brown bear and lynx, can be trapped that may cause their injury or death. To prevent this, all trenches will be fenced for the access restriction when the works are ceased or will be covered with boards if the trenches are small enough. These measures will prevent the access of animals to the trenches.

During the construction period, additional workers will accommodate in the camp locating in Bakhvistskali valley. Unorganized waste may attract the brown bear and encourage it to come into conflict with humans. The project Waste Management Plan will be carried out in the construction and operation phases, where the preventive measures against accessing the wild animals (brown bear, wolf, lynx, others) to the warehouses will be reflected.

All types of hunting will be prohibited for the project personnel.

As these species are more active at night, any work that require using of heavy vehicles, removal of vegetation or soil will not be carried out at night (from sunset to sun rise) to prevent additional disturbing factor.

At nightfall, the reduction of vehicles' movement will benefit the species that are active at night and are not described here, such as badger, marten and wildcat, as the risk of collision of a vehicle will be reduced.

To reduce the probability of injury of brown bears being in hibernation, the vegetation removal works will start before the hibernation period (approx.. from November to March); the reason for this is that if the vegetation is removed during the active period of brown bears, they will avoid noise and disturbances and will not hibernate in the working area.

Mitigation

No mitigation measures are proposed with regard to the brown bear, wolf or lynx. However, the re-planting in the habitat by replacing the lost forest habitat will be beneficial for theses in the long-term period.

Monitoring

No targeted monitoring of this species is proposed, however, all accidental occurrences will be collected. This includes to record the data by ESG team, as well as the project personnel. An annual report is prepared annually, which reflects all records.

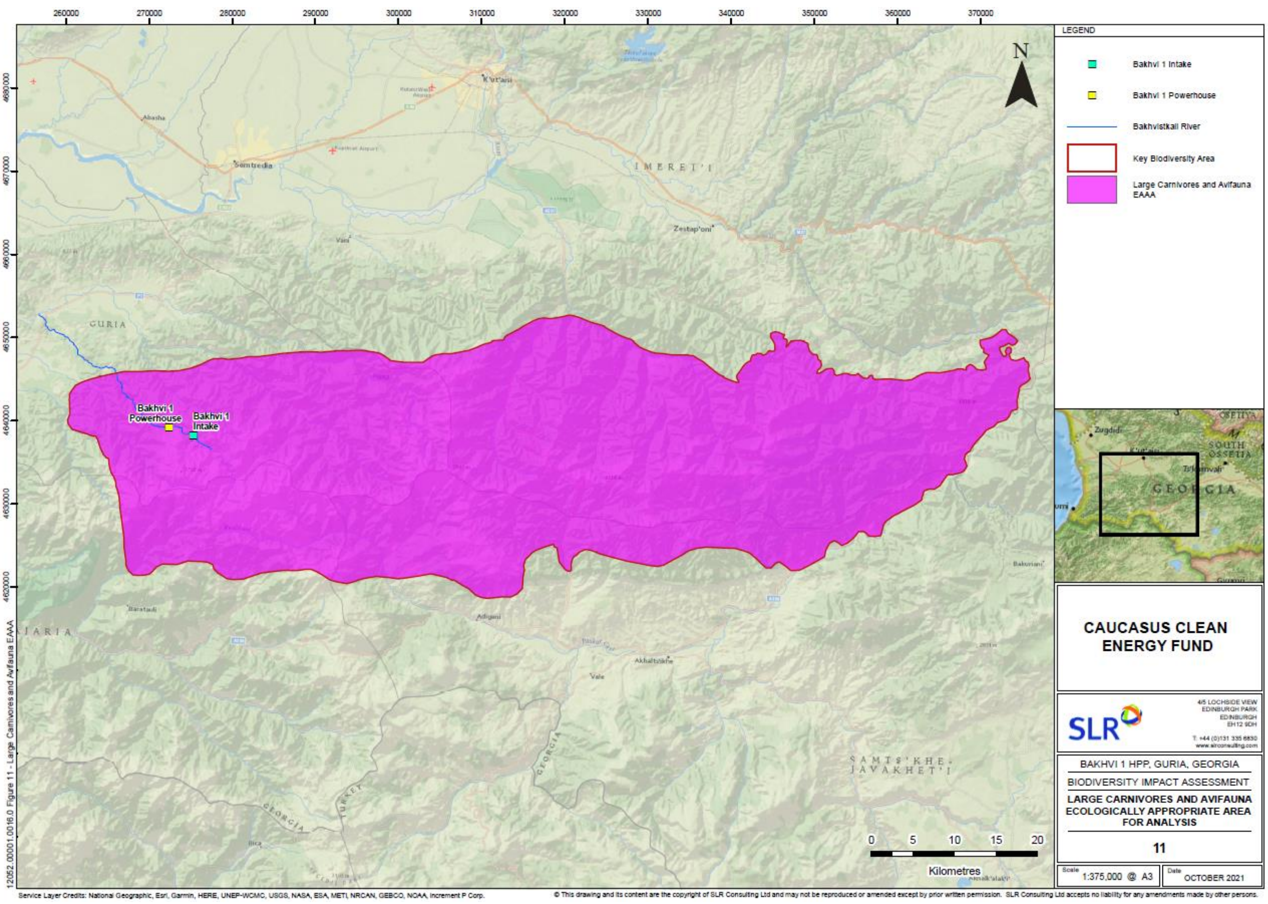
Compensation

In frames of the educational package, the encouragement of the habitat of a wolf, lynx and brown bear as well as the benefits of protecting them instead of hunting, will be included in the environmental awareness training.

Final result

It is considered that the project impact on the species will be temporary and limited as they occupy quite a large area. As a result of the implementation of preventive measures, no net loss of biodiversity will be achieved in the project construction and operation phases. Compensation measures, in the long-term period, will reduce the hunting pressure on these species, which will cause the achievement of final net gain.

Ecologically Appropriate Area of Analysis of large predator animals, birds of prey and other birds



Bat species - Group

Information about the species

The bats' survey showed that the number of species is reduced in parallel to increasing the altitude. Although seventeen bat species were observed in Ukanava village, only three of them were found at Bakhvi 1 powerhouse area. Bats common in Georgia is known as Microbats. Within the active period, from March/April to October/November, depending on the altitude, bats feed on insects according to the habitats they choose, often forest edges, clearings, gardens and surroundings of farms or open habitats with linear objects such as live fences or the line of trees and ponds and streams. Bats species as a colony prefer certain habitats, however, the majority of them inhabit trees, buildings or caves in summer and they give birth to the only pup in June/July. Within the hibernation period, bats look for an area with a stable temperature that does not drop significantly below 0^{o}C.

Although the bats' species have various conservation statuses in Georgia, all of them are relatively widespread in Europe. Limited data are available on the distribution of bats by altitude. However, they are adaptable and in favorable weather conditions, if their victims (insects) are available, they migrate to higher elevations for food. Based on available data, Rhinolophus species are common below 1000 m, while all the other species are common up to 1800 m a.s.l. and rarely, some species, e.g. Pipistrelllus pipistrellus are distributed even above 2000 m (Benda, et al., 2016).

Determine of Ecologically Appropriate Area of Analysis

It is difficult to determine the Ecologically Appropriate Area of Analysis for such widespread species, so this area was based on the continuity of the habitat, or the area of interconnected forest habitats (including villages) included within the borders of the Important Biodiversity Area , Map 12. This area includes three species of bats: Bechstein's bat *Myotis bechstenii,* Geoffroy's bat *Myotis emarginatus,* lesser horseshoe batR *hinolophus hipposideros*.

Critical Habitat Assessment

All species identified within the study of baseline condition, which has not been detected but is expected to exist, are assessed as LC, NT orVU in the IUCN and Georgian Red Lists. As a result, for the determination of critical habitat, it is necessary that the Ecologically Appropriate Area of Analysis to ensure the area of globally important concentrations of one or more bat species with the status of Vulnerable (VU) included in the IUCN Red List, the loss of which will result in the change of status to EN or CR in the IUCN Red List and therefore, to meet the thresholds provided in the above-described C1. Due to the size of the Extent of Occurrence (EOO) of the European bats' species, which is much larger than the assessed Ecologically Appropriate Area of Analysis (1 960.87 km2), it is considered that this Ecologically Appropriate Area of Analysis is not able to meet the critical habitat thresholds regarding the bats' species and accordingly, it is not critical habitat.

Risk

In the project construction phase, trees will be cut and removed from the RoW of the road/penstock, as well as the powerhouse area. The impoundment of this project is small 0.24 ha) and cutting of trees will not be required for its water intake. No significant hibernation sites were detected during the survey of bats (no cave or tunnel), therefore, it is less expected to lose any important hibernation sites.

Cutting and removal of trees without mitigation measures (especially in maternity season) may have an adverse impact on the species inhabiting in trees.

In operation phase, the impoundment can be a beneficial in terms of the bats' food habitat, as the water habitats are often associated with the productivity of invertebrates (flying insects) that can be a positive impact on the bats' species in terms of a rich food habitat.

In the construction and operation phases, even the minor light penetration may hinder bats to obtain food in the lit area. If light illuminates trees, it will presumably prevent the bats to rest in trees near the illuminated area

Prevention

Although the specific study of the bats' resting trees have not been carried out in the study area, in practical terms, such specific studies are not recommended prior to tree felling. It is recommended to take precautions and when cutting large cracked or hollow trees during the construction phase, if there is a suspicion that it was a resting place for bats, it is necessary to leave this tree overnight so that if there are bats, they can fly away in the dark.

To avoid impact on birds, trees will not be cut during the birds' nesting season unless a duly qualified ornithologist confirms that there are no nests in the tree. This will be beneficial for bats as well, as cutting the trees during this period will also protect bat nests and resting places, if any. The gestation period of bats lasts from June to July (including).

In the construction and operation phases, safety and other permanent illumination will be directed downward to the working area to reduce the illumination of trees and forest and to avoid hindering of bats in finding of food and resting. Illumnation will only be used when needed and will not be turned on overnight unless it is needed for health and safety purposes. Timer switches and motion-activated lighting control will be used.

Mitigation

The possibility of arrangement of the bats' roost in the powerhouse will be explored to mitigate the potential loss of bat rest habitat. Such roost can be made by attaching ten wooden bat boxes to the outer side of the building (from different sides) or making a roost in a structure of a building, e.g. hollows brick or blocks with a small entrance.

In addition, an additional forty bat boxes will be placed along the road from the powerhouse to the water intake.

After the construction is completed, local plant species will be planted in all temporary work areas to compensate for the lost habitat. After a while, when the trees grow, they will be useful for the bats as well.

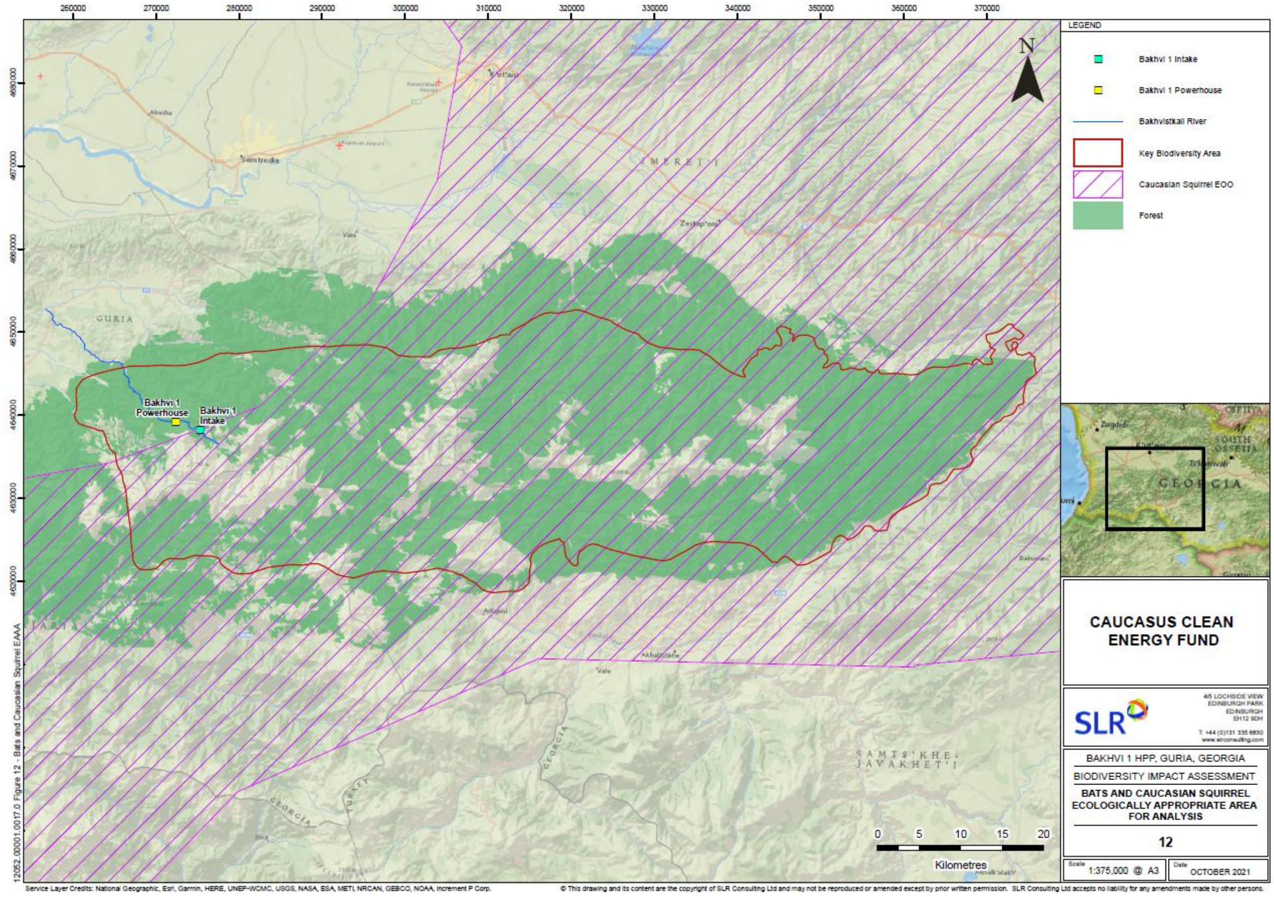
Compensation

Compensation is not recommended regarding bats.

Final Result

Although certain habitats will be lost, as expected, it will have a minor impact on the bats' species in the Ecologically Appropriate Area of Analysis. It is assumed that the creation of equivalent roosts, together with the development of additional forest food habitats along the roads will result in achievement no net loss regarding the bats' species.

Ecologically Appropriate Area of Analysis of bats and the Caucasian squirrel



Otter Lutra lutra

Information about the species

The otter is spread through the study area of Bakhvistskali River that is confirmed by the video taken by the surveillance camera (CCTV) at the water intake of Bakhvi 3 HPP and footprints were also observed in this area; in addition, feces were detected upstream of the water intake in 1 km distance. Various studies have been conducted to estimate the area of otter based on the river length, the results of which show that the food availability is a significant factor, while the size of territory can vary along the river from 10 to 50 km for each otter (Sulkava & Sulkava , 2009). Thus, the otter area at the water intake of Bakhvi 3 HPP can be extended to Bakhmaro in favorable conditions. Male specimens have a wider area that may cover the territory equal to the area of several females. Due to the size of Bakhvistskali River (from the head in Bakhmaro to the confluence of Supsa River), the otter is expected to feed on various species depending on their availability, such as brook trout, crustaceans, frogs, lizards and small mammals (Gorgadze, 2013). For young otters, the main component of their diet is frogs as they are easier to catch than fish. This mainly nocturnal species sets a group territory, where the female otter occupies the major area, the size of which is determined by the abundance of food and demand for shelter.

Determine of Ecologically Appropriate Area of Analysis

The Ecologically Appropriate Area of Analysis of this species is based on the interconnected habitats. Thus, in this given case, it was determined on the catchment level – Bakhvistskali River, Map 13. In frames of this Ecologically Appropriate Area of Analysis, the linear length of the river and streams, which were considered suitable for the presence of otter, was determined to be 40.54 km.

Critical Habitat Assessment

When the length of the river (40.54 km) of the Ecologically Appropriate Area of Analysis is compared to the length of the rivers within the Extent of Occurrence (EOO) of this species (which extends from the United Kingdom to Siberia), it is clear that the Ecologically Appropriate Area of Analysis will not meet the thresholds established by Criterion 1 of Critical Habitat and consequently, it is not critical habitat.

Risk

Obstacles may be created at the powerhouse and water intake areas for the movement of otters in the river during the construction and operation processes. However, as a small HPP is being constructed, the otter should be able to bypass both the powerhouse and water intake areas relatively easily. Otter can move through the forest and roads far from the river. However, this can have potentially two significant impacts during the construction phase in the absence of mitigation measures: 1) trapping, if trenches are not covered after excavations; and 2) injury/death due to collision of vehicles.

Since the project operation is started, the otter will still be able to use Bakhvistskali River for obtaining the food. The distance between the water intake and power plant is 4 km, which is only a small part of the estimated area of the otter. No hydrological change is expected above the intake. The hydrological regime between the water intake and the power plant will change, the environmental flow will provide a connection to this section of the river. The proposed environmental flow is 0.29 $m^{3/}s^{-1}$. As estimated, this is sufficient to maintain the ecological connection between upstream of the river Bakhvitskali and downstream of the powerhouse. Thus, it is expected that there, where the brook trout inhabits (found only downstream of the Bakhvi 3 HPP powerhouse), its population will be maintained. As for the food, such as semi-aquatic species (frog) and terrestrial species (small mammals and lizards), the change of their number is not expected due to the project in the operation phase.

Thus, it is estimated that after the operation is started, the project will have negligible impact is expected on the otter currently present in the Bakhvistskali River catchment area.

Prevention

Preventive measures that will be carried out for large predators (that is described in detail above) to avoid getting trapped and colliding with a vehicle will also beneficial for otters.

Mitigation

No specific mitigation measures are proposed regarding the otter.

Compensation

No specific measures are proposed regarding the otter.

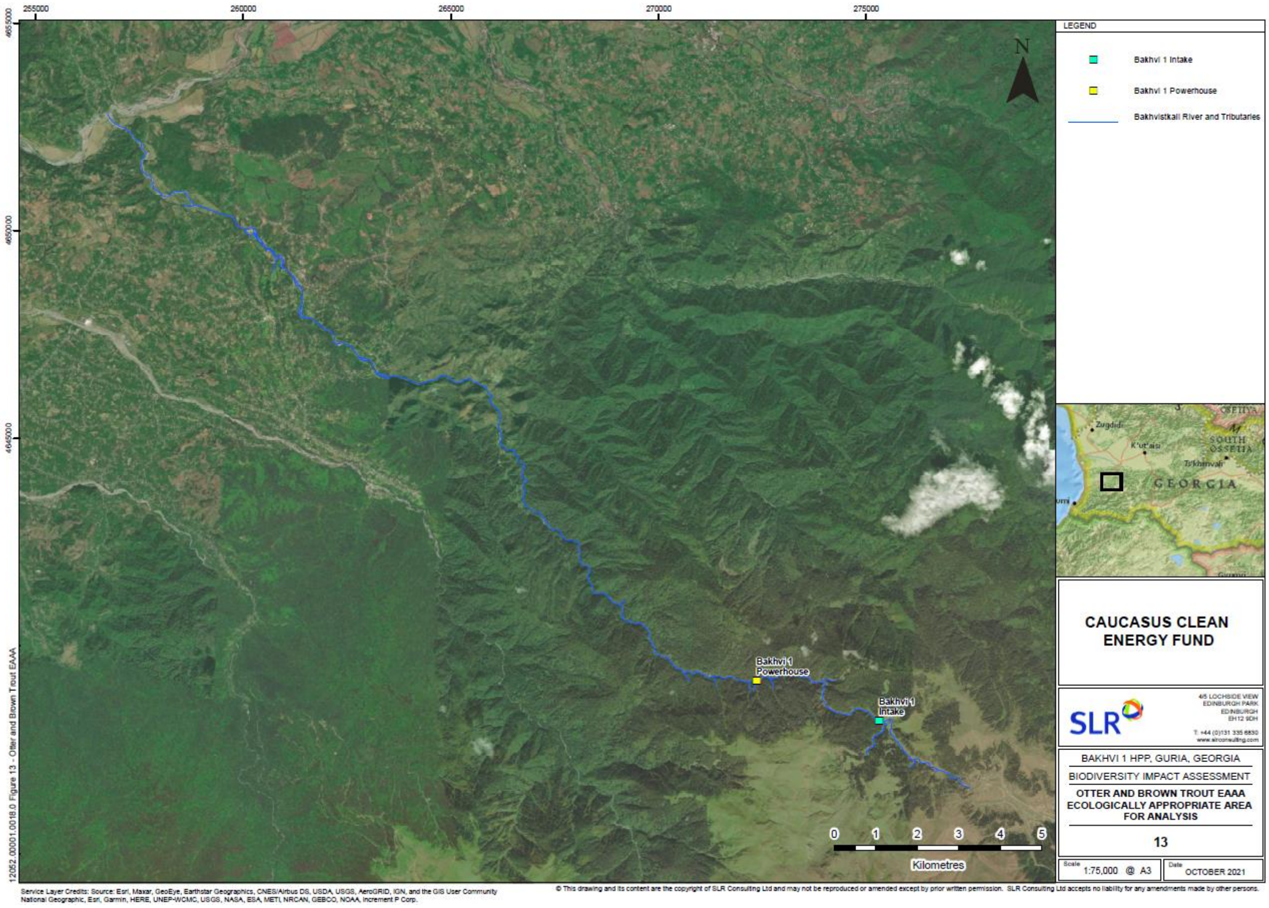
Monitoring

The surveillance camera (CCTV) will be installed at the intake of Bakhvi 1 HPP, which will be used for the monitoring of the water intake operation. All signs of vitality of the otter will be recorded and the video material will be kept. It is possible to prepare an annual report on the otter detection.

Final Result

Since the preventive measures against the adverse impact of the collision and trapping of the otter are carried out, no loss is expected regarding the otter.

The Ecologically Appropriate Area of Analysis of otter and brook trout



Caucasian squirrel Sciurus anomalus

Information about the species

Although this species was not detected during the survey, it is considered that the Caucasian squirrel inhabits this territory as there is a favorable habitat and it is common in many countries, including in Georgia, Armenia, Azerbaijan, Greece and Turkey up to 2000 m above the sea level (IUCN, 2021). Locals have also confirmed its existence, especially during the autumn period when the hazelnut is harvested. In addition, the natural habitat of Caucasian squirrels is the broad-leaf and mixed forests that exist in the study area. Squirrels make dreys in trees and their food is hazel (pine nuts, hazelnuts and acorn), seeds, tree roots and buds (Nakanishi, 2021).

Determine of Ecologically Appropriate Area of Analysis

It has been determined that the Ecologically Appropriate Area of Analysis includes all appropriate habitats that exist in this Key Biodiversity Area and is the same Ecologically Appropriate Area of Analysis that is used for bats (Map 12). Its area is 1 960.87 km². The Extent of Occurrence (EOO) determined by IUCN has been reflected to reflect the north-west side of this area, as the local population informed the researchers that it is also distributed in that area.

Critical Habitat Assessment

According to the assessment, the Extent of Occurrence (EOO) is 2 387 504 km² and the area of identified Ecologically Appropriate Area of Analysis is 1 960.87 km². As this Ecologically Appropriate Area of Analysis is only 0.082% of the estimated Extent of Occurrence (EOO) of this species, this Ecologically

Appropriate Area of Analysis is not critical habitat for this species, as it does not meet the threshold of the 1st Criterion

Risk

In frames of the project, temporarily or permanently used forest areas represent only a small part of suitable habitat in the region.

The habitat of the Caucasian squirrel is assumed to be locally disturbed. However, it is a mobile species that is able to inhabit the human environment, find food through the residential areas and even remove food from garbage cans.

According to the period of tree cutting, in case of absence of mitigation measures, destruction of trees, where the squirrel inhabits, especially, when they are young and inactive, will adversely affect this species.

Prevention

Poor information is available about the mating and breeding of this species. Therefore, for their safety, during the bird nesting season, along with the inspecting nests, each tree should be inspected first of all, to determine whether squirrels are in their dreys or not. In general, adult squirrels migrate when the trees are cut, however, if young specimens are in a tree, they should be left intact until the squirrels become mobile (6-8 weeks after birth) and come out of the nest.

The Caucasian squirrel is not characterized by winter hibernation but may become inactive in winter months, in cold or too wet weathers, when they less react to the disturbing activities. Therefore, even in winter, trees should be thoroughly inspected before cutting to check whether there are squirrels or not.

The nest can also be checked from below, via binoculars. Nests may need to be inspected more than once (e.g., on the first day and then on the second day) to evaluate their usability.

Mitigation

No specific mitigation measures are proposed regarding the Caucasian squirrel.

Compensation

No specific mitigation measures are proposed regarding the Caucasian squirrel.

Final Result

Since the preventive measures are carried out, net loss will not be achieved regarding the Caucasian squirrel.

Birds – the group of birds of prey

Information about species

Long-legged buzzard *Buteo rufinus* – this species was not detected within the survey of 2021. It is a migrant in the territory of Eurasia, every autumn it returns to the south, to Africa. This species prefers the open area, steppe or/and semi-deserts. The estimated Extent of Occurrence (EOO) of this species is (IUCN, 2021) 30 200 000 km^2.

Griffon vulture *Gyps fulvus*- this species was not observed through the study area, but it can be a rare visitor (if there is carrion). On the IUCN website, this species is determined as the Least Concerned taxon. It is spread from Western Sahara to Finland (its Extent of Occurrence (EOO) is about 20 400 000 km^2). The estimated population of this species is from half a million to a million, with a tendency to grow its population.

Golden eagle A*quila chrysaetos* – In general, this species is common in the Western Palaearctic and may periodically appear in the study area; However, due to the lack of suitable nesting habitat in the study area, it is considered that this species is not a permanent resident, it prefers rocky capes and high points. The map of this species distribution created by the IUCN (2021), shows that its distribution area is huge and includes North America, Europe, Asia and partly North Africa (139 000 000 km^2).

Eastern imperial eagle *Aquila heliaca* – this species was not observed within the survey of 2021. According to the map of birds' distribution (IUCN 2021), this species does not breed in Guria region, it is rarely observed there, it is only a passage migrant through this territory. The estimated Extent of Occurrence (EOO) of this species is 14 900 000 km^2.

Greater spotted eagle *Aquila clanga* – this species was not observed within the survey of 2021. According to the maps of birds' distribution (IUCN 2021), this species does not breed in the region of Guria and is rarely observed there, it is only a passage migrant through this territory. The estimated Extent of Occurrence (EOO) of this species is 18 100 000 km^2.

European honey buzzard *Pernis apivorus*- this species was not observed within the survey of 2021. According to the maps of birds' distribution (IUCN 2021), this species does not breed in the region of Guria and is rarely observed there, it is only a passage migrant through this territory. The estimated Extent of Occurrence (EOO) of this species is 18 200 000 km^2.

Short-toed snake eagle *Circaetus gallicus* - this species was not observed within the survey of 2021. According to the maps of birds' distribution (IUCN 2021), this species may breed/inhabit Guria region and its Extent of Occurrence (EOO) is 48 600 000 km^2.

Lesser Spotted Eagle *Clanga pomarine* - this species was not observed within the survey of 2021 and in general, it is a passage migrant, ir it does not inhabit in Guria region (BirdLife International, 2021). However, as confirmed it breeds in larger areas. The estimated Extent of Occurrence (EOO) of this species is wide and is 5 340 000 km^2 (IUCN, 2021) area.

Determine of Ecologically Appropriate Area of Analysis

In this case, Ecologically Appropriate Area of Analysis was determined by using the thresholds of Birds Important Areas and Key Biodiversity Areas, Map 11. Its area is 2 618 km^2.

Critical Habitat Assesment

As birds of prey are distributed through a large area, the Extent of Occurrence (EOO) is less than 0.05% of the area of the least distributed species (lesser spotted eagle). In addition, there are no significant breeding areas in this Ecologically Appropriate Area of Analysis; it was concluded that this Ecologically Appropriate Area of Analysis does not provide critical habitat for these species and accordingly, this area is not a critical habitat for them.

Risk

As these species are less expected to nest within the Area of Influence (AOI) of the project, the planned activities will have a negligible risk with respect to these species. No additional measures have been proposed regarding the birds of prey.

Final Result

The loss of biodiversity is not achieved with respect to the birds of prey.

Birds – non-predators

Information about species

Caucasian grouse *Lyrurusmlokosiewiczi* – this species was not observed within the surveys of 2021, but the signs of its vitality were detected in Important Birds Areas and Key Biodiversity Areas by SLR in frames of the survey conducted through the wider area (SLR, 2019). As expected, this species is observed in the alpine territories Important Birds Areas and Key Biodiversity Areas and is associated with the evergreen alpine nature, alpine wetlands and shrubs. This species shelters the forest from cold winters. The Extent of Occurrence (EOO) of this species is 321 000 km^2 area.

Caspian snowcock *Tetraogallus caspius* – this species has a quite dispersed Extent of Occurrence (EOO), which includes Armenia, Georgia and Turkmen. The estimated Extent of Occurrence (EOO) is 1 830 000 km2 area. According to the IUCN website, this species uses meadows in subalpine and alpine zones at 2 400-4 000 m above the sea level and rarely descends to 1,800 m. This species is observed on steep slopes with less snow cover and cliffs, which are not fully covered with snow and a little grass cover is observed. This bird prefers the southern slopes in summer and the northern slopes in winter. In winter, they avoid areas covered with snow and use open areas with steppe-like vegetation.

Corn crake *crex*– this species is the Least Concerned taxon and it has a large Extent of Occurrence (EOO), the estimated are of which is 7 070 000 km^2. Corn crake is a mixed migrant, but in breeding period it uses open or semi-open habitats, mainly the meadows with tall grasses. Due to the loss of habitat, this bird is closely associated with pastures and grasslands. Suitable habitat includes moist, non-fertilized meadows and regularly mowed meadows, areas, where the agricultural practices are of low intensity and high vegetation grows in summer.

Great snipe *Gallinago media*– this species has a large Extent of Occurrence (EOO), the estimated are of which is 9 730 000 km^2. It mainly breeds in Russia (150 000-250 000 male), this species is abundant in Belarus (4 600-6 000 male) and Norway (5 000-15 000 male). The nesting habitat includes floodplain meadows and turfy areas, with scattered shrubs and peatlands up to 1,200 meters above sea level.

European nightjar *Caprimulgus europaeus* – this species was not observed within the survey of 2021. However, it is considered that there is a relatively limited suitable habitat due to the thickets or open pastures in the study area. This species is widespread (IUCN, 2021), its Extent of Occurrence (EOO) is 19 500 000 km^2.

European roller *Coracias garrulous*- this species was not observed within the survey of 2021. As estimated, its maternity population includes 75 000-158 000 adult individuals (BirdLife International, 2021). According to BirdLife, its European population is 40% of its global population. It prefers the open rural territories with a sparse Georgian oak forest, clearing of the pine forest massifs, gardens, mixed agricultural lands, river valleys and thorny and deciduous trees scattered through a lowland.

White stork *Ciconia ciconia*- this widespread species was not observed in 2021. It nests in tall trees and as a rule, avoids densely forested territories on steep slopes. According to the data of the IUCN Red List (IUCN, 2021), it is a passage migrant through this territory.

Black stork *Ciconia nigra* - this widespread species was not observed in 2021. According to the data of the IUCN Red List (IUCN, 2021), this specie may inhabit the wider area (including Guria region and beyond), but prefers old, intact, open forest habitats.

Boreal owl A*egoliusfunereus* – it is included in Annex 1 of the EU Birds Directive and as the Leas Concerned taxon – in the IUCN Red List. Boreal owl is a nocturnal bird of prey, it is observed in forest massifs and forest ecosystems. This species is found in coniferous forests (taiga), reproduces mainly in spruce (Picea) forests but also uses mixed forests of pine (Pinus), birch (Betula) and poplar (Populus tremula), as well as pure pine forests. The maternity population of the boreal owl accounts 32 300-128 000 pairs, while the Extent of Occurrence is 1 180 000 km2 in the EU (EAA, n.d.).

WoodlarkL *ullula arborea* – is an abundant species, however, it was not observed within the survey of 2021. In Guria region, it can be found as a summer breeder, as well as a migrant. The Extent of Occurrence (EOO) of this widespread, Least Concerned taxon is 10 500 000 km^2.

Red-backed shrike *Laniuscollurio* – Although this species was not observed within the survey of 2021, it is distributed in Guria region and observed as the summer breeder and passage migrant through the wider area. The Extent of Occurrence (EOO) of this widespread, Least Concerned taxon is 15 700 000 km^2.

Determine of Ecologically Appropriate Area of Analysis

In this case, the Ecologically Appropriate Area of Analysis was determined by using the thresholds of Important Bird Areas and Key Biodiversity Areas, Map 11, its area is 2 618 km^2.

Critical Habitat Assessment

Due to the size of the Extent of Occurrence (EOO) and the IUCN conservation status of all birds' species described in this section (except Caucasian grouse), none of the species meet the thresholds of Criterion 1 for critical habitat. The Extent of Occurrence (EOO) of the Caucasian grouse (321 000 km^2) is small than other species; however, this species is assessed as Near Threatened (NT) taxon, it is not able to meet the thresholds of Criterion 1, hence, the area is not critical habitat for this species.

Risk

In the construction phase, if the trees and other vegetation cover is removed in the nesting season (from April/May to July/August), birds may abandon their nests or young specimens during nesting period, this will lead to their death and adverse impact.

No additional impact is expected on birds since the construction is completed.

Prevention

Cutting of trees and shrubs will be restricted in the birds' nesting season as a general strategy of prevention. In exceptional cases, when the area is small or a small number of trees are to be cut in the birds' nesting season, a properly qualified ornithologist or an environmental officer will be hired in frames of the project. Before cutting, ornithologist/environmental officer will check trees to determine whether there is a nesting bird in a tree or not. If the survey revealed that there are the birds are nesting in a tree, then, it will not be cut until the nestlings are fledged. This action will be an exception to the rule that no tree should be cut during the nesting season.

Mitigation

The restoration of vegetation and planting of trees in temporarily lost habitats will be useful for the birds' species to mitigate the loss of a potential nesting habitat.

Some species use "birds' boxes", one of such species are the boreal owl. Thus, five boxes of owl will be installed in an appropriate habitat to mitigate the loss of its potential nesting habitat. In addition, twenty small sparrow boxes will be placed in trees, 10-30 m from the road between the water intake and power plant.

Compensation

Although it is considered that the project will have no impact on the common house martin, common swift and other swallows, it will be useful for this species to place at least twenty eggeries and boxes on the building of the powerhouse. According to the survey of May 2021, the Bakhvi 3 power plant formed a habitat for at least 30 pairs of common swift and swallows.

Monitoring

Since the nesting boxes are installed, they will be fixed with the GPS, based on which, maps will be prepared. An Environmental officer will check each boxes (as a rule, in autumn) once a year to identify damages and if any, they will be repaired/replaced as needed during the operation of the facility.

Final results

As a result of the implementation of the proposed preventive, mitigation and compensation measures, net loss of birds is not expected, while for the species, such as common swift and other swallows, eve net gain can be achieved.

Caucasian parsley frog Pelodytes caucasicus

Information about the species

This species of frog is included in the IUCN as NT taxon, therefore, it is considered in this part, as it is the determining characteristic of the Key Biodiversity Area. this species is associated with broadleaf, mixed coniferous-deciduous forests, rarely with mountainous coniferous forests. As a rule, it is observed in shaded vegetation cover (shrubs and grasses). The aquatic habitat of this species includes ponds and the banks of streams with transparent and cold running water, as well as standing water. Adult specimens are observed in shaded moist areas where they shelter stones and other covers in daytime. This species breeds in slow moving streams or standing waters, where they lay 1,000-2,000 eggs during the warm period (usually from May to October, and in the mountains from June to August). They need a leaf litter and its removal is not favorable for this species (e.g. fully cut). It is a hidden species and is found only after rain and during the breeding season.

Determine of Ecologically Appropriate Area of Analysis

Due to the conservation status of this species, the Ecologically Appropriate Area of Analysis have not been determined as it does not create critical habitat.

Critical Habitat Assessment

This species does not create critical habitat.

Risk

In frames of deforestation, specimens may be frightened, while in hibernation or cold periods, they may be damaged or died.

Prevention

For this species, as well as for other reptiles, it is recommended to collect and move eggs (spawning) as well as tadpoles in ponds and working areas (e.g. flooded wheel traces) along the access roads. This will be useful for many species of amphibians.

Mitigation

In general, mitigation measures planned for reptiles include this species as well.

Compensation

In general, mitigation measures planned for reptiles include this species as well.

Final result

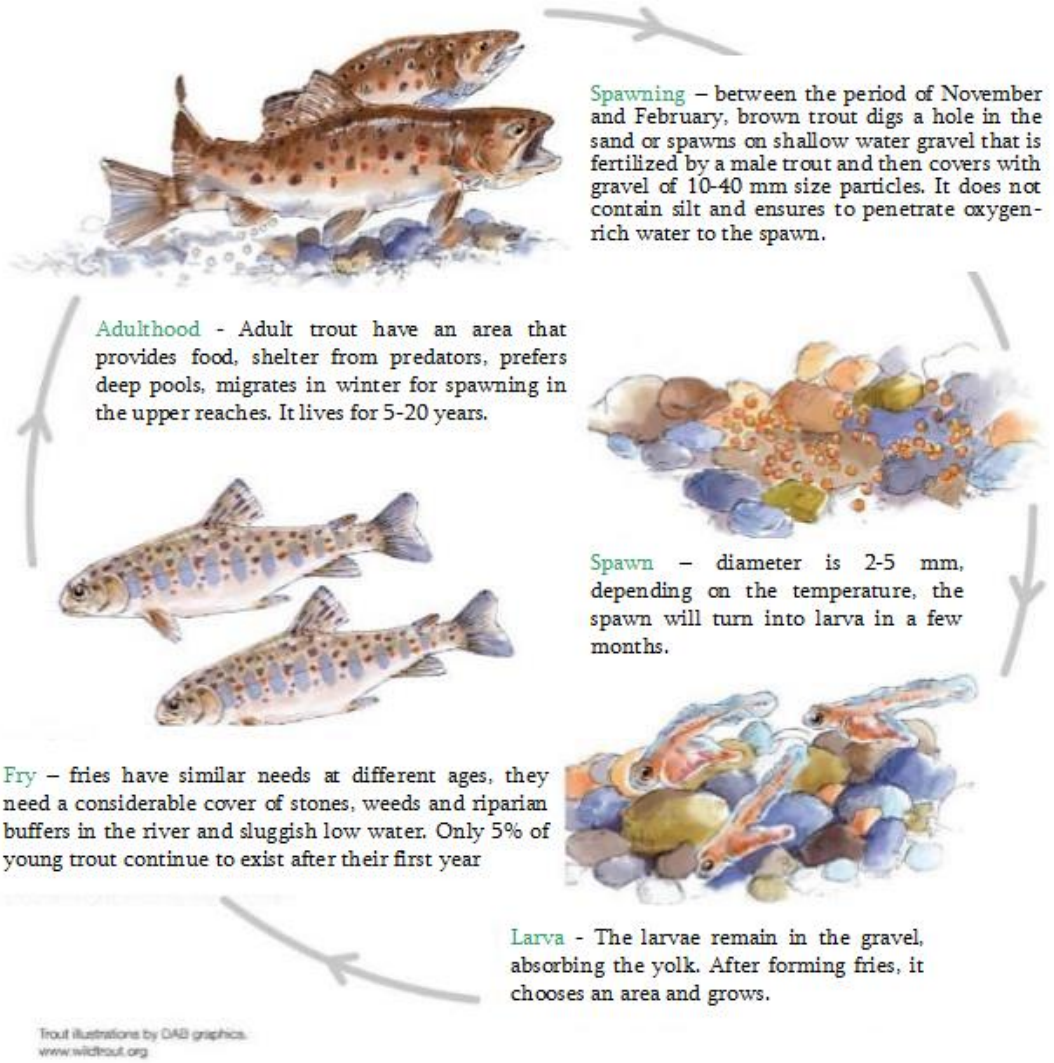
As a result of prevention, mitigation and compensation measures, no biodiversity loss is expected.

Brown Trout Salm trutta

Information about the species

Brook trout is included in the IUCN Red List as LC taxon and according to its distribution map, it is observed in Georgia. However, in Georgia, this species is considered to be synonymous with salmo trutta, which is classified as VU (for more information on classification and species names, see section**Ошибка! Источник ссылки не найден.**).

This species inhabits cold streams, rivers and lakes. It spawns in rivers and streams with well-saturated oxygen rapid flows. Through the spawning ground, gravel is needed for the spawn to be stable, but at the same time to supply oxygen during the movement of water. This species adapts very well and can become a migratory (sea trout) or stay in a local river or stream and spend its entire life cycle in one section of the river. In 2018, 2019 and 2020 the monitoring was conducted on Bakhvi 3 HPP, as well as the baseline condition was studied in May 2021 for this project, in addition, two studies of fish fauna were carried out by Gamma in September 2020 and October 2020. The only fish species identified in each study was brown trout *Salmo trutta*. Interviews with local fishermen confirmed that there is only one species of fish in this river. The brown trout inhabiting in Bakhvistskali river does not migrate, it only moves locally, from downstream, where the water is sufficient in winter, to the upstream, in gravel section for spawning. The lifecycle of brown trout is described in the illustration below.



Determine of Ecologically Appropriate Area of Analysis

The Ecologically Appropriate Area of Analysis of this species was defined as the catchment area of Bakhvistskali River, from where it is derived, to the confluence of Supsa River (Map 13). It is assumed that there is not a favorable habitat in Supsa River, as it is a lowland river. Thus, as estimated, the length of the Ecologically Appropriate Area of Analysis is 40.54 km.

Critical Habitat Assessment

The Extent of Occurrence (EOO) of the brown trout covers north Europe. This diverse and adaptable species is distributed in the most suitable rivers, streams and reservoirs throughout the region. The Ecologically Appropriate Area of Analysis used in this estimation includes the entire river of Bakhvistskali. The reason for this is that the presence of brown trout was confirmed downstream of the Bakhvi 3 HPP powerhouse (the survey conducted with an electrical fish attracting device in May 2021), in addition, fishermen verbally confirmed that the brown trout is distributed upstream, where the fish was caught near the water intake of the design Bakhvi 1 HPP in June 2021.

Due to the limited quantity of the population in frames of the size of Extent of Occurrence (EOO) of this species and the Ecologically Appropriate Area of Analysis, it is considered that the river Bakhvistskali does not provide a globally significant concentration of this species with the habitat, and this species is assessed as Vulnerable (VU) in Georgia, although globally it is considered as Least Concerned (LC) taxon; therefore, Bakhvistskali River is not critical habitat.

Risk

The only possible change in the hydrological regime during the construction period will be localized and implemented in the water intake area where construction will take place in the river. In the water intake area, a small impoundment will be provided, Through a short section of the river, the riverbed will be temporarily narrowed from one side to implement the construction works. Since the construction of one side of the intake is completed, the river will be diverted to the other side and the other part of the intake will be constructed. This will result in minimum and only temporary interruption of river continuity, so in terms of the brown trout, the only minimum impact will take place upstream of the river Bakhvistskali.

The brook trout in Bakhvistskali River endures the slight increase of sediment, which takes place upstream due to natural processes such as erosion and landslides. Due to the gradual construction of the intake facility, no significant increase in solid sediment in the river is expected. Thus, it is considered that a slight increase in sediment during the construction period is expected, although it is unlikely that this will have a negative impact on the brown trout in this river.

In the construction phase, the accidental contamination such as the spill of fuel oil into water, is estimated to have a significant impact on the aquatic environment. However, as the water intake will be built gradually and the direction of the river will be temporarily changed, this will reduce the impact of contamination on the downstream river environment. If the significant spill of fuel and oil takes place, it will be possible to contain it in the riverbed to prevent contaminants from moving downstream. This method of construction will presumably prevent the significant impact of contamination on aquatic species and the habitat downstream of the catchment, outside the project area, in case of spilling. Thus, it is less expected that the polluting events to have the significant impact on the fish population in the river.

The change of water quality is not expected during the project construction period, except sediment and accidental contamination (as discussed above).

The most significant project-related impact will be the change of hydrological regime of Bakhvistskali River that will be entailed by the construction of the Bakhvi 1 HPP water intake, which will divert part of the Bakhvitskali River water into a penstock, through which the water flows into the gorge and meet the Bakhvistskali River downstream the powerhouse of Bakhvi 1 HPP. The project is a run-off the river type HPP with a small impoundment (0,24 ha).

Information below is directly associated with the biodiversity and taken from the survey of the baseline hydrological conditions (Bakhvi 1 Scoping Report). It should be noted that the data used for the survey of baseline hydrological conditions have been taken from both data of Bakhvistskali hydrological gauging station and additionally selected regional data. Bakhmaro gauging station located upstream of Bakhvi 1 HPP (catchment area 33.4 km^2) has the available data for 1947, 1949-50, 1953, 1955-57 and 1959-78. Additional data were available from the lower Bakhvi gauging station for the periods of 1940-47 and 1949-86.

For the Bakhvi 1 water intake area, the long-term average flow was calculated and amounted to 2.52 $m^{3/}s^{-1}$. In addition, an excess of 95% flow was also calculated and it equals 0.46 m^3s^{-1}, or the flow that exceeds average flow during 18 days in a year.

The demand for environmental flow or minimum flow can be determined by assuming a certain percentage of the average flow.

The environmental flow proposed by the project of Bakhvi 1 HPP is 0.29 m^3/s that is calculated in conditions of annual 5-day minimum flow conditions. This methodology is also consistent with the environmental flow that is 0.348 m^3/s.

The monitoring results of Bakhvi 3 confirmed that in the conditions of this flow, the brown trout can migrate freely between the section of Bakhvi 3 HPP powerhouse and water intake as well as enter the fish pass without obstacles. It should be noted that this section of the river is fed only by the environmental flow left by Bakhvi 3 HPP. In addition, the riverbed is monitored through the section between the Bakhvi 3 water intake and powerhouse, in frames of which, the obstacles that hinder the trout migration through this section of the river are eliminated.

To summarize: the elevation decreases by 360 m in about 4 km between the water intake and powerhouse and the river flows into a steep ravine.

Presumably, there are two separate populations of brown trout in Bakhvistskali River, so the environmental flow was estimated on the basis that the ecological continuity of the river could be restored over time (naturally or artificially).

Considering the narrowness of the riverbed in the section between the water intake and powerhouse and the fact that an additional 0.33 m^3/s average flow will enter from the tributaries, it is estimated that this flow will be sufficient for the fish migration (upstream and downstream).

In heavy rains, it is expected that the water from the intake will add to the environmental flow that will be useful for the sediment downstream transportation, removal of gravel and creating/maintaining spawning habitat suitable for fish species. Seasonal change of the environmental flow is not currently proposed.

In the low flow conditions, as well as in winter, the water intake will form the impoundment (2-3 m depth) that will not freeze. This impoundment can become a suitable shelter for brown trout and beneficial.

Overall, it is considered that the proposed environmental flow 0.29 m^3/s is sufficient for the presence of fish population in the river.

Prevention

Numerous prevention measures have been developed within the project, which were discussed above in the context of the risk assessment. This included the prevention of contamination, maintaining the continuity of the river during construction, and ensuring the environmental flow required for fish migration (if the connection between downstream and upstream is restored in the future.

A fish pass will be arranged behind the water intake.

The water intake will create 0.24 ha area impoundment with 2-3 m depth. This impoundment may become a shelter for the brown trout in winter (and even in other seasons). As a result, fishing will be completely prohibited upstream and downstream of the water intake, in 200 m radius. This will prevent overfishing of the collected brown trout.

Mitigation

The construction of a fish pass is proposed to reduce the impact on brown trout at minimum. Although it is assumed that there is a natural obstacle for the fish migration between the water intake and Bakhvi 1 powerhouse, the current population in Bakhvistskali river will still migrate in the river. In the future, this obstacle can be removed naturally or artificially and the connection restored. The engineering design of the water intake facility envisages the construction of a fish pass. If the project also considers the arrangement of a natural type fish pass, it is a better alternative but will depend on the feasibility study to be carried out prior to its construction. Any type of fish pass will have a positive impact on the fish population in the future.

The surveillance camera (CCTV) will be installed at the intake area for monitoring. The consultations with fishermen showed that poisonous and illegal electrical devices were used to catch fish in the river. The surveillance cameras may hinder similar actions or make it possible to identify the perpetrators filmed by the camera.

Compensation

As it is considered that there are natural obstacles in Bakhvistskali River, the riverbed management can be one of the compensation approaches; the purpose of this action will be to restore the continuity of the Bakhvitskali River over time. Implementing such work is expensive and difficult to plan, but this is an alternative that will be taken into consideration in the project.

Monitoring

The fish monitoring program will be carried out. Six locations will be monitored, including Bakhvi 1 powerhouse (the spillway upstream and downstream), Bakhvi 1 water intake (the water intake upstream and downstream), two more locations upstream of the water intake toward Bakhmaro. Monitoring will be carried out by electric fishing devices and other relevant ways. Monitoring will be carried out annually in autumn. Local fishermen will be also involved in the monitoring to define where they are fishing, what season of the year and how much/what size of fish they catch. Then this information can be used to estimate the effectiveness of a fish pass and to study the status of the brown trout population through the river study section.

Final result

As considered that there are two separate trout population in the river, it is assumed that the project will not result in “no net loss” regarding the brown trout population. The proposed environmental flow, fish pass and the riverbed management program will support to restore the ecological continuity of Bakhvistskali River. Small impoundment (2-3 m depth, 0.24 ha area) will be beneficial for the brown trout in terms of formation of a winter shelter. Overall, through the additional management of the riverbed that aims at removing of naturally obstacles formed by the boulders in Bakhvistskali River, will cause net gain with respect to the brown trout. To achieve this, certainly, requires some time and resources in such difficult terrain conditions.

C2: Endemic and/or Restricted-Range Species

C2: Singnificant area for endemic species, where the restricted area means Extent of Occurrence ((EOO) It has the following thresholds:

- For terrestrial vertebrates and plants, restricted-range species is defined as those species, which have an extent of occurrence (EOO) of 50 000 km^2 or less.
- For marine systems, restricted-range species are provisionally being considered those with an extent of occurrence (EOO) of 100 000 km^2 or less.
- For coastal, river and other aquatic species, habitats with a width not exceeding 200 km at any point (e.g rivers), a restricted-range area is defined as a global area equal to or less than 500 km geographical section (or, the distance between the furthest distribution sites).

The botanic survey did not identify any species the Extent of Occurrence of which (EOO) is less than 50 000 km^2, however, the species, which are only common in the Caucasus (estimated area 170 000 km^2) were identified. It is deemed that the Extent of Occurrence (EOO) of all species identified within the field surveys and theoretical studies, except the Caucasian Salamander, exceeds 50 000 km^2, so they are not additionally reviewed here.

Caucasian Salamander Mertensiella caucasica

Information about the species

According to IUCN (2021), this species is mainly observed in the forests of oriental beech *(Fagus orientalis),* coniferous *(Abies nordmanniana and Piceaorientalis)* boxwood *(Buxus sp.)* forests, in the Mediterranean shrubbery, mixed forests, sub-alpine zone and alpine meadows. This species avoids large streams and mainly inhabits the river tributaries, usually in streams 1-1.5 m wide and about 20-30 cm deep. These streams flow in massive shades and their banks are covered with woody and herbaceous vegetation (including the ferns *Mateuccias trutiopteris*). There is a thick layer of leaves and branches, moss and grass. It breeds in streams. In general, salamanders avoid anthropogenically altered landscapes.

The distribution area and habitat demands of this species is described as follows in Amphibiaweb (Amphibiaweb, 2021):

“Caucasian Salamander is a rare species with uneven spatial distribution. In suitable places, numerous individuals may be encountered. Maximum density is observed in places where there are logs and wooden blocks, combined with stone conglomerations, and a lot of small pools and shelters under tree roots. However, elsewhere, even in "visibly suitable" habitats, the salamander is absent. Such local populations inhabit relatively small plots, from 200-500 m along stream banks with the maximum concentration of sites suitable for shelter and reproduction”.

The Extent of Occurrence (EOO) of this species is 25,000 km^2 (data source (IUCN, 2021)). However, it should be noted that the areas in the study territory, where the Caucasian Salamander was observed, are beyond the Extent of Occurrence (EOO) of this species by approximately 3-4 km to the north of EOO. Proper examination of the existing records has shown that there are many exceptions (iNaturalist, 2021); it means that the Extent of Occurrence (EOO) of this species extends further north and south than is currently assumed.

In the study area, this species was found in humid locations and boggy fields near Bakhvistskali River, the upstream area of the proposed Bakhvi 1 water intake. Interestingly, there are mostly open habitats, without tree shade. Moist habitats are mosaic, with open pastures locating above the tree-covered area. Salamanders were observed under large rocks in the study area, including *Juncus spp* and in the vegetation cover half-submerged in water.

Determine of Ecologically Appropriate Area of Analysis

The borders of the Ecologically Appropriate Area of Analysis of this species can be determined above 1,645 m, where the appropriate habitat exists (confirmed by the specimens observed during the survey 2021), to the altitude of 1800 m. Such habitat is extended over a large area (personal observation), where water leaks and swamped areas are formed. However, it is mainly isolated in each catchment area without continuity/connection to other habitats. Map 14 shows the assessment of the Ecologically Appropriate Area of Analysis of this species based on the interconnected habitat, therefore, the Ecologically Appropriate Area of Analysis used in this assessment is located directly only in the Bakhvitskali River catchment area.

Critical Habitat Assessment

According to this criterion, critical habitat is determined as endemic or/and significant habitat for the restricted-range species. The threshold criterion is “the territory that regularly provides ≤10 % a global population of the species and ≤10% of reproductive individuals with a living habitat”

In this Ecologically Appropriate Area of Analysis, the area of habitats, where this species was detected, is 1.51 km^2 that is a part of wider similar habitat (SLR, 2019) and populations are distributed quite a large geographic area (25 000 km^2). According to the data of the published documentation showed that the populations (frequently, more than 10 reproductive individuals) are found in the area, where the appropriate habitat exists. Therefore, it is assumed that this Ecologically Appropriate Area of Analysis regularly provides ≤10 % of a global population of this species with a living habitat. Thus, this Ecologically Appropriate Area of Analysis is not critical habitat for this species.

Risk

Within the study area, this species is observed in swamped areas and boggy meadows near the river of Bakhvistskali, upstream of water withdrawal area of Bakhvi 1 HPP.

A small area of “Moist or wet eutrophic and mesotrophic grassland (0.18 ha)“ will be lost during the construction process. This is an optimal habitat for the Caucasian salamander, so there is a risk that individuals may die and suitable habitat may be lost during the construction phase.

Caucasian salamander hibernates in winter and the earthworks in a hibernation habitat in winter may adversely impact on this species.

This species lays eggs in tributaries, so changing the flow rate of a stream during the roads’ construction or occurring surplus solids in water during the construction process may also have a negative impact on the Caucasian Salamander.

Prevention

Good international practice in the field will be used during the construction process. Bridges or suitable drainage systems will be used when crossing streams by roads to avoid impeding the water flow.

A “triton fence” will be installed around the working site, the boundaries of which will be defined in the Biodiversity Management Plan. The fence will form the inaccessible space for the Caucasian Salamander. The area will be manually cleared from the Caucasian Salamander, in addition, hole traps will be also used for this purpose, they will be checked by ESG team on a daily basis. Found individuals will be removed to another appropriate habitat beyond the project Area of Influence (AOI).

Any piles of stones/wood/mud that will form in the habitat suitable for the Caucasian salamander will be fenced to prevent access of individuals of this species; these piles will not be removed in winter to prevent damage or death of hibernating individuals.

Mitigation

In case of crossing the streams by roads, solid sediment collectors will be installed to avoid occurring of solids in water. Solid sediment collectors should be suitable for the stream and may include using the filters such as hay bale or fibrous cloth or settling basin.

Compensation

Creating a habitat near upstream of the impoundment where the water is flowing. Minimum eight deepening or holes with a surface area of 6-8 m^2 will be created where stones will be placed. These holes will be excavated in the areas where they will be filled with the runoff from slopes or the river water will fill them during the flood. This will form a pool-like eutrophic meadow that will be used by the Caucasian Salamander. Detailed information about the location and arrangement of these holes will be provided in BAP.

Arranging a shelter for the winter hibernation will be useful for the Caucasian Salamander depending on the place of its arrangement. At least three out of 10 winter hibernation sites will be arranged upstream of the water intake near the areas where the Caucasian Salamander is distributed and its potential habitats.

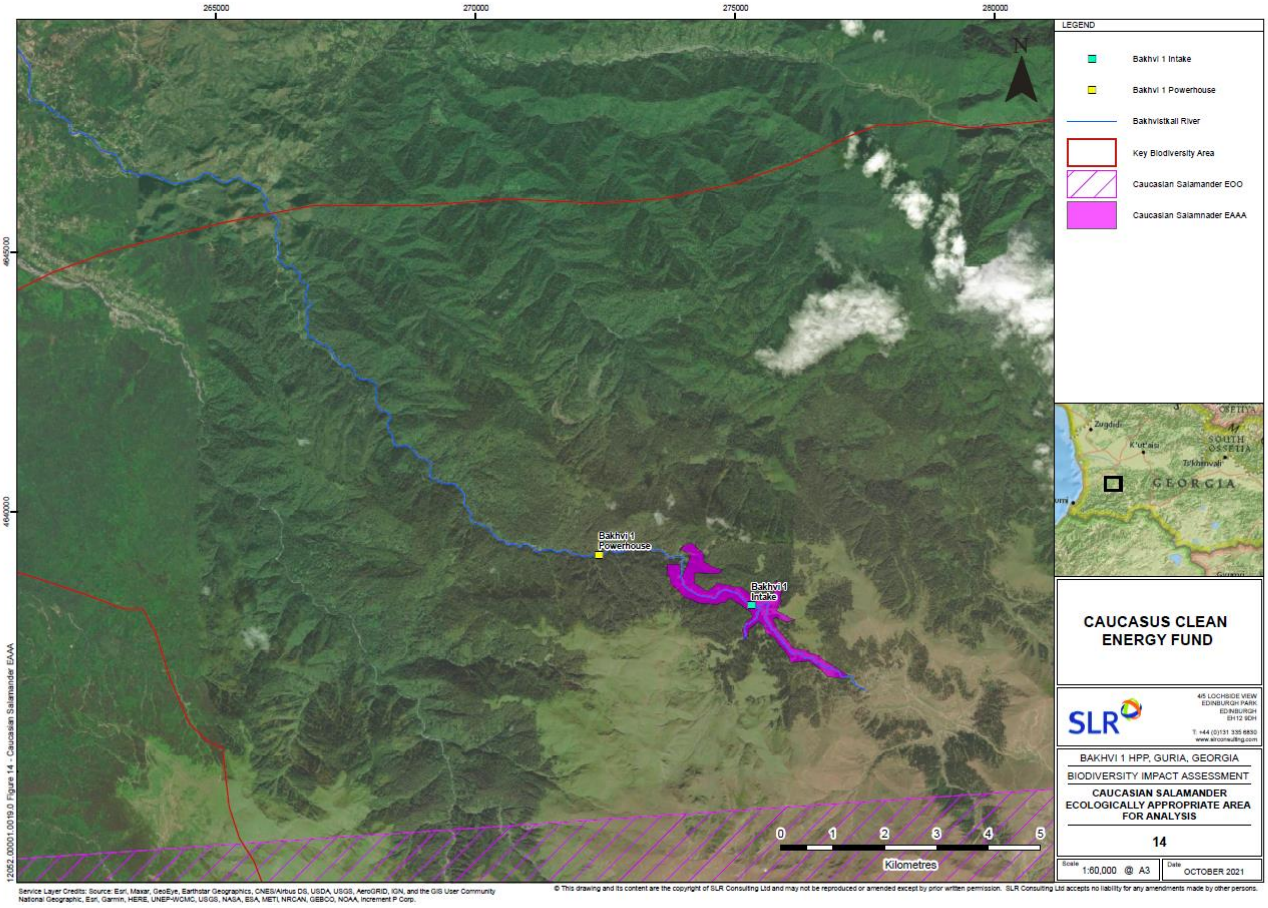
Monitoring

In the project Area of Influence (AOI), the monitoring of the Caucasian Salamander will be carried out annually for the first five years (in June), including before the construction is launched in June (to study the baseline condition of its distribution), for two years during the construction and then, for two years of the operation. After this, the need of additional monitoring will be revised. The purpose of the monitoring will be to determine which habitat is mainly used by this species and to define the above mentioned holes and hibernation sites, as well as to determine whether the compensation measures were successful. The results of monitoring and evaluation of compensation measures will be shared with stakeholders of Key Biodiversity Areas as this is a defining characteristic of this area.

Final result

In frames of the project, the construction works will be carried out in a habitat suitable for the Caucasian Salamander, however, this will be reduced at minimum when practically possible. Since the prevention and mitigation measures are implemented, the main goal will be to avoid the loss of individuals. Additional compensation measures are also proposed to achieve no net loss and even net gain in a long-term period as these holes and hibernation sites will create additional optimal habitat for this species.

Ecologically Appropriate Area of Analysis of Caucasian Salamander



C3: Significant habitat for concentrations of Migratory and Congregatory Species.

Thresholds of this criterion:

a) Areas known to sustain, on a cyclical or otherwise regular basis, the inhabiting environment for ≥ 1 % migratory or congregatory species at any point of the species' lifecycle.

b) Areas kown to sustain the inhabiting environment for approximate ≥10 % of the global population during the period of ecological stress.

Migratory species are species that move cyclically between two different geographic area one of which is usually the area where they breed (Cyrille de Klem, 1994). The only group of actually migratory species in Georgia are birds and bats. Brown bears and lynx are not considered to move between two different geographical areas in this context; However, they have a large area where they move cyclically.

The fish species identified in Bakhvistskali river is also considered here, however, although the brown trout migrates locally, e.g. from breeding site to feeding grounds, it is not considered as a true migrant. However, the fish species such as the Black Sea Salmon is classified as migratory species, because it spends its lifecycle in two different geographical areas. Based on the analysis of available fish research data, migratory Black Sea Salmons are not observed in the Ecologically Appropriate Area of Analysis described under Criterion 1.

As for birds, the Ecologically Appropriate Area of Analysis described under Criterion 1 is located through the birds' migration trajectory, so it will be crossed by migratory species. However, the most usable migration trajectory is along the Black Sea coast. Migratory birds species try to fly relatively high and it is less expected to stop in a small, steep gorge in this Ecologically Appropriate Area of Analysis, instead of continuing to fly to their final destination. Although this Ecologically Appropriate Area of Analysis may locate across the migration trajectory, birds use the airspace instead the habitat below. The Ecologically Appropriate Area of Analysis is not attractive for migratory and congregatory species.

Numerous bat species were observed in this Ecologically Appropriate Area of Analysis (as described within Criterion 1). As estimated migratory species are distributed in this Ecologically Appropriate Area of Analysis, which migrate from their summer feeding areas to winter hibernation sites (as a rule, caves abandoned shafts). All bat species observed in this Ecologically Appropriate Area of Analysis are widespread. Even though they are rare species, they have a common distribution area that covers most of Europe, in many cases North Africa and in some cases Iran and beyond. For significant congregation, there must be a system of caves, or abandoned shafts, suitable for the formation of important hibernating colonies in the Ecologically Appropriate Area of Analysis. No similar habitat was detected in the study area and therefore, in this Ecologically Appropriate Area of Analysis.

C4: Highly Threatened and/or Unique Ecosystems.

Their thresholds are:

a) Areas globally representing ≥5% of the ecosystem type that meet the IUCN CR or EN status criteria.

b) Other areas not yet assessed by the IUCN but according to regional or national systemic conservation planning, considered to have a high priority for conservation.

According to Chapter 4, there is a spectrum of habitats in the study territory, which forms the threshold of this Key Biodiversity Areas and they are considered to have a conservation value; forest massifs are dominant in these habitats that have been modified by humans over many years, mainly for timber logging and cattle grazing. This is evidenced by numerous tracks and trails, as well as tree stumps of beech and other species detected in the forest.

Open areas above the forested territories are used for cattle grazing and a short lawn is formed, where the non-edible grass - *Nardus stricta* is mostly dominant. Natural habitats provided in IFC (2019) are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition. IFC (2019) also reads "in practice, natural and modified habitats exist on a continuum that ranges from largely untouched, pristine natural habitats to intensively managed, modified habitats. Project sites will often be located among a mosaic of habitats with varying levels of anthropogenic and/or natural disturbance. Clients are responsible for delineating the project site as best as possible in terms of modified and natural habitat."

Despite some forests included in the Ecologically Appropriate Area of Analysis and anthropogenic modification of some meadow habitats, there are the areas of natural habitat, especially, on steep, inaccessible slopes of Bakhvistskali valley.

There are many habitats in this Ecologically Appropriate Area of Analysis, which may meet the EU habitat regulations given in Annex I "Habitat". However, as it was mentioned above, some of these habitats are modified by humans to a certain extent, so they are unlikely to be the habitat types listed in Annex 1.

Habitat types, which potentially belong to the habitats of Annex 1 or include many species included in the Red List of Georgia , were identified during the flora survey. In particular:

Beech forest (G1.6, G1.6E and G1.6H) – this habitat type is widespread in the western Georgia and observed on the north-west slope of the Greater Caucasus and Adjara-Imereti range (Akhalkatsi, 2015).

Beech forests occupy 46.6 % of the Georgian forest habitats and its area is 10 600 km^2. Beech forests are not mosaic (G1.6E andG1.7DA) in the study territory, their area is 12.44 km^2.

Chestnut forest massif (G1.7D and G1.7DA) – covers both the natural forest massif and the forest massif plantation that was naturalized. The area of chestnut forest is1 050 km^2 that is 3.8 % of the entire forests of Georgia. The area of such forest is 2.37 km^2 in this Ecologically Appropriate Area of Analysis and as a rule it is mosaic along with the beech and riparian forests.

Pine forests (G3.17) – extend higher elevation above sea level that deciduous forests in this Ecologically Appropriate Area of Analysis. In Georgia, pine forests occupy 4.7 % of the entire forest territories (Akhalkatsi, 2015) that is about 3 275.9 km^2. This forest covers 1.14 km^2 area in this Ecologically Appropriate Area of Analysis. Pine and beech mixed forests (G4.6), are much more dominant, they do not meet the habitat's criteria provided in Annex 1.

Moist or wet eutrophic and mesotrophic grasslands are common in Georgia, especially near streams, in poorly drained/waterlogged soils, where water enters.

As these habitats are common in Georgia or they do not occupy a small area, and due to the fact that they are observed in Europe/Russia, it is considered that they are not endangered and unique ecosystems as this is defined by Criterion 4.

C5: Territories associated with key evolutionary processes.

Quantitative thresholds are not established for this criterion, however, the consultation document (IFC, 2019) provides examples of the range of areas associated with major evolutionary processes.

Critical Ecosystem Partnership Fund (CEPF, 2021) defines the territory of the Caucasus as a "biodiversity hotspot". Deserts, dry forest massifs and forests forming the "hotspot" of the Caucasus include many endemic plant species. The Caucasus hotspot stretches over 532 658 km^2, through the areas of countries such as Georgia, Armenia, Azerbaijan and the North Caucasus part of the Russian Federation. The vegetation covers 143,818 km^2 and includes 1,600 endemic plant species, two endangered mammal species and two endangered amphibian species.

Boundaries of this Ecologically Appropriate Area of Analysis was established for some species across those Important Bird and Biodiversity Areas and Key Biodiversity Areas where the project is located. Amendments were made in the boundaries of Important Bird and Biodiversity Areas/Key Biodiversity Areas in 2018 and now, it covers 261 831 ha area.

Brief description of this Key Biodiversity Area and Important Bird and Biodiversity Areas, as well as their characteristics are provided in the report. Each characteristic was reviewed in detail in frames of Criterion 1. The only characteristic that is considered to determine the habitat of the Caucasus salamander and regarding which a small net gain can be achieved through a hierarchy of mitigation measures. With respect to other characteristics too small no net gain of biodiversity can be achieved.

Habitats identified in this Ecologically Appropriate Area of Analysis are relatively widespread in the region and despite the fact that the project is located in wider biodiversity hotspot, Key Biodiversity Area and Important Bird and Biodiversity Areas, these habitats are not considered critical habitats with respect to major evolutionary processes.

ESS3 additional criterion: Biodiversity or/and ecosystem having significant social, economic or cultural importance for local communities and indigenous groups

Local residents of Bakhvistskali River use wider area for the range of ecosystem services, including hunting, fishing and food. This territory is also used for the cattle grazing. As a result of social impact assessment and consultations with local hunters, none of the sites in the study area have significant social or cultural significance for local communities. Sending cattle to pastures in summer is of economic importance, but this practice, in general, will not change due to the project implementation. Hunting practices, as well as fishing, will not change. The fishermen said that the Bakhvitskali River is not their preferred river for fishing - they can catch more fish elsewhere. Thus, it appears that there is no critical habitat for this additional criterion within ESS3.

Assessment natural, semi-natural and modified habitats

Habitat's extent and range

According to PS6 of IFC, natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.

Semi-natural habitat is category is reflected as required by ESS3. Although it is not exactly specified as in the ESS3 guidance document, but this type of habitat is considered to be a natural habitat and is closely related to the modified habitat. Habitats belong to the category of semi-natural habitats, where most of their original species are preserved, but modified by humans as a result of intensive grazing, logging or other activities.

For the purposes of the present assessment, semi-natural habitats are habitats that, through management and time, can re-start providing the natural habitat-like species (fauna and flora) with the habitat from which it initially originated.

According to PS6, modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition. Modified habitats may include areas managed for agriculture, forest plantations, and others.

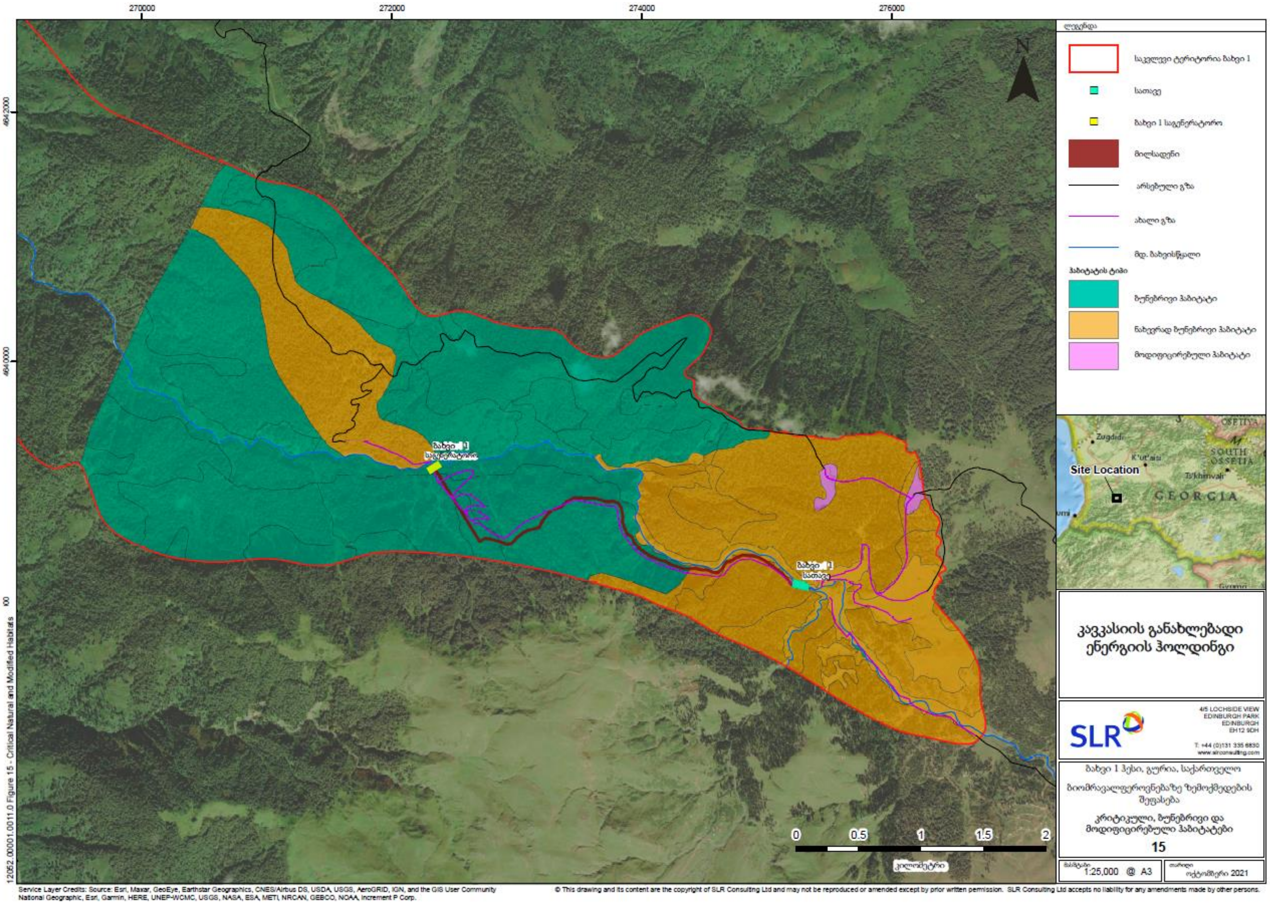
The table below provides a brief description of each habitat of the project territory. For a visual representation of habitat categories (natural, semi-natural and modified) see the map below.

Modified, semi-natural and natural habitats in the study area

Habitat type	Natural habitat	Semi-natural habitat	Modified habitat
Permanent mesotrophic lakes, ponds and pools (C1.2)	Yes, they remain unmodified	No	No
Permanent non-tidal, fast, turbulent watercourses (C2.2)	Yes, they remain unmodified	No	No
Moist or wet eutrophic and mesotrophic grassland (E3.4)	Yes, they are partly modified due to grazing, but still meet the natural habitat criteria.	No	No
Pontic alpenrose heaths (F2.226)	Yes	No	No
Riparian and gallery woodland, with dominant alder (G1.1)	Yes, original habitat and long-established habitat	Only near Bakhvi 3 HPP, where it is trimmed.	No
Trampled mesophilous grasslands with annuals (E2.8)	No, meadows are significantly changed due to grazing.	Yes, Cattle grazing has stopped, the habitat will return to its original state.	No

G1.6 Beech forests	Yes, but the signs of timber logging are observed.	Yes, where the forest has historically been significantly intruded	No
Pontic beech forests (G1.6E)	Yes, but the signs of timber logging are observed.	Yes, where the forest has historically been significantly intruded	No
Caucasian beech forests (G1.6H)	Yes, but the signs of timber logging are observed.	Yes, where the forest has historically been significantly intruded	No
Chestnut woodland (G1.7D)	Yes, but the signs of timber logging are observed.	No	No
Chestnut forests G1.7DA	Yes, but the signs of timber logging are observed.	No	No
Balkano-Pontic fir forests (G3.17)	Yes, but the signs of timber logging are observed.	No	No
Mixed fir - spruce - beech woodland (G4.6)	Yes, but the signs of timber logging are observed.	No	No
Arable land and market gardens (I1)	No	No	Modified due to grazing and plowing
Entire area of the category as to Map 15.	**925.51 ha**	**579.25 ha**	**7.30 ha**

Natural, semi-natural and modified habitats



Risks and Impact on Vegetation

Habitat loss – general

Due to the small impoundment, a habitat will be lost (0.24 ha). No habitat loss is expected beyond the area of project facilities.

Ошибка! Источник ссылки не найден. Habitat losses were estimated for both permanent and temporary losses:

1. Total area – this is the total area of each habitat in the study territory.
2. Loss due to the construction – This is the total area that will be affected by the construction. It includes both permanent and temporary loss of habitat.
3. Permanent loss - This is a loss of habitat caused by the arrangement of permanent infrastructure; for instance, flood zone, powerhouse, new roads and others, they will replace the existing habitat at least during the project operation. These are habitats that will be impossible to restore during the project operation period.
4. Temporary loss – This is a habitat that will be destroyed/affected during the construction phase but restored or rebuilt during the construction period/since construction is completed. Territories considered to be temporarily lost include the workers' camp and others that will be subject to a restoration plan once work is stopped in those areas.

Estimation of habitat loss, ha

Characteristic (*habitat of conservation value)	1. Total area	2. construction impact	3. Permanent loss	4. Temporary loss
* Moist or wet eutrophic and mesotrophic grassland (E3.4)	3.34	0.18	0.09	0.09
* Pontic alpenrose heaths (F2.226)	81.42	0	0	0
Riparian and gallery woodland, with dominant alder (G1.1)	229.05	4.43	1.22	3.21
Trampled mesophilous grasslands with annuals (E2.8)	92.78	6.26	3.07	3.19
*Beech forests (G1.6)	405.16	2.28	0.5	1.78
* Pontic beech forests (G1.6E) mosaic * Chestnut forests G1.7DA	199.40	0	0	0
* Caucasian beech forests (G1.6H)	839.73	7.12	0.95	6.17
Chestnut woodland (G1.7D) mosaic along with Riparian and gallery woodland, with dominant alder (G1.1)	37.98	0	0	0
* Balkano-Pontic fir forests (G3.17)	114.97	1.6	0.28	1.32
Mixed fir - spruce - beech woodland (G4.6)	580.54	14.02	1.4	12.62
Arable land and market gardens (I1)	7.30	3.16	1.58	1.58
Total	**2599.41**	**39.05**	**9.09**	**29.96**

*habitats with a star are that meet the habitat criteria in Annex 1.

The loss of siginificant vegetation habitats

From habitats that will be lost, four habitats are of conservation value (mainly due to the fact that they meet the habitats criteria of Annex 1), which will be affected by the project:

- Moist or wet eutrophic and mesotrophic grassland (E3.4)
- Beech forests (G1.6)
- Caucasian beech forests (G1.6H)
- Balkano-Pontic fir forests (G3.17)

The most humid eutrophic and mesotrophic grassland habitats are those that are located near streams or ponds or on a slope where water flows. These habitats are common in these areas above the forest strip, but their area is limited and fragmented as they depend on the availability of suitable ground conditions. Due to its fragmentary nature, it is impossible to map all these areas. Therefore, two main areas identified during the survey were mapped. The total loss of this type of habitat will be 0.18 ha, 0.09 out of which is likely to be restored.

Beech and alter is distributed in these Caucasian beech forests. These types of forests are the most common in the study area. the forest is felled in some areas, but it is intact in less accessible places. 1,244 ha of this habitat in the study area, where it did not have a mosaic nature along with other habitats was mapped. But additional 199 ha is mosaic along with Euxinian chestnut forests. The loss due to the project will presumably be 9.40 ha, 1.45 ha out of which will be permanently lost, while trees will be possible to be re-planted on 7.95 are.

Balkano-Pontic fir forests are observed in the upper part of the study area and often form a line of trees between the forest and the meadows. It appeared that the fir forests close to the line of trees (and at the water intake area) are the secondary forests developed after deforestation. Relatively intact forests are extended on steep slopes of the valley and they will not be affected by the project. Due to the project, 1.6 ha of such forests will be lost, 0.28 ha out of which will be permanently lost.

Loss of Valuable Botanical Species

The only species included in the Red List of Georgia detected in the study area was sweet chestnut. Due to size of the study area and the location of project infrastructure (upstream of forests where sweet chestnut is developed), the loss of this species is not expected.

Invasive Species

It is assumed that invasive species may be introduced from outside into the project territory, when large trucks and other machinery move through the project construction site. However, as it is known at this stage, cobble stone, aggregate and rocks will be brought from local quarries, so this action is less expected to become a source of invasive species.

Three invasive species were observed in the study area.

- *Erigeron annuus* annual fleabane – grows along paths, roads and degraded habitats. This species was developed worldwide, but it originates from the east of the North America. It can spread with great density due to rapid growth and rapid seed production (Parcanoski, 2017), which can cause some damage to local ecosystems.
- *Erigeron (Conyza) canadensis* horseweed - grows along paths, roads and degraded habitats. This is onse of the widespread invasion species in the region. The research conducted in Russia confirmed

that horseweed is distributed in 30 regions and it originates from the North America (Vinogradova, et al., 2018).

- *Polygonum thunbergii knotweed* – grows near the rivers and humid areas. In the manual – "Non-native flora of Georgia" (Kikodze, et al., 2010), this species is described as a naturalized species in the territory. Naturalized species are species that are constantly reproducing and maintaining populations for many life cycles without direct intervention from humans. It is not necessary that they occupy the habitat, so this species is not classified as an invasive plant.

From three invasive species, two of them are daisy species grown on soils, their natural state has changed because they are mainly colonisers. Within the project construction stage, these two species may develop along the new roads, from the powerhouse to the water intake area. Polygonum thunbergia can also spread there, where the infrastructure is close to the river of streams. The spread of these three species without mitigation measures is likely to have a negligible but negative impact. None of them is very invasive and/or harmful species, all of them are naturalized in Georgia. However, mitigation measures will be carried out to prevent these species from spreading to the project area.

Additional information on the survey of critical habitats is provided in Annex N4 – the Report on Biodiversity Impact Assessment (SLR).

5.4.1.3 Results of Recording Wood Resouces through the Project Affected Territories

According to the results of the preliminary recording (taxation) of wood resources through the project affected territories of Bakhvi 1 HPP, the umber of cutting tree-plants is 3 526 stands, while the volume of wood resources - 6062.27 m^3. Quantity of tree-plants and the volumes of wood resources are provided I Table 5.4.1.3.1.

According to Table 5.4.1.3.1., three species of trees are subject to felling within the project impact zone of Bakhvi 1 HPP, namely: beech, spruce and alder. Based on taxation, no species included in the Red List of Georgia were detected in the project territory.

The electronic version of the complete wood taxation materials is attached to the EIA report, Annex N5.

Table 5.4.1.3.1. Number of tree-plants and volumes of wood resources according to the species

Species	Quantity	Volume - m^3
Beech	2638	5521.23
Spruce	472	516.76
Alder	416	24.28

5.4.1.4 Conclusions and Recommendations

- The project implementation is planned in a zone covered with a medium density forest. Cutting-uprooting of vegetation will be required through a significant part of the project territory. However, the removed vegetation will not be equivalent to extinction for any species;
- According to the survey results, no species included in the Red List of Georgia were detected through the project corridor. In some sections, the red-listed species - sweet chestnut (*Castanea sativa)* was observed. In addition, it should be noted that some rare, relict and vulnerable species are found through the project territory;
- The impact on endemic/relict plant species found through the project corridor of Bakhvi 1 HPP can be assessed as significant;

- The impact on vegetation cover and the integrity of local habitats can be assessed as moderate;
- The entire corridor of the planned construction works can be assessed as moderately sensitive;
- The spread of diseases is expected that can be entailed by the destruction of vegetation cover due to the construction works, which in its turn may lead to the rapid spread of insects and fungi that cause diseases of ligneous plants, followed by invasion and desiccating of large areas of the forest;
- Habitats will be fragmented during the planned works.

Reccommendations

- The company, which plans and implements the construction of Bakhvi 1 HPP must follow the relevant standards established by the Georgian law when removing the plant specimens included in the Red List of Georgia; in case of cutting the red-listed tree species, the wood should be stored in a safe place and the compensation value of the removed resource should be determined according to its cubic volume
- Red-listed tree and shrub specimens with a trunk smaller than 8 cm in diameter (if any) should be transplanted to the safe territories from the project territories and those areas where the vegetation is removed for the construction of access roads. Transplantation should be carried out in accordance with safety rules in a similar habitat from which these individuals will be uprooted.
- Personnel should be instructed on vegetation protection and species identification issues before the works are launched;
- Avoid endemic, relict and red list species in the project corridor as much as possible.
- Do not use the equipment there where it is possible to work with manpower;
- Do not disturb the established boundaries;
- For the construction and subsequent maintenance of the HPP, the road network should be planned in a way that not to cross large areas of the forest and to avoid forest fragmentation; a secondary road has already been arranged through the project territory and in its vicinities that is useful for the construction organizer;
- A plan for the removal of plants' resources and the impact on vegetation cover should be developed in a way that to reduce the quantity of cutting trees and uprooting shrubs as far as possible;
- Preventive measures should be taken in cooperation with the municipality, communities and forestry department to prevent arbitrary, illegal deforestation by the population;
- Vegetation cover should be restored artificially or naturally through the roads and cleared territories arranged during the construction works, which will no longer be required after completion of works (eg construction camp area, secondary access roads);
- Substances containing pollutants, such as oil products, asbestos and heavy metals should be controlled to avoid their propagation in the environment during the construction works.

5.4.1.5 Photo Material of Some Species Present through the Project Corridor


Geranim psilostemon


Mentha longifolia


Rumex alpinus


Gentiana septemfida


Origanum vulgare


Helleborus caucasicus


Digitalis schischkinii


Inula magnifica


Veratrum lobelianum


Rhododendron caucasicum


Globularia trichosantha


Hieracium umbellatum


Prunella vulgaris


Helichrysum graveolens


Rhamnus imeretina


Campanula glomerata

Corylus avellana

Picea orientalis

Swertia iberica

Astrancia maxima

Alchemilla rigida

Ribes alpinum

Paris incompleta

Ruscus colchicus

Ilex colchica

Sorbus aucuparia

Vaccinium arctostaphylos

Petasites albus

Vaccinium myrtillus

Fagus orientalis

5.4.2 Fauna

5.4.2.1 Introduction

The results of biological survey through the project corridor of Bakhvi 1 HPP on Bakhvistskali River in Ozurgeti and Chokhatauri municipalities are provided in this paragraph.

5.4.2.2 Survey Goal

It should be noted that the field surveys were conducted in August 2020 and October 2021, the basic purpose of the surveys was to determine the animal species composition through the study area and to identify significant habitats of inhabiting animals; to define the expected impact on animal's species diversity in the construction and operation processes and to develop mitigation measures. Special attention was drawn to the species protected by the Georgian legislation and international treaties (Red-listed and other species with conservation status); as well as the species significant and interesting for the local population and tourists. Fauna study results are based on the literary data, professional experience, data obtained during the fieldwork carried out within the study area.

5.4.2.3 Materials and Methods Used for the Survey

A transect method was used during the survey. All found species were visually detected and identified on the transect along the valley. signs of vitality were recorded as well: footprints, feces, holes, feathers, fur, etc. Extrapolation of animal species distribution based on landscape belonging was also carried out and it was determined what species may have existed in the study area. Depending on the characteristics of the location, what is their purpose for certain species - they use it as a feeding area, shelter and due to the proximity of water and settlements, etc.

Fauna survey methods used within the field surveys

	Method
Large and medium mammals	Mammals are recorded according to footprints along 1-5 km routes and transects, as well as visually, they were photographed both day and night. Identification of species according to the signs of vitality (hollow, hole, lair, footprints, feces, fur). [note: the survey method also involves identifying a predator based on a wound inflicted on the body if prey is found.]
Bats	Visual recording of bats, finding and register their roosts; detection with a bat's detector. Recording of bats is conducted along the routes and transects, as well as in forests, lanes, at separate trees, in underground shelters, buildings and by long-term observations at the banks of reservoirs. Bats were recorded both visually and with an ultrasonic detector Anabat Walkabout. The presence of a large number of one species in a small area indicates the presence of a colony (maternity, male or wintering colonies), in such case the colony is recorded, its approximate size is determined.
Birds	Birds watching was carried out along the transects and recording sites. In addition, nests and birds' concentration sites were accounted. Watching with a binocular, visual observation and photographing, identification by voice, finding of signs of vitality. The birds watching was carried out in sunny and windless weather. Some species were identified by their voices. We determined the species through special birds' handbooks. (Birds of Europe: Second Edition by Lars Svensson and Dan Zetterström და Collins Bird Guide. 2Nd Edition).
Reptiles and amphibians	Visual observation and photographing, inspection special areas. Reptiles and amphibians were observed on transects, in shelters and reservoirs. We also used material obtained in previous years, data published in the scientific literature, and also interviewed local hunters and employers of the forestry agency.
Invertebrates	Visual recording, inspection of stones, soil, plant residues.

International Union for Conservation of Nature (IUCN) categories and criteria were used to evaluate the vulnerability of species distributed through the study area. The assessment was performed in accordance with the Red List of Georgia and IUCN Red List (version 2021).

Used tools

- Photo cameras: Canon PowerShot SX50 HS; Canon PowerShot SX60 HS;
- GPS: Garmin montana 680 GPS;
- Binocular: Opticron Trailfinder 3 WP, 8x42;
- Bats detector: Anabat Walkabout Bat Detector (Version 1.3).

5.4.2.4 Protected Areas

It should be noted that the project territory does not fall within the boundaries of any protected area of Georgia, however, it falls within the Key Biodiversity Area (KBA) of "Bakhmaro" (Zazanashvili, N., Sanadiradze, G. et al. 2020), according to the plan of „ECOREGIONAL CONSERVATION PLAN FOR THE CAUCASUS 2020 EDITION“ developed in 2020.. Consequently, standards considering the safety of species and implementation of surveys within the protected areas and Key Biodiversity Areas were taken into account in frames of the field surveys.

The most part of KBA of "Bakhmaro" falls within the conservation landscapes of the “Western Lesser Caucasus” and it is presented by 4 fauna species, they are:

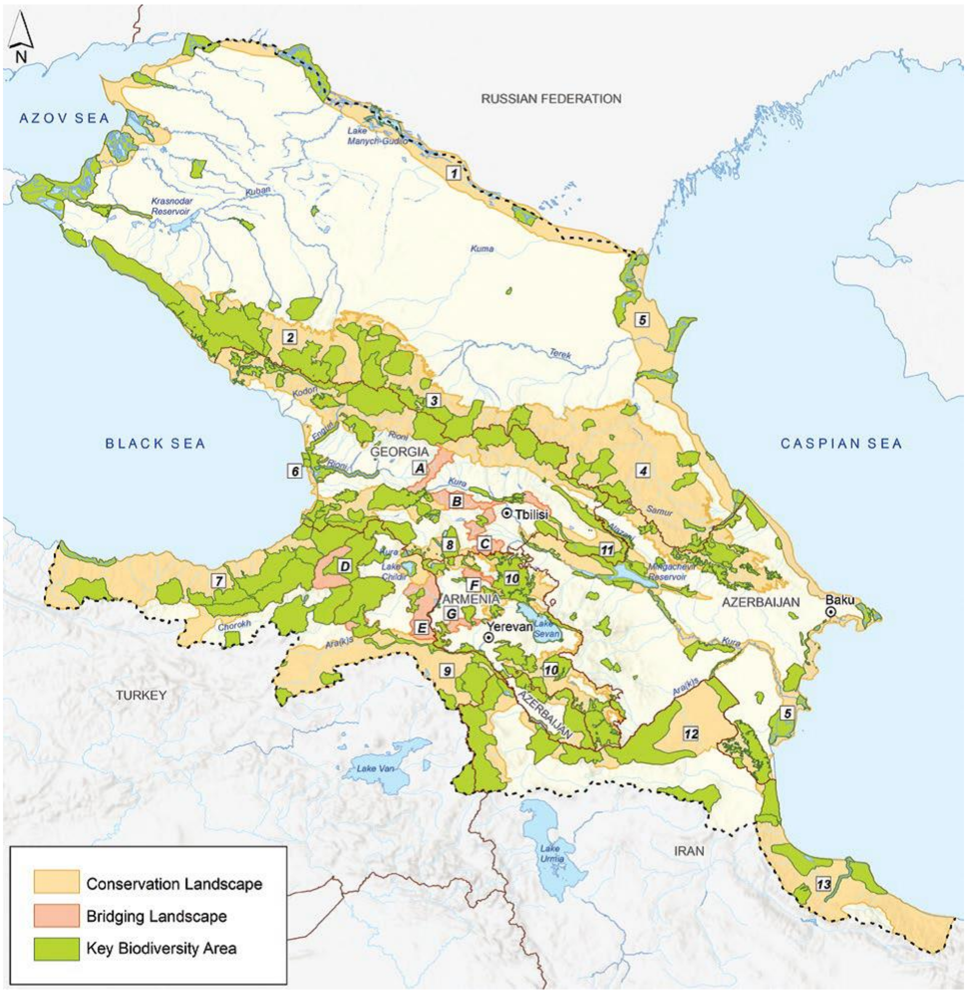
- Mehely's horseshoe bat *Rhinolophus mehelyi (mammal; bat)*
- Caucasian Grouse *Lyrurus mlokosiewiczi - same Tetrao mlokosiewiczi (bird)*
- Caucasian viper *Vipera kaznakovi (reptiles)*
- Caucasian Salamander *Mertensiella caucasica (Amphibia)*

Map 5.4.2.4.1. Mutual location of Bakhmaro biodiversity area and the project zone

In frames of the implemented field surveys, none of the mentioned four fauna species were observed through the project corridor, favorable or/and inhabiting habitat of the Caucasian Grouse *(Lyrurus mlokosiewiczi)* is observed upstream of the project zone (HPP headwork) in Bakhmaro adjacent areas. The vertical distribution area of the Caucasian viper *(Vipera kaznakovi)* is not extended up to these elevations (the project zone falls within 1400-1800 m a.s.l.). It is observed up to 1000 m above the sea level, accordingly, its presence is less expected; as for two other species, their presence cannot be ruled out through the project impact zone.

According to the „Ecoregional Conservation Plan (ECP)“, 231 Key Biodiversity Areas (KBA) have been identified in the Caucasus region [60 of which are found in Georgia]. Also 13 conservation [in Georgia 7] and 7 connecting (corridor) [in Georgia 3] landscapes (See Map 5.4.1.4.2.).

Map 5.4.2.4.2. Landscapes of the Caucasus region and Key Biodiversity Areas (KBAs)



In terms of landscape point of view, the project zone falls within the conservation landscape - „7-Western Lesser Caucasus", which covers quite large territories and extends beyond Georgia, the most part is located in Turkey.

The project area fully gets within the Important Bird Areas (IBA), namely „Adjara-Imereti Ridge GE015", the relevant information is given in detail in Paragraph 5.4.2.7.2. Birds *(Aves).*

To protect biodiversity and forest ecosystems of Guria region, the design works of Guria National Park are being carried out. The project is implemented by the Ministry of Environmental Protection and Agriculture of Georgia with the financial assistance of Sweden. The survey works of the biological environment baseline conditions of the National Park are carried out by World Wildlife Fund for Nature (WWF).

The survey of the international consulting company SLR included the finding of protected territories in a 15 km radius from the study area. Six protected territories provided on the map have been identified. Three out of five are located within the study radius, but they are beyond the 15 km radius from the water withdrawal and powerhouse areas, so these territories are not reviewed here (Kintrishi Emerald area; Kintrishi National Protected Area and National Park; and Kintrishi Important Bird and Biodiversity Areas). Those three territories located closer than 15 km distance are described below:

Important Bird and Biodiversity Areas (IBA) Adjara-Imereti Range

Boundaries of these Important Bird and Biodiversity Areas were changed in 2018 and now includes 261 831 ha where the study area and project infrastructure are located.

This Important Bird and Biodiversity Areas was created for the following bird species:

Caucasian grouse Lyrurusmlokosiewiczi;
Corn crake Crex crex;
Great snipe Gallinago media; and
Eastern imperial eagle *Aquila helica.*

Key Biodiversity Area (KBA) Adjara-Imereti Range

The boundary of this Key Biodiversity Area was changed in 2018 and now includes 261 831 ha where the study area and project infrastructure are located. The above mentioned Important Bird and Biodiversity Area and Key Biodiversity Area have the same borders.

This Key Biodiversity Area was created to protect the following species (four species out of five bird species are the same as in the case of the above-mentioned Important Bird and Biodiversity Area)

Bufo verrucosissimus Caucasian toad
Mertensiellacaucasica Caucasian Salamander
Pelodytes caucasicus Caucasian parsley frog
Aquila heliacal eastern imperial eagle
Crex crex Corn crake
Gallinago media Great snipe
Lyrurusmlokosiewiczi •Caucasian grouse
Tetraogallusc aspius Caspian snowcock
Barbastella barbastellus Western Barbastelle
Myotis bechsteinii Bechstein's bat
Myotis emarginatus Geoffroy's bat
Rhinolophus hipposideros Lesser horseshoe bat
Vipera kaznakovi Caucasian vipre

Pontic Oak Managed Reserve

There is a managed reserve formed to protect Pontine Oak *Quercus pontica.* This Reserve borders the main road to Bakhmaro, which is located 4.35 km northeast of the water intake. The Pontic oak is a species of oak native to the Caucasus Mountains of western Georgia, northeastern Turkey, and Armenia. It grows from 1,300 to 2,100 m above the sea level. The height of the tree reaches only 6-8 meters, so it can look quite dwarf from a distance.

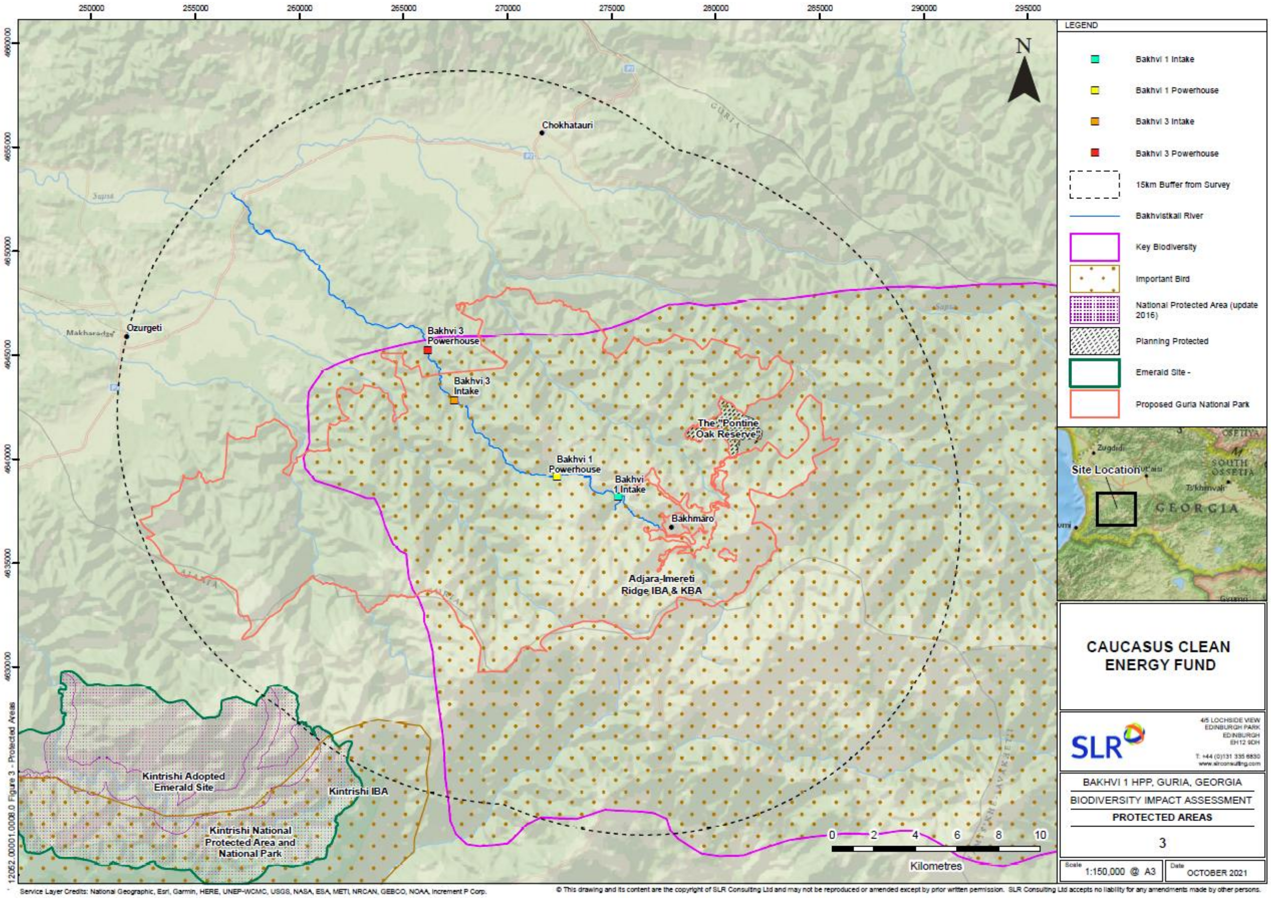
Planned National Park – Guria

In frames of the theoretical research, information was obtained about the work that has been done to form a new national park in Guria. The Guria National Park project is being implemented by the Ministry of Environmental Protection and Agriculture of Georgia, Agency of Protected Areas and World Wildlife Fund for Nature (WWF), with the financial assistance of the Swedish Embassy and the active involvement of local authorities.

The aim of the project is to respond to the challenges associated with the Guria forest landscape, in particular, the damage due to human activities, the protection of biodiversity and ecosystems, and the promotion of population growth. The project of creating a national park has just started, the study of baseline conditions and consultations are currently being implemented.

Full information on these studies is provided in Annex N4, the Report of Biodiversity Impact Assessment (SLR).

Protected areas



5.4.2.5 General Zoogeographical Description of the Study Area

In zoogeographical point of view, the South Caucasus is part of the Eastern Mediterranean sub-region of the Palearctic region. Bakhvistskali River valley is located in the Caucasus part of this sub-district (Верещагин 1959; Гаджиев 1986). In terms of physical-geographical viewpoint, it is included in the Western Caucasus sub-region of the Caucasus Highlands (Ukleba 1981).

For zoological purposes, the given landscapes can be roughly divided into two main parts – forest and sub-alpine meadow. Rocky and riparian ecosystems are separately allocated that are included in these landscapes. The wildlife is homogenous in these 4 ecosystems as they are mostly located in the forest belt, however, they are partially composed of species that are typical only for those ecosystems.

The gorge is narrow within the powerhouse area; the forest is developed on steep slopes. Landscapes are in good natural conditions. Animals typical for water banks and forest ecosystems inhabit in this area but in small numbers, as the declined areas are less populated. The forest is in good condition, suitable as a shelter as well as a feeding area (see Pic. 5.4.2.5.1.).

Pic. 5.4.2.5.1. Habitats in the lower part of the valley (toward the power house)

Pic. 5.4.2.5.2. Habitats in the middle of the valley

The valley is relatively wider in the upper elevation of the project corridor (toward Bakhmaro borough) where subalpine meadows, as well as forested sections with a dense and well-developed undergrowth are observed. There is a subalpine meadow at the HPP headwork, as well as the sections covered with a coniferous forest on the left bank of the river (see Pic. 5.4.2.5.3.).

Pic. 5.4.2.5.3. Habitats in the upper part of the valley (toward the headwork)

Pic. 5.4.2.5.4. Habitats on the access roads to the power house

Pic. 5.4.2.5.5. Habitats on the access roads to the HPP headwork

5.4.2.6 Distribution of Animal Species according to Ecosystems, Literary Data and Landscape Belonging

According to the literary and our unpublished data, 63 species of mammals, 259 species of birds, 11 species of reptiles, 9 species of amphibians are currently found in Guria (Bukhnikashvili and others 2015, Банников и др. 1977). These data are not sufficient as the fauna of Guria region is poorly studied, especially, invertebrates, 80-85 % of them is not studied at all.

Forest fauna of the project region:

Mammals – Caucasian mole *(Talpa caucasica),* Levant mole (*Talpa levantis*), Transcaucasian water shrew *(Neomys teres),* group "whiskered bat" *(„Myotis mystacinus" group)*,* Natterer's bat *(Myotis nattereri),* Daubenton's bat *(Myotis daubebtonii),* greater noctule bat *(Nyctalus lasiopterus),* common noctule *(Nyctalus noctula),* common pipistrelle *(Pipistrellus pipistrellus),* least weasel *(Mustela nivalis),* European pine marten *(Martes martes),* European badger *(Meles meles),* otter *(Lutra lutra),* Brown bear *(Ursus arctos),* wildcat *(Felis sylvestris),* lynx *(Lynx lynx),* grey wolf *(Canis lupus),* red fox *(Vulpes vulpes),* golden jackal *(Canis aureus),* red fox *(Sciurus vulgaris),* forest dormouse *(Dryomys nitedula),* edible dormouse *(Glis glis*), Major's pine vole *(Microtus majori),* bank vole *(Clethrionomys glareolus),* eastern broad-toothed field mouse *(Sylvaemus mystacinus),* herb field mouse(*Sylvaemus uralensis),* Caucasus field mouse *(Sylvaemus ponticus)*, black rat *(Rattus rattus),* wild boar *(Sus scrofa),* western roe deer *(Capreolus cdpreolus)* et.al.

Birds (only those species that permanently inhabit, nest, or winter there are provided here and in all other cases)– Levant sparrowhawk *(Accipiter brevipes),* northern goshawk *(Accipiter gentilis),* Eurasian Sparrowhawk *(Accipiter nisus),* Common Buzzard *(Buteo buteo),* Peregrine Falcon *(Falco peregrinus)*, Common Wood-Pigeon *(Columba palumbus),* Common Cuckoo *(Cuculus canorus),* Tawny Owl *(Strix aluco),* Greater Spotted Woodpecker *(Dendrocopos major),* Eurasian Green Woodpecker *(Picus viridis),* Wood Lark *(Lullula arborea),* Tree Pipit (*Anthus trivialis*), Winter Wren *(Troglodytes troglodytes),* Hedge Accentor (Dunnock) *(Prunella modularis),* European Robin *(Erithacus rubecula),* Common Redstart *(Phoenicurus phoenicurus),* Black bird*(Turdus merula),* Song Thrush *(Turdus philomelos),* Mistle Thrush *(Turdus viscivorus),* Blackcap *(Sylvia atricapilla),* Common Chiffchaff *(Phylloscopus collybita)*, greenish warbler *(Phylloscopus trochiloides)*, Spotted Flycatcher *(Muscicapa striata),* Long-tailed Tit *(Aegithalos caudatus),* Coal Tit *(Parus ater),* Blue Tit *(Parus caeruleus),* Great Tit *(Parus major),* Wood Nuthatch *(Sitta europaea),* Eurasian Tree-creeper *(Certhia familiaris),* Eurasian Jay *(Garrulus glandarius),* Common Raven *(Corvus corax),* Eurasian Chaffinch *(Fringilla coelebs),* Eurasian Siskin *(Carduelis spinus),* Hawfinch *(Coccothraustes coccothraustes).*

Reptiles – Slow worm *(Anguis colchicus)*, Derjugin's lizard *(Darevskia derjugini),* Ajarian lizard *(Darevskia mixta),* grass snake *(Natrix natrix),* Caucasian viper *(Vipera kaznakovi)* et. al.

Amphibians – northern banded newt *(Ommatotriton ophryticus),* Caucasian toad *(Bufo verrucosissimus),* European green toad *(Bufo viridis),* European tree frog *(Hyla arborea),* long-legged wood frog *(Rana macrocnemis).*

Fauna inhabiting close to water bodies in the project region:

(This biotope is mostly composed of the same species as the forest, but here are also typical, water-related species)

Mammals – Caucasian mole *(Talpa caucasica),* Levant mole (*Talpa levantis*), Transcaucasian water shrew *(Neomys teres),* group "whiskered bat" *(„Myotis mystacinus" group)*,* Natterer's bat *(Myotis nattereri),* Daubenton's bat *(Myotis daubebtonii),* greater noctule bat *(Nyctalus lasiopterus),* common noctule *(Nyctalus noctula),* common pipistrelle *(Pipistrellus pipistrellus),* least weasel *(Mustela nivalis),* European pine marten *(Martes martes),* European badger *(Meles meles),* otter *(Lutra lutra),* Brown bear *(Ursus arctos),* wildcat *(Felis sylvestris),* lynx *(Lynx lynx),* grey wolf *(Canis lupus),* red fox *(Vulpes vulpes),* golden jackal *(Canis aureus),* red fox *(Sciurus vulgaris),* forest dormouse *(Dryomys nitedula),* edible dormouse *(Glis glis*), Major's pine vole *(Microtus majori),* bank vole *(Clethrionomys glareolus),* eastern broad-toothed field mouse *(Sylvaemus mystacinus),* herb field mouse(*Sylvaemus uralensis),* Caucasus field mouse *(Sylvaemus ponticus)*, black rat *(Rattus rattus),* brown rat *(Rattus norvegicus),* western roe deer *(Capreolus cdpreolus)* et.al.

Birds (only those species that permanently inhabit, nest, or winter there are provided here) – Levant sparrowhawk *(Accipiter brevipes),*)– Levant sparrowhawk *(Accipiter brevipes),* northern goshawk *(Accipiter gentilis),* Eurasian Sparrowhawk *(Accipiter nisus),* Common Buzzard *(Buteo buteo),* Peregrine Falcon *(Falco peregrinus)*, Common Sandpiper *(Actitis hypoleucos),* Common Wood-Pigeon *(Columba palumbus),* Common Cuckoo *(Cuculus canorus),* Tawny Owl *(Strix aluco),* Greater Spotted Woodpecker *(Dendrocopos major),* Eurasian Green Woodpe *(Picus viridis),* Wood Lark *(Lullula arborea),* Tree Pipit *(Anthus trivialis),* White Wagtail *(Motacilla alba),* Grey Wagtail *(Motacilla cinerea),* White-throated Dipper *(Cinclus cinclus),* Winter Wren *(Troglodytes troglodytes),* Hedge Accentor (Dunnock) *(Prunella modularis),* European Robin *(Erithacus rubecula),* Common Redstart *(Phoenicurus phoenicurus),* Black bird *(Turdus merula),* Song Thrush *(Turdus philomelos),* Mistle Thrush *(Turdus viscivorus).* Blackcap *(Sylvia atricapilla),* Common Chiffchaff *(Phylloscopus collybita),* greenish warbler *(Phylloscopus trochiloides)*, Spotted Flycatcher *(Muscicapa striata),* Long-tailed Tit *(Aegithalos caudatus),* Coal Tit *(Parus ater),* Blue Tit *(Parus caeruleus),* Great Tit *(Parus major),* Wood Nuthatch *(Sitta europaea),* Eurasian Tree-creeper *(Certhia familiaris),* Eurasian Jay *(Garrulus glandarius),* Common Raven *(Corvus corax),* Eurasian Chaffinch *(Fringilla coelebs),* Eurasian Siskin *(Carduelis spinus),* Hawfinch *(Coccothraustes coccothraustes).*

Reptiles – Slow worm *(Anguis colchicus),* Derjugin's lizard *(Darevskia derjugini)*, Georgian lizard *(Darevskia rudis),* Ajarian lizard *(Darevskia mixta),* grass snake *(Natrix natrix),* dice snake *(Natrix tesselata),* Caucasian viper *(Vipera kaznakovi).*

Amphibians – Caucasian salamander *(Mertensiela caucasica),* northern banded newt *(Ommatotriton ophryticus),* Caucasian toad *(Bufo verrucosissimus),* European green toad (*Bufo viridis*), European tree frog *(Hyla arborea),* marsh frog *(Pelophylax ridibundus),* long-legged wood frog *(Rana macrocnemis).*

Fauna of the rocky ecosystems of the project region:

(This biotope is the most different from the others due to the specificity of its habitats):

Mammals - group "whiskered bat" *(„Myotis mystacinus" group)*,* Natterer's bat (*Myotis nattereri*), greater noctule bat *(Nyctalus lasiopterus),* common noctule *(Nyctalus noctula),* Lesser horseshoe bat *(Rhinolophus hipposideros),* common pipistrelle *(Pipistrellus pipistrellus),* least weasel *(Mustela nivalis),* beech marten *(Martes foina),* wildcat *(Felis sylvestris),* lynx *(Lynx lynx),* grey wolf *(Canis lupus),* red fox *(Vulpes vulpes),* edible dormouse *(Glis glis),* Major's pine vole *(Microtus majori),* eastern broad-toothed field mouse *(Apodemus mystacinus),* herb field mouse *(Sylvaemus uralensis)* et.al.

Birds (majority of forest birds use rocky ecosystems for feeding, so they are observed there as well) - Levant sparrowhawk *(Accipiter brevipes),* northern goshawk *(Accipiter gentilis),* Eurasian Sparrowhawk *(Accipiter nisus),* Common Buzzard *(Buteo buteo),* Common Wood-Pigeon *(Columba palumbus),* Common Cuckoo *(Cuculus canorus),* Tawny Owl *(Strix aluco),* Wood Lark *(Lullula arborea),* Tree Pipit *(Anthus trivialis),* Winter Wren *(Troglodytes troglodytes),* Hedge Accentor (Dunnock) *(Prunella modularis),* European Robin *(Erithacus rubecula)*, Common Redstart *(Phoenicurus phoenicurus),* Northern wheatear *(Oenanthe oenanthe),* Black bird *(Turdus merula),* Song Thrush *(Turdus philomelos),* Mistle Thrush *(Turdus viscivorus),* Red-backed shrike *(Lanius collurio),* Blackcap *(Sylvia atricapilla),* Common Chiffchaff *(Phylloscopus collybita),* Spotted Flycatcher *(Muscicapa striata),* Long-tailed Tit *(Aegithalos caudatus),* Coal Tit *(Parus ater),* Blue Tit *(Parus caeruleus),* Great Tit *(Parus major),* Eurasian Jay (*Garrulus glandarius*), Common Raven *(Corvus corax),* Eurasian Chaffinch *(Fringilla coelebs),* Eurasian Linnet *(Linaria cannabina),* Twite *(Carduelis flavirostris),* Eurasian Siskin *(Carduelis spinus),* Hawfinch *(Coccothraustes coccothraustes),* Rock Bunting *(Emberiza cia),* Corn Bunting *(Miliaria calandra).*

Reptiles – Derjugin's lizard *(Darevskia derjugini),* Georgian lizard *(Darevskia rudis),* Ajarian lizard *(Darevskia mixta),* Slow worm *(Coronela austriaca),* Caucasian viper *(Vipera kaznakovi).*

Amphibians – Caucasian toad *(Bufo verrucosissimus),* European green toad *(Bufo viridis),* long-legged wood frog *(Rana macrocnemis).*

Fauna of subalpine meadow of the project region

Mammals – Caucasian mole *(Talpa caucasica),* Levant mole *(Talpa levantis),* group "whiskered bat" *(„Myotis mystacinus" group)*,* Natterer's bat *(Myotis nattereri),* Daubenton's bat *(Myotis daubebtonii),* greater noctule bat *(Nyctalus lasiopterus),* common noctule *(Nyctalus noctula),* common pipistrelle *(Pipistrellus pipistrellus),* least weasel *(Mustela nivalis),* beech marten *(Martes foina),* European badger *(Meles meles),* red fox *(Vulpes vulpes),* otter *(Lutra lutra)*, Caucasian squirrel *(Sciurus anomalus),* Robert's snow vole *(Chionomys roberti)*, Major's pine vole *(Microtus majori),* eastern broad-toothed field mouse (*Sylvaemus mystacinus*), herb field mouse *(Sylvaemus uralensis),* Caucasus field mouse *(Sylvaemus ponticus),* house mouse (*Mus musculus*), black rat (*Rattus rattus*), brown rat (*Rattus norvegicus*) and others.

Birds (only those species that permanently inhabit, nest, or winter there are provided here)– Caucasian Grouse (*Lyrurus mlokosiewiczi*), Red Crossbill (*Loxia curvirostra*) Eurasian Linnet *(Linaria cannabina),* Twite (*Carduelis flavirostris*), Rock Bunting *(Emberiza cia),* Common Raven (*Corvus corax*), Red-billed Chough (*Pyrrhocorax pyrrhocorax*), Yellow-billed Chough *(Pyrrhocorax graculus),* Common Rosefinch *(Carpodacus erythrinus)*, European Serin *(Serinus serinus),* Fire-fronted Serin *(Serinus pusillus),* Hawfinch *(Coccothraustes Coccothraustes),* European Goldfinch *(Carduelis carduelis),* Eurasian Chaffinch *(Fringilla* *coelebs*), Ring Ouzel *(Turdus torquatus),* Eurasian Blackbird *(Turdus merula),* Alpine Accentor *(Prunella collaris)* et.al.

Reptiles – grass snake *(Natrix natrix),* dice snake *(Natrix tessellata)*, smooth snake (*Coronella austriaca*), Georgian lizard *(Darevskia rudis),* sand lizard *(Lacerta agilis),* et.al.

Amphibians – European green toad (*Bufo viridis*), European tree frog *(Hyla arborea),* marsh frog (*Pelophylax ridibundus*) et.al.

5.4.2.7 Field Survey Results

There are both subalpine meadows and forested sections with well-developed undergrowth through the design corridor of Bakhvi 1 HPP, which makes it difficult to move within the valley and to identify animals and signs of their vitality.
The field surveys identified the fauna species present within the project territory. In addition, species were identified and their taxonomically valid scientific names were determined.
As a result of field works and processing of scientific literature, more than 30 mammal species, up to 20 bats, more than 90 birds species, up to 20 species of reptiles and amphibians, more than 500 species of mollusks and various invertebrates were identified throughout the project area and its surroundings.
5 main habitats were determined through the design corridor within the field surveys, they are as follows according to the IUNIS habitats classification:

- G3.1H Oriental spruce (Picea orientalis) forests;
- G1.1 Riparian and gallery woodland, with dominant alder, birch, poplar or willow;
- G1.6E13 Western Pontic rhododendron-oriental beech forests;
- E4 Alpine and subalpine grasslands;
- E3.4 Moist or wet eutrophic and mesotrophic grassland.

The international consulting company SLR conducted the additional, detailed survey of habitats; based on the field recording and the EUNIS classification system 14 habitats including 5 habitats identified by Gamma were accounted through the study area.

The list of habitats:

1. Permanent mesotrophic lakes, ponds and pools (C1.2)
2. Permanent non-tidal, fast, turbulent watercourses (C2.2)
3. Trampled mesophilous grasslands with annuals (E2.8)
4. Moist or wet eutrophic and mesotrophic grassland (E3.4)
5. Pontic alpenrose heaths (F2.226)
6. Riparian and gallery woodland, with dominant alder (G1.1)
7. Beech forests (parent category of G1.6E and G1.6H)
8. Pontic beech forests (G1.6E)
9. Caucasian beech forests (G1.6H)
10. Chestnut woodland (G1.7D)
11. Chestnut forests G1.7DA
12. Balkano-Pontic fir forests (G3.17)
13. Mixed fir - spruce - beech woodland (G4.6)
14. Arable land and market gardens (I1)

5.4.2.7.1 Terrestrial Mammals (class: *Mammalia*)

Tredators: Grey wolf *(Canis lupus).* Brown bear *(Ursus arctos)*, red fox *(Vulpes vulpes),* golden jackal *(Canis aureus)*, lynx *(Lynx lynx)*, European pine marten *(Martes martes),* wildcat *(Felis sylvestris),* otter *(Lutra lutra).* Ungulates: roe deer *(Capreolus capreolus)* and sometimes wild boar *(Sus scrofa)* enters the area. Insectivora: Caucasian mole *(Talpa caucasica),* Levant mole *(Talpa levantis),* Transcaucasian water shrew *(Neomys teres)* et.al. Rodents: Caucasian squirrel *(Sciurus anomalus),* edible dormouse *(Glis glis),* Forest Dormouse *(Driomys nitedula),* Major's pine vole *(Terricola majori),* Robert's snow vole *(Chionomys roberti),* eastern broad-toothed field mouse *(Apodemus mystacinus),* wood mouse *(Apodemus sylvaticus)* Ural field mouse *(Apodemus uralensis)* Black Sea field mouse *(Apodemus ponticus)* et.al. **In the corridor of the HPP headwork and the penstock initial section**:

Mammals: footprints and feces of brown bear *(Ursus arctos)*, as well as voles' holes and mole's *(Talpa sp.)* mounds. (Pic.5.4.2.7.1.1.- 5.4.2.7.1.4.)

In the corridor of middle section of the penstock and in the powerhouse area: following mammals were observed: feces of European pine marten *(Martes martes)* and footprints of brown bear *(Ursus arctos)*.

Pic. 5.4.2.7.1.1. Footprints of brown bear *(Ursus arctos)*
E 275798 N 4638422

Pic. 5.4.2.7.1.2. Footprints of brown bear *(Ursus arctos)*
E 271974 N 4639210

Pic. 5.4.2.7.1.3. Feces of brown bear *(Ursus arctos)*

E 276314 N 4638215

E 277064 N 4636772

Pic. 5.4.2.7.1.4. Feces of European pine marten *(Martes martes)*
E 271601 N 4639272

Pic. 5.4.2.7.1.5. Holes of voles
E 276319 N 4638246

Pic. 5.4.2.7.1.6. Mound of a mole *(Talpa sp.)*

E 275678 N 4638298

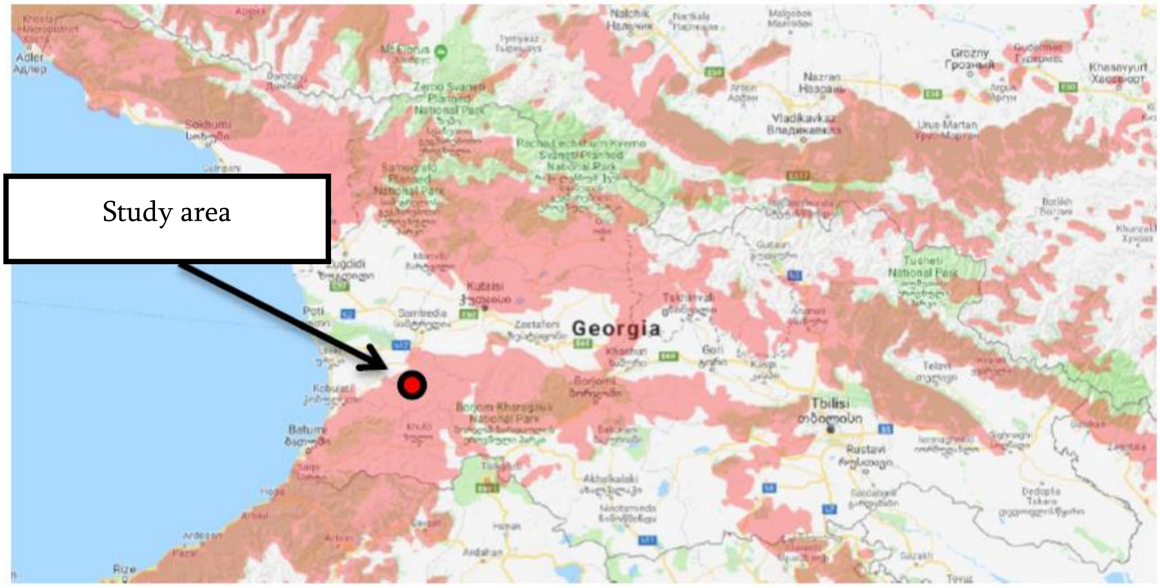
E 276409 N 4638326

Table 5.4.2.7.1.1. Species included in the Red List of Georgia

English name	**Latin name**	**IUCN**	**RLG**	**Bern Conv.**
Brown bear	*Ursus arctos*	LC	EN	√
Otter	*Lutra lutra*	NT	VU	√
Lynx	*Lynx lynx*	LC	CR	√
Caucasian squirrel	*Sciurus anomalus*	LC	VU	√
Bank vole	*Clethrionomys glareolus ponticus*	LC	EN	

Brown bear - *Ursus arctos:* Inhabiting area of brown bear is quite large, it wanders in the areas rich in food. Brown bear prefers forested mountainous region on upper elevations with widespread shelters and rocky caves. Habitat should be rich in food vegetation, such as: cherry laurel, hazel, wild pear, chestnut, berries and others. Bears are distinguished by low-density. Inhabiting territory of brown bear varies as follows: for males - 200-2000 km^2, while for females - 100-1000 km^2. Mating period of Brown bear is from May to June. It is active all day long, but it is mainly active at night. It is characterized by winter dormancy. Beginning and duration of dormancy depends on weather conditions. Brown bear arranges a lair by itself or uses a cave in upper elevations, on protected areas, which are covered with snow and preserve stable temperature. It lines an earth lair with dry vegetation. A lair is inaccessible for humans. Brown bear belongs to omnivores. It attacks a prey on the head and neck, after which skeletal system is broken and considerable bruises are also observed. Brown bear mainly feeds on innards and chest. It lives for 20/30 years.

Map 5.4.2.7.1.1. Distribution of brown bear in Georgia



Source: *http://biodiversity-georgia.net*

<u>Based on field surveys and information provided by local population, brown bears are common within the project territory, it uses these areas as a corridor for migration and food searching, but we cannot rule out its presence in the valley. Due to the small scale of the project, the planned construction works are less expected to have a significant impact on the conservation status of the brown bear population.</u>

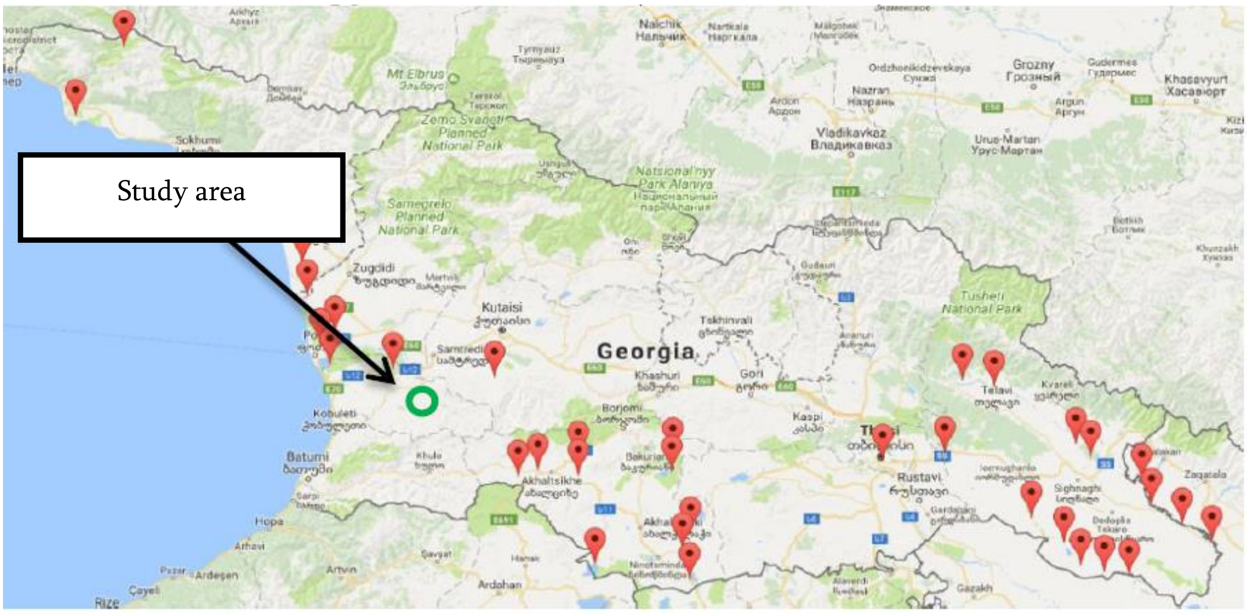
Otter - ***Lutra lutra:*** Special attention was drawn to the otter *(Lutra lutra)* included in the Red List of Georgia. According to the surveys in the Bakhvistskali River valley and scientific literature, the presence of this species is confirmed. It should be noted that the banks of Bakhvistskali River are rocky, however, there is a favorable habitat for the otter within the environs of the headwork; it means that a certain impact is expected on the otter, accordingly, implementation of mitigation measures is essential.

Pic. 5.4.2.7.1.7. Banks of Bakhvistskali River

<u>It should be noted</u> that the type and small scale of the planned works do not endanger the otter population in the valley, however, it is recommended to implement the mitigation measures to avoid any risks.

Map 5.4.2.7.1.2. Distribution of the otter in Georgia



Source: *http://biodiversity-georgia.net*

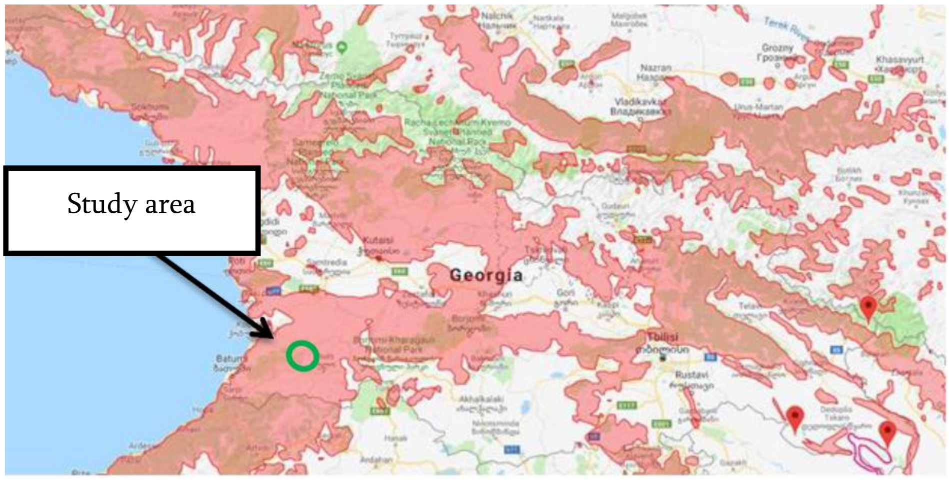
Mitigation Measures

- The period of construction works to be carried out near the river should be selected as far as possible so that it does not coincide with the breeding season of otters (it should be noted that otter mates in February-April, they give birth in various periods – April-May, June-August and even in December-February);
- The construction personnel will be instructed and warned about prohibition of illegal hunting and fishing;
- Before the construction works are launched, it will be inspected whether there are otter's holts or not;
- Detected holts will be accounted and it will be prohibited to approach them from April to July;
- The construction corridor will be protected so that the earthworks do not go beyond the marked area and do not damage the otters. Earthworks will be controlled by the properly qualified personnel;

Lynx- ***Lynx lynx*** **:** Way of life: habitat of a lynx is characterized by the diverse landscape structure. It prefers densely forested inclined slopes with undergrowth; rocky structure is extremely important for this species, it selects such rocky areas for inhabiting and observation the area; lynx permanently controls its territory. Its habitat should be rich in food: chamois, roe deer, hare, fox and others. Lynx is characterized by a solitary way of life. It establishes connection with other specimens only in mating period/January-April. After two months it gives birth 1-4 cubs, winter dormancy is not typical for this species. Lynx is active at night. In daytime it moves through 1,5- 2,5% of its inhabiting area. It permanently changes hunting area within its inhabiting territory. Lynx is characterized by special sight and hearing. Inhabiting area varies 100-1000 km^2 for males and 100-500 km^2 - for females. Scientific researches confirmed that the lynx hunts basically, at the forest edges; it rarely intrudes into an agricultural or populated territories. It attacks a prey from the ground and inflicts a deadly wound on a throat area. Lynx hides a prey and feeds for 3-7 days. According to the scientific researches, the lynx less inhabits in those habitats, where the wolf population is abundantly presented. Status RLG- [CR] IUCN-[LC].

According to the literary sources, the lynx inhabits within the study region, but it was not observed during the fieldworks. No signs of vitality of the lynx were found, however, due to its area of distribution, we can not rule out its presence and migration in the vicinity of the project area.

Map 5.4.2.7.1.3. Map of distribution of the lynx

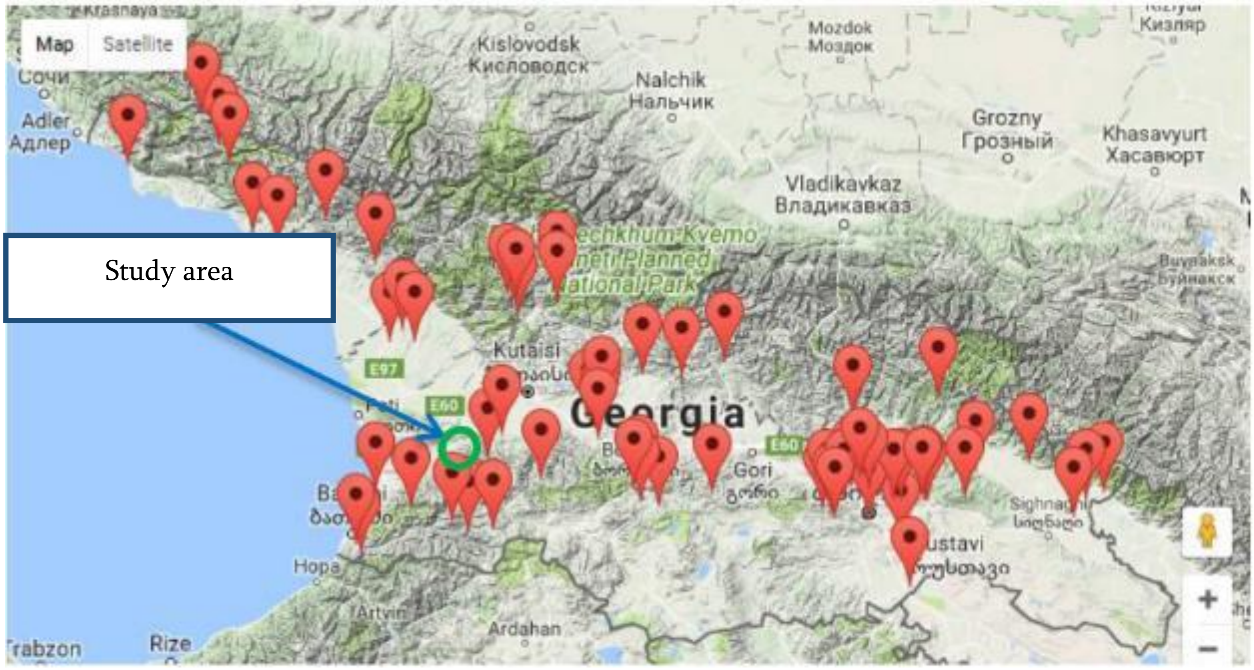


Source: *http://biodiversity-georgia.net*

Caucasian squirrel - *Sciurus anomalus*

Way of life: inhabits in deciduous, mixed forests. It also likes rocky areas and inhabits up to 2000 m. It feeds on walnut, hazel, acorn, chestnut, beech seed and others. Caucasian squirrel is characterized by special color, it has no fur at the end of ears, it has 20 teeth without premoral pair of teeth. This species is active in the morning and afternoon. It mainly spends the active period on the ground, stony areas. It selectes hollow trees for inhabiting up th 3-5 m from the ground. Deciduous and mixed forest with abundance of food and hollow trees is a favorable environment. As for the anthropogenic factor, the Caucasian squirrel well adapts and even inhabits within the populated territories. Status RLG- [VU (A1e)], IUCN-[LC].

Map5.4.2.7.1.4. Map of distribution of the Caucasian squirrel



Source: http://biodiversity-georgia.net

According to the literary sources, Caucasian squirrel is common within the project territory and in its environs, there are also favorable habitats (coniferous, beech woodlands) for this species, however, it was not observed during the survey. We selected the areas through the HPP project territory for the survey where construction works may have a direct impact. No hollows of the Caucasian squirrel were found in these sites.

Table 5.4.2.7.1.2. Mammals distributed through the study area and in its environs

N	English name	Latin name	IUCN	RLG	Bern Conv.	Observed (Habitat's types 1-4) not observed X
	Brown bear	*Ursus arctos*	LC	EN	√	1,4
1.	Wolf	*Canis lupus*	LC	-	√	x
2.	Red fox	*Vulpes vulpes*	LC	-		x
3.	Golden jackal	*Canis aureus*	LC			x
4.	Lynx	*Lynx lynx*	LC	CR	√	x
5.	Wildcat	*Felis silvestris*	LC	-	√	x
6.	European pine marten	*Martes martes*	LC	-	√	2,3
	Beech marten	*Martes foina*	LC	-	√	x
	Least weasel	*Mustela nivalis*	LC	-	√	x
	Forest dormouse	*Dryomys nitedula*	LC	-	√	x
7.	Edible dormouse	*Glis glis*	LC		√	x
8.	European badger	*Meles meles*	LC	-	√	x
9.	European hare	*Lepus europeus*	LC	-	√	x
	Southern white-breasted hedgehog	*Erinaceus concolor*	LC	-	√	x
	Levant mole	*Talpa levantis*	LC	-		4
10.	Caucasian mole	*Talpa caucasica*	LC		√	4
	Roe deer	*Capreolus capreolus*	LC	-	√	x
11.	Wild boar	*Sus scrofa*	LC		√	x

12.	Otter	*Lutra lutra*	NT	VU		2
	Caucasian squirrel	*Sciurus anomalus*	LC	VU	√	x
13.	Red squirrel	*Sciurus vulagaris*	LC			x
14.	Transcaucasian water shrew	*Neomys teres*	LC		√	x
15.	Major's pine vole	*Terricola majori*	LC			x
16.	Robert's snow vole	*Chionimys roberti*	LC			x
17.	bank vole	*Clethrionomys glareolus*	LC	EN		x
18.	Eastern broad-toothed field mouse	*Apodemus mystacinus*	LC			x
19.	Wood mouse	*Apodemus sylvaticus*	LC	-		x
20.	Ural field mouse	*Apodemus uralensis*	LC			x
21.	Black Sea field mouse	*Apodemus ponticus*	LC			x
22.	House mouse	*Mus musculus*	LC			x
23.	Black rat	*Rattus rattus*	LC			x
24.	Brown rat	*Rattus norvegicus*	LC			x
IUCN – categories are formulated as follows: EX – Extinct; EW – Extent in the wild; CR – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Near Threatened; LC – Least Concerned; DD – Data Deficient; NE – Not Evaluated						

In the biodiversity study, a number of mammals were also detected by the international consulting company SLR.

According to the desk surveys, the class of terrestrial mammals could be presented by the following species through the study area:

Predators: grey wolf *(Canis lupus).* Brown bear *(Ursus arctos)*, red fox *(Vulpes vulpes),* golden jackal *(Canis aureus)*, lynx *(Lynx lynx)*, marten *(Martes martes),* wildcat *(Felis sylvestris),* otter *(Lutra lutra).*

Ungulates: roe deer *(Capreolus capreolus)* and sometimes wild boar *(Sus scrofa)* enters the territory.

Insectivora: : Caucasian mole *(Talpa caucasica),* Levant mole *(Talpa levantis),* Transcaucasian water shrew *(Neomys teres)* et.al.

Rodents: Caucasian squirrel *(Sciurus anomalus),* edible dormouse *(Glis glis),* Forest Dormouse *(Driomys nitedula),* Major's pine vole *(Terricola majori),* Robert's snow vole *(Chionomys roberti),* eastern broad-toothed field mouse *(Apodemus mystacinus),* wood mouse *(Apodemus sylvaticus)* Ural field mouse *(Apodemus uralensis)* Black Sea field mouse *(Apodemus ponticus)* et.al.

Field zoological surveys confirmed that many mammal species are distributed in the study area. Favorable habitats were found for some mammals, but their presence could not be confirmed either by direct observing or by accidental finding, e.g., footprints, feces, fur or other signs. Locals, as well as hunters and fishermen were also interviewed about the presence of mammals.

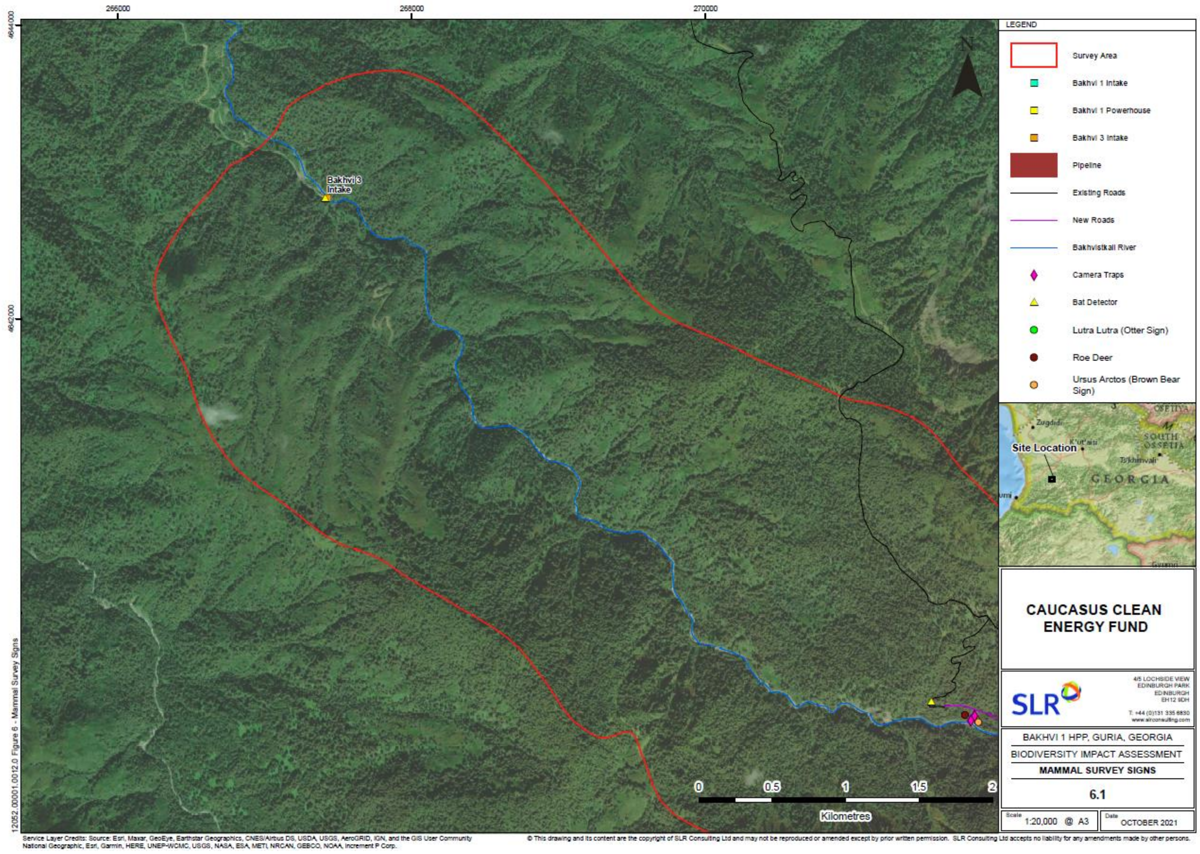
Mammals of conservation value in the study area

Latin name	Common name	Evidence	Notes
Lutra lutra	Otter	Feces on a stone, Footprints, camera trap	Surveillance camera (CCTV) Bakhvistskali River, the Bakhvi 3 watwr withdrawal location. Feces upstream of Bakhvi 1 water withdrawal site .

			Its presence in the study area was also confirmed during the working meeting in October.
Ursus arctos	Brown bear	Footprints, photos	Various locations. All studies detected footprints or feces. Locals also confirmed the detection of signs of vitality of a brown bear in fields near the water withdrawal site. Its presence in the study area was also confirmed during the working meeting in October.
Meles meles	European badger	No signs	There is a favorable habitat but we have not seen any signs of its presence. Its presence in the study area was confirmed during the working meeting in October.
Prometheomysschaposchnikowi	Prometheus vole	No signs	This species is found in subalpine, moderately humid, tall herbaceous meadows, at the altitude of 1500 – 2800 m. (IUCN, 2021). In general, there is not a suitable habitat in the study area.
Sciurus anomalus	Caucasian squirrel	No signs	The presence of this species is assumed in the study area as there is a favorable habitat, the territory is mostly covered with the forest. The presence of the Caucasian squirrel was confirmed during the working meeting in October.
Lynx lynx	Lynx	No signs	The study area may include a larger area where this species is found. According to locals, this species exists but is rarely seen.
Felis silvestris	Wildcat	No signs	Uncatchable species, it is difficult to confirm its presence, however, there is a favorable habitat.
Rupicapra rubicapra	Chamois	No signs	It was observed in 2016 in the wider surroundings, may enter the project area in cold winter for the water/ shelter.
Canis lupus	Grey wolf	No signs	There is a favorable habitat. The personnel of the forestry agency confirmed its presence, but this species is rarely seen. Local hunters also confirmed that they have seen a wolf.
Capreolus capreolus	Roe deer	Photo	Photo taken by the camera. Local hunters confirmed that they have seen this species.

There are two images below taken by the camera trap installed by SLR and the time and date of each image are also shown. During the study period, 542 images were taken with a camera trap, two of which are images of brown bears, five of roe deer and two of fast-moving mammals, it is assumed to be marten. Taking the other photos was entailed by the change in the angle of the sunlight, birds, lizards and wind blowing through the vegetation. The survey with a camera trap was supposed to carry out till October, but both camera traps were stolen in August after receiving the first data. It was concluded that if the camera traps were replaced, they would presumably be stolen again.

A map of signs of mammals' presence



A map of signs of mammals' presence

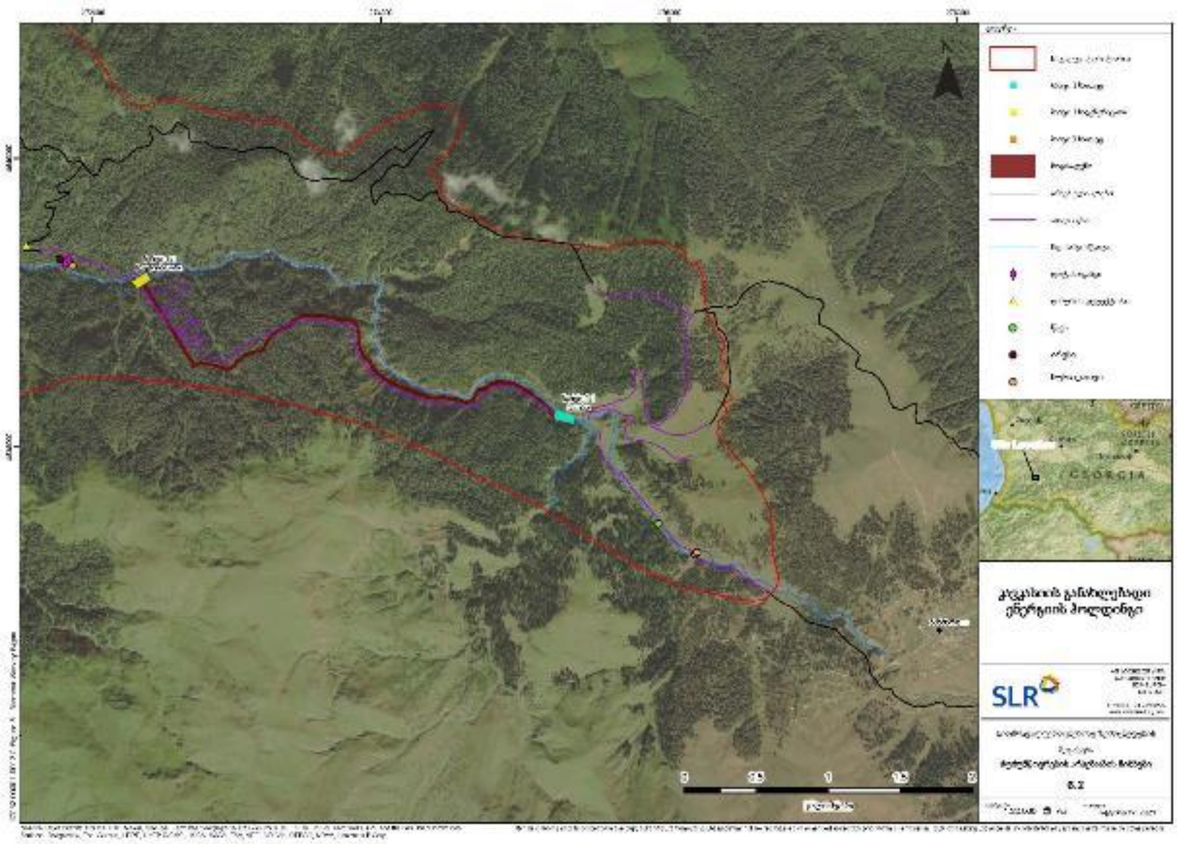


Photo - brown bear, young

Picture – roe deer

The following summaries are provided in the biodiversity impact assessment report prepared by SLR: the temporary migration of large predators – brown bear/lynx/grey wolf is expected during the construction process due to non-natural noise and activity. However, it is assumed that sufficient alternative areas for searching of food and sleeping will be accessible beyond the project area, especially if this is only required temporarily during the construction phase (approximately 24 months).

During the construction process, there is also a risk that unorganized wastes can attract the brown bear, lynx or wolf and encourage them to come into conflict with humans.

As expected, these species will return to their habitats after completion of the construction process, especially, after restoration of the temporary damaged territories. The temporary migration will not be significant as alternative areas with abundant food are available outside the project area.

The human activity of the construction area can impact on the populations of brown bear, wolf and lynx due to their curiosity. For instance, without mitigation measures, if reclamation works are not carried out after the excavation, curious animals may be trapped, which may result in injury and/or death, which has a significant impact. The same can be said about a vehicle collision with the brown bear. The death of the brown bear, lynx or wolf may not be significant in terms of the conservation status of these species, but it does have significant negative impacts on them.

If construction works are started in winter upstream of the powerhouse proposed area, in the forested territory, then the disturbance or injury of a brown bear being in a winter hibernation can take place. The injury or death of the brown bear is a considerable adverse impact on this species providing a critical habitat.

Since the construction is completed, the loss of habitat due to the basin area is not assumed to have a significant impact on migration of the brown bear, wolf or lynx, because this basin will be too small (0.24 ha) and even the change of flow velocity in Bakhvistskali River will not affect the migration of these species, as crossing the river will still be possible and the environmental flow release will enable the appropriate habitat to exist for drinking /bathing the brown bear. According to the signs of vitality of the brown bear, it currently moves freely through the territory of Bakhvi 3 HPP and the powerhouse and upstream, so the free migration will continue during the operation of Bakhvi 1 HPP that is expected for all three species.

Obstacles may be created at the powerhouse and water intake areas for the movement of otters in the river during the construction and operation processes. However, as a small HPP is being constructed, the otter should be able to bypass both the powerhouse and water intake areas relatively easily. Otter can move through the forest and roads far from the river. However, this can have potentially two significant impacts during the construction phase in the absence of mitigation measures: 1) trapping, if trenches are not covered after excavations; and 2) injury/death due to collision of vehicles.

Since the project operation is started, the otter will still be able to use Bakhvistskali River for obtaining the food. The distance between the water intake and power plant is 4 km, which is only a small part of the estimated area of the otter. No hydrological change is expected above the intake. The hydrological regime between the water intake and the power plant will change, the environmental flow will provide a connection to this section of the river. The proposed environmental flow is 0.29 m^3/s^{-1}. As estimated, this is sufficient to maintain the ecological connection between upstream of the river Bakhvitskali and downstream of the powerhouse. Thus, it is expected that there, where the brook trout inhabits (found only downstream of the Bakhvi 3 HPP powerhouse), its population will be maintained. As for the food, such as semi-aquatic species (frog) and terrestrial species (small mammals and lizards), the change of their number is not expected due to the project in the operation phase.

Thus, it is estimated that after the operation is started, the project will have a negligible impact is expected on the otter currently present in the Bakhvistskali River catchment area.

In the case of Caucasian squirrel, the permanently and temporarily forest areas used for the project constitute a very small part of suitable habitat in the region.

During the construction process, the habitat of a Caucasian squirrel will be locally disturbed, however it is a mobile species and it can live in a human environment, obtain food in residential areas and even from bins.

Mitigation measures

For large predators:

To avoid the impact on these species (brown bear, wolf and lynx) following measures will be carried out:

Trenches will be arranged during the construction and deep excavations will be carried out. As it is mentioned above, wandering mammals, such as brown bear and lynx, can be trapped that may cause their injury or death. To prevent this, all trenches will be fenced for the access restriction when the works are ceased or will be covered with boards if the trenches are small enough. These measures will prevent the access of animals to the trenches.

During the construction period, additional workers will accommodate in the camp locating in Bakhvistskali valley. Unorganized waste may attract the brown bear and encourage it to come into conflict with humans. The project Waste Management Plan will be carried out in the construction and operation phases, where the preventive measures against accessing the wild animals (brown bear, wolf, lynx, others) to the warehouses will be reflected.

All types of hunting will be prohibited for the project personnel.

As these species are more active at night, any work that requires using of heavy vehicles, removal of vegetation or soil will not be carried out at night (from sunset to sunrise) to prevent additional disturbing factors. At nightfall, the reduction of vehicles' movement will benefit the species that are active at night and are not described here, such as badger, marten and wildcat, as the risk of collision of a vehicle will be reduced.

To reduce the probability of injury of brown bears being in hibernation, the vegetation removal works will start before the hibernation period (approx.. from November to March); the reason for this is that if the vegetation is removed during the active period of brown bears, they will avoid noise and disturbances and will not hibernate in the working area.

Mitigation

No mitigation measures are proposed with regard to the brown bear, wolf or lynx. However, the re-planting in the habitat by replacing the lost forest habitat will be beneficial for these in the long-term period.

Monitoring

No targeted monitoring of this species is proposed, however, all accidental occurrences will be collected. This includes recording the data by ESG team, as well as the project personnel. An annual report is prepared annually, which reflects all records.

Compensation

In frames of the educational package, the encouragement of the habitat of a wolf, lynx and brown bear as well as the benefits of protecting them instead of hunting, will be included in the environmental awareness training.

Final Result

It is considered that the project impact on the species will be temporary and limited as they occupy quite a large area. As a result of the implementation of preventive measures, no net loss of biodiversity will be achieved in the project construction and operation phases. Compensation measures, in the long-term period, will reduce the hunting pressure on these species, which will cause the achievement of final net gain.

Otter

Prevention

Preventive measures that will be carried out for large predators (that is described in detail above) to avoid getting trapped and colliding with a vehicle will also be beneficial for otters.

Mitigation

No specific mitigation measures are proposed regarding the otter.

Compensation

No specific mitigation measures are proposed regarding the otter.

Monitoring

The surveillance camera (CCTV) will be installed at the intake of Bakhvi 1 HPP, which will be used for the monitoring of the water intake operation. All signs of vitality of the otter will be recorded and the video material will be kept. It is possible to prepare an annual report on otter detection.

Final Result

Since the preventive measures against the adverse impact of the collision and trapping of the otter are carried out, no loss is expected regarding the otter.

Caucasian squirrel

Poor information is available about the mating and breeding of this species. Therefore, for their safety, during the bird nesting season, along with the inspecting nests, each tree should be inspected, first of all, to determine whether squirrels are in their dreys or not. In general, adult squirrels migrate when the trees are cut, however, if young specimens are in a tree, they should be left intact until the squirrels become mobile (6-8 weeks after birth) and come out of the nest.

The Caucasian squirrel is not characterized by winter hibernation but may become inactive in winter months, in cold or too wet weathers, when they less react to the disturbing activities. Therefore, even in winter, trees should be thoroughly inspected before cutting to check whether there are squirrels or not.

The nest can also be checked from below, via binoculars. Nests may need to be inspected more than once (e.g., on the first day and then on the second day) to evaluate their usability.

Mitigation

No specific mitigation measures are proposed regarding the Caucasian squirrel.

Compensation

No specific mitigation measures are proposed regarding the Caucasian squirrel.

Final Result

Since the preventive measures are carried out, net loss will not be achieved regarding the Caucasian squirrel.

Additional information on these issues is provided in Annex N4 of the Biodiversity Impact Assessment Report.

5.4.2.7.1.1 Bats (Microchiroptera)

Bats are the only flying mammals. They have been existed for about 50 million years and they are the most significant living organisms in evolutionary viewpoint. They live in groups and even can live with other bat species. They need quite different roosts:

- Transitive roosts;
- Hibernation roost;
- Mating roost;
- Maternity roost;

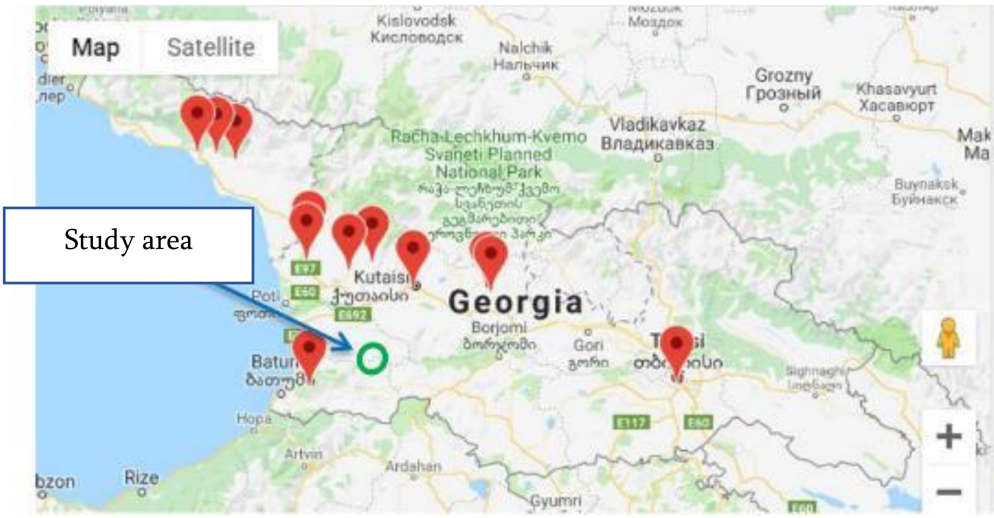
- Summer roost;

They are characterized by winter dormancy. Caves, rocky fractures, old buildings, where the temperature is up to 6-12^{0}C are their hibernation roosts. The majority of bats die in conditions of lower than 5 ^{0}C. In the active period they use caves, rocky fractures, buildings and hollow trees. They mainly feed on insects. One bat destroys several thousand insects in a night.

All bat species found in Georgia are included in Annex II of Bonn Convention and protected by the agreement of EUROBATS. According to this agreement, Georgia is mandatory to protect all bat species common in the project area and its surroundings.

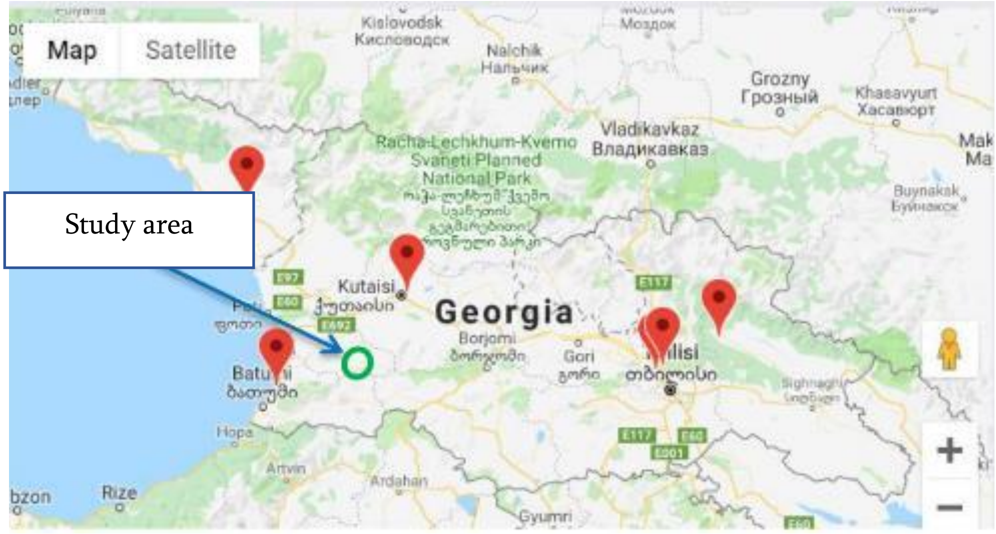
Based on the literary sources and field surveys, 19 bats species are distributed through the project corridor and its neighboring territories. (Tab. 2), among them, only two species Mediterranean horseshoe bat *(Rhinolophus euryale)* status RLG-[VU], IUCN-[Global-NT] and Mehely's horseshoe bat *(Rhinolophus mehelyi)* IUCN-[Global-VU]; RLG-[VU].

Mediterranean horseshoe bat *Rhinolophus euryale* - is a species of bats from family *Rhinolophidae*. It is of medium size, length 65-88 mm, length of wings - 300-320 mm. Female is bigger than male (Schober and Grimmberger, 1997), nose and mouth are light brown, ears and wings membranes are light grey. They mainly don't migrate. Mating period is August-middle September. They deliver in June-middle July. They overwinter in caves and grottos, as well as in tunnels; they give birth 1 baby bat. They basically feed on insects. They use echolocation during flying and hunting, they basically hunt at night, in the areas with dense scrubs and trees. Status RLG- [VU], IUCN-[NT]



Source: http://biodiversity-georgia.net

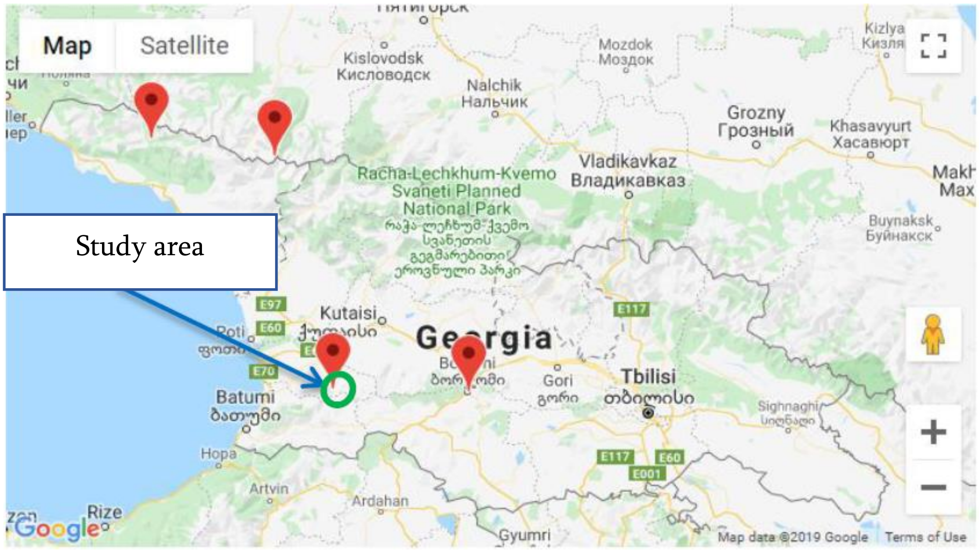
Mehely's horseshoe bat *(Rhinolophus mehelyi)* – is a bats' species of Rhinolophidae family. It is common in the Eastern Europe and the Middle east. Mehely's horseshoe bat is of medium size, pale lips and greyish-brownish ears. The fur is relatively dense, greyish-whitish in color. The belly fur is almost entirely white, while the dorsal fur is greyish-brown. Dorsal and ventral sides are sharply separated. The body length is 5,5-6,4 cm, weight - 10-18 g. wing span - 33-34 cm. It inhabits in caves, prefers limestone sites there where the water is available. It catches a prey on the ground, as well as in shrubs and trees. They mate in August-mid September, give birth in June-mid July. They overwinter in grottos or caves, as well as tunnels, they deliver 1 baby. Mehely's horseshoe bat basically feeds on insects. They use echolocation during flying and hunting, they basically hunt at night, in the areas with dense scrubs and trees. Status RLG- [VU], IUCN-[VU].



Source: [*http://biodiversity-georgia.net*](http://biodiversity-georgia.net)

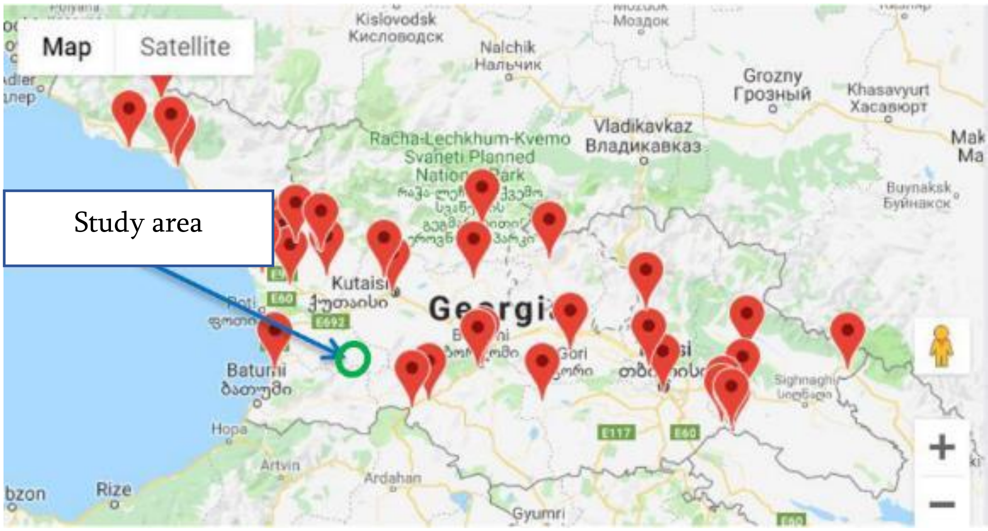
<u>Among the species protected by international treaties following ones are noeworthy</u>: greater noctule bat *(Nyctalus lasiopterus)* IUCN-[Global-VU], Lesser mouse-eared bat *(Myotis blythii),* Lesser horseshoe bat *(Rhinolophus hipposideros)* and greater horseshoe bat *(Rhinolophus ferrumequinum)* only across Europe. IUCN-[Global-LC, Europe-NT]. <u>From these species following ones are noteworthy in terms of impact on them:</u>

Greater noctule bat *(Nyctalus lasiopterus)* – is a mammal from Vespertilionidae family. It is the largest bat in Europe in terms of body size, its wingspan is 410-460 mm, the ears are wide, the fur is dense, long and reddish-brown. Its thin wings allow it to fly fast as well as at high altitudes. It is distributed in deciduous forests. This species lives in colonies in hollow trees. Greater noctule bat mainly feeds on beetles, sometimes small birds when migrating. It is a beneficial species because it destroys insect pests. Status RLG- [-], IUCN-[Global-VU, Europe-DD].



Source: [*http://biodiversity-georgia.net*](http://biodiversity-georgia.net)

Lesser mouse-eared bat *(Myotis blythii)* - is a mammal of species of insectivorous bat in the family Vespertilionidae. Length of body 6.5-8 cm. Its small eyes are narrow and has brown-grey fur. Ears are short and tapered. This species prefers warm and open habitats, such as humid meadows, pastures and others. They mate in August, deliver in June-July; they form clusters in winter. They give birth 1-2- baby bats. They mainly live in caves, grottos, abandoned buildings, as well as in hollow trees. They have small range of migration – 10 km. They feed on insects (bugs, grasshoppers, et.al). They use echolocation during flying and hunting. Status RLG- [-], IUCN-[Global-LC, Europe-NT].



Source: *http://biodiversity-georgia.net*

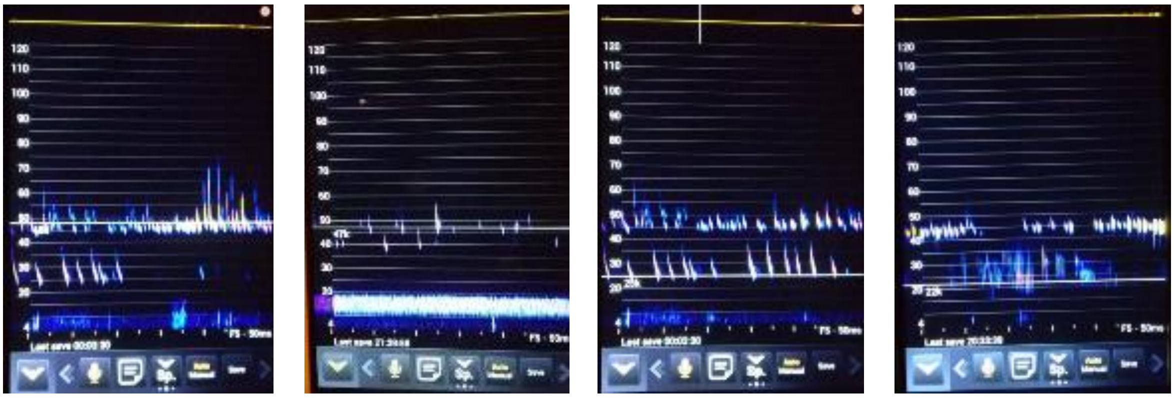
There are hollow trees, forested and rocky massifs in the project zone, which are hibernation or/and temporary roosts of bats. Just a small amount of hollow trees may fall within the impact zone, as most of the project corridor (penstock) follows the meadow or the areas with a lack of trees and plants, where no hollow trees are observed, however, there is a risk of damage/destruction of roosts during construction, consequently, certain impact on bats is expected.

Pic. 5.4.2.7.1.1.1. Favorable massifs and hollow trees for bats

If habitats suitable for bats are destroyed, the implementation of conservation and mitigation measures will be required, but maintaining the existing habitats is better.

Representatives of *Pipistrellus* and *Nyctalus* were detected within the fieldworks conducted in August 2020. All species of these families are common throughout Georgia (see Pic. 10; Tab. 2).

Pic. 5.4.2.7.1.1.2. Bats detector - Anabat Walkabout Bat Detector (Version 1.3)



Pipistrellus sp. *Nyctalus sp.*

Table 5.4.2.7.1.1.1. Bats species common in the study area and its surroundings

№	Latin name	English name	RLG	IUCN	Bern Conv.	CMS	Observed - 1 Not observed X
1	*Rhinolophus ferrumequinum*	Greater horseshoe bat		Global- LC EU- NT	√	√	x
2	*Rhinolophus hipposideros*	Lesser horseshoe bat		Global- LC EU- NT	√	√	x
3	*Rhinolophus euryale**	Mediterranean horseshoe bat	VU	Global-NT; EU-VU	√	√	x
4	*Rhinolophus mehelyi**	Mehely's horseshoe bat	VU	Global-VU EU-VU	√	√	x
5	*Myotis blythii*	Lesser mouse-eared bat		Global- LC EU- NT	√	√	x
6	*Myotis mystacinus group #*	Group “whiskered bat“			√	√	x
7	*Myotis nattereri*	Natterer's bat			√	√	x
8	*Myotis emarginatus*	Geoffroy's bat			√	√	x
9	*Myotis daubentonii*	Daubenton's myotis			√	√	x
10	*Nyctalus lasiopterus*	Greater noctule bat		VU	√	√	1?
11	*Nyctalus leisleri*	Lesser noctule			√	√	1?
12	*Nyctalus noctula*	Common noctule			√	√	1
13	*Eptesicus serotinus*	Serotine bat			√	√	x
14	*Pipistrellus pipistrellus*	Common pipistrelle			√	√	1
15	*Pipistrellus pygmaeus*	Soprano pipistrelle			√	√	1?
16	*Pipistrellus nathusii*	Nathusius' pipistrelle			√	√	1?
17	*Hypsugo savii*	Savi's pipistrelle			√	√	x
18	*Plecotus auritus*	Brown long-eared bat			√	√	x
19	*Vespertilio murinus*	Parti-coloured bat			√	√	x

IUCN – categories are formulated as follows:
EX – Extinct; EW – Extent in the wild; CR – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Near Threatened; LC – Least Concerned; DD – Data Deficient; NE – Not Evaluated

Active period of bats

N	English name	Latin name	Mating	Delivery
	Brown long-eared bat	*Plecotus auritus*	August-April	May-July
	Parti-coloured bat	*Vespertilio murinus*	Autumn	Summer

	Greater horseshoe bat	*Rhynolopus ferrumequinum*	August-middle September	June-middle July
	Lesser horseshoe bat	*Rhinolophus hipposideros*		
1.	Mehely's horseshoe bat	*Rhinolophus mehelyi*		
2.	Mediterranean horseshoe bat	*Rhinolophus euryale*		
	Serotine bat	*Eptesicus serotinus*	September-October	Middle May –July
3.	Common pipistrelle	*Pipistrellus pipistellus*	August-October	May-July
4.	Soprano pipistrelle	*Pipistrellus pygmaeus*		
5.	Nathusius' pipistrelle	*Pipistrellus nathusii*		
6.	Savi's pipistrelle	*Hypsugo savii*		
7.	Common noctule	*Nyctalus noctula*	August	June-July
8.	Greater noctule bat	*Nyctalus lasiopterus*		
9.	Lesser noctule	*Nyctalus leislerii*		
10.	Whiskered bat	*Myotis mystacinus*	August	June-July
11.	Lesser mouse-eared bat	*Myotis blythii*		
12.	Geoffroy's bat	*Myotis emarginatus*		
13.	Daubenton's myotis	*Myotis daubentonii*		
14.	Natterer's bat	*Myotis nattereri*		

In addition, the international consulting company SLR carried out an additional study of bats in 2021, the survey was conducted with static bat detectors at three representative locations: 1) dense forest; 2) water withdrawal site of Bakhvi 3 HPP, and 3) Ukanava village. The detector includes three "song metre mini bat" acoustic recorders. These are small static recording devices that detect and record the sound of a bat. Each of them needs a 4 x AA battery and an SD memory card. Detectors are installed via the Bluetooth application of the smartphone. Detectors for this study were installed so that to start recording 30 minutes before sunset and end 30 minutes after sunrise.

Files of bat's data have been recorded with a wide range, it only records when an acoustic event occurs, i.e. recording the sound of a bat flying in front of a microphone. A wide range of format provides files that are suitable for analysis through the Kaleidoscope Pro software

The digital record of the bats was analyzed using Kaleidoscope Pro (v 5.3.9) software through the filter Bats of Europe 5.1.0, and then manually verified by a specialist experienced in bats sonogram analysis (Nikola Folks CEcol MCIEEM), if necessary.

It is deemed that identification of noctule bats and pipistrelles is not very reliable (Nicholas Folks, personal observation), as their sound parameters, as well as the parameters of common pipistrelles and bats may overlap each other. Due to this, all files where noctule bats and common pipistrelles were identified have been manually verified through the Kaleidoscope software to confirm or modify the obtained result as needed. An additional 20% of bat sounds were also manually checked to confirm the automatic identification process.

It should be noted that the filters of Kaleidoscope Pro provide only an approximate estimate of bat activity in the data set. Weak or poor quality bat sonograms can be omitted if they are rejected by the sound filter.

Thus, Kaleidoscope Pro can attach a single species label to an audio file, even if there are more than one bat species. When the sound of several species of bats was recorded in a single file, their identification was done manually to record their species.

The term "bat-pass" has been used for the data analysis. The "bat-pass" is two or more sounds that may belong to a bat species and means that the only bat is flying towards the detector's microphone and back.

In some cases, the “bat-pass” is a clearly depicted series of 40 or more sounds, and sometimes only two sounds can be recorded. Each sound is considered one “bat-pass” (at the microphone). Therefore, the number of “bat-pass” can be used to assess the bat activity, but not as an indicator of the number of bats. The number of “bat-pass” will be the same if 100 bats fly near the microphone once per night or one bat flies near the microphone 100 times per night.

The map shows three locations used for the survey:

1st location – near the water withdrawal site of Bakhvi 3 HPP. This area is close to the pond (standing water) and the water course flowing over the fish pass. There are some artificial structures, tracks and almost adult trees (in general, *Alnus barbata*). This habitat is suitable for bat species feeding at water courses and forests, where tree canopy and branches do not touch each other.

2nd location – in the village of Ukanava where houses, gardens, orchards and pastures are located. It is a mosaic habitat that will be suitable for various bats, especially those that inhabit in houses.

3rd location – a beech forest near the Bakhvi 1 HPP powerhouse. This is a densely forested area and is located at higher altitude than the first two areas.

Recorders were installed at each location for different periods, at different altitudes and temperatures. The information received from each detector is given in the table:

Data of detectors

Location	Date of installation	Date of data collection	Number of nights when recording was performed	Average temperature C
1st location	June 14, 2021	June 17, 2021	4	19
2nd location	June 14, 2021	June 18, 2021	5	25
3rd location	June 16, 2021	June 17, 2021	1	15

In conclusion, it can be said that at the 3rd location near the Bakhvi 1 HPP powerhouse, several bats’ species were detected, the recording was performed for a night and only six “bat-passes” were accounted: *Nyctalusnoctula* (1 pass), *Pipistrellus pipistrellus* (3 passes), two passes are recognizable only at the genus level, *Myotis* Genus.

The majority of bats’ species were detected at the 2nd location, at houses, meadows and gardens. About 17 species of bats have been recorded there, 900 “bat-passes”, or as an average, 180 “bat-passes” were recorded per night for five nights. It was assumed that the detection of more bats’ species in this location was stipulated by the warmer nights, mixed habitat (meadows, fences, gardens, ponds, et.al.) and the availability of roosts in houses, barns and adult trees.

Below, in Bakhvistskali valley, at the 1st location, much more bat species and “bat-passes” were observed than at the 3rd location, but fewer bat species were observed than at the 2nd location. Totally, 3,044 “bat-passes” were recorded at the 1st location, which belonged to 10 species of bats. It means that 761 “bat-passes” were recorded per night at this location and the majority of them were Common Pipistrelle.

It is deemed that the quantity and species of bats decrease as the altitude increases, mainly due to the influence of temperature. Bats are insectivores and insects are more active at relatively warm temperatures. The bats population uses adult trees and artificial structures for nesting. No caves were found during the survey, therefore, it is considered that there are no resting/hibernation roosts in caves.

The following species have been identified, or considered to exist. For each species, its conservation status is indicated according to the Red List of Georgia, IUCN Red List and the European Red List, in compliance with Annexes II or/and IV of the EU Habitats Regulation(HR) along with the status of each species.

The list of species detected through the study area along with the conservation status

Latin name	Common name	Red List of Georgia	IUCN Red List	European Red List	HR Annex IV	HR Annex II
Barbastella barbastellus	Western Barbastelle	VU	NT	VU	Y	Y
Eptesicus nilssonii	Northern bat	-	LC	LC	Y	-
Eptesicus serotinus	Serotine bat	-	LC	LC	Y	-
Miniopterus schreibersii	Common bent-wing bat	-	NT	NT	Y	Y
Myotis Bechsteinii	Bechstein's bat	-	NT	VU	Y	Y
Myotis emarginatus	Geoffroy's bat	-	LC	LC	Y	Y
Myotis mystacinus	Whiskered bat	-	LC	LC	Y	-
Myotis nattereri	Natterer's bat	-	LC	LC	Y	-
Nyctalus lasiopterus	Greater noctule bat	-	VU	DD	Y	-
Nyctalus leisleri	Lesser noctule	-	LC	LC	Y	-
Nyctalus noctule	Common noctule	-	LC	LC	Y	-
Pipistrellus kuhlii	Kuhl's pipistrelle	-	LC	LC	Y	-
Pipistrellus nathusii	Nathusius' pipistrelle	-	LC	LC	Y	-
Pipistrellus pipistrellus	Common pipistrelle	-	LC	LC	Y	-
Pipistrellus pygmaeus	Soprano pipistrelle	-	LC	LC	Y	-
Plecotus auritus	Brown long-eared bat	-	LC	LC	Y	-
Rhinolophus ferrumequinum	Greater horseshoe bat	-	LC	NT	Y	Y
Vespertilio murinus	Parti-coloured bat	-	LC	NT	Y	Y

Impact on bats

In the project construction phase, trees will be cut and removed from the RoW of the road/penstock, as well as the powerhouse area. The impoundment of this project is small 0.24 ha) and cutting of trees will not be required for its water intake. No significant hibernation sites were detected during the survey of bats (no cave or tunnel), therefore, it is less expected to lose any important hibernation sites.

Cutting and removal of trees without mitigation measures (especially in maternity season) may have an adverse impact on the species inhabiting trees.

In the operation phase, the impoundment can be a benefit in terms of the bats' food habitat, as the water habitats are often associated with the productivity of invertebrates (flying insects) that can be a positive impact on the bats' species in terms of a rich food habitat.

In the construction and operation phases, even the minor light penetration may hinder bats to obtain food in the lit area. If the light illuminates trees, it will presumably prevent the bats to rest in trees near the illuminated area.

Mitigation Measures

Although the specific study of the bats' resting trees has not been carried out in the study area, in practical terms, such specific studies are not recommended prior to tree felling. It is recommended to take precautions and when cutting large cracked or hollow trees during the construction phase, if there is a suspicion that it was a resting place for bats, it is necessary to leave this tree overnight so that if there are bats, they can fly away in the dark.

To avoid impact on birds, trees will not be cut during the birds' nesting season unless a duly qualified ornithologist confirms that there are no nests in the tree. This will be beneficial for bats as well, as cutting the trees during this period will also protect bat nests and resting places, if any. The gestation period of bats lasts from June to July (including).

In the construction and operation phases, safety and other permanent illumination will be directed downward to the working area to reduce the illumination of trees and forest and to avoid hindering bats in finding food and resting. Illumination will only be used when needed and will not be turned on overnight unless it is needed for health and safety purposes. Timer switches and motion-activated lighting control will be used.

Mitigation

The possibility of arrangement of the bats' roost in the powerhouse will be explored to mitigate the potential loss of bat rest habitat. Such roost can be made by attaching ten wooden bat boxes to the outer side of the building (from different sides) or making a roost in a structure of a building, e.g. hollows brick or blocks with a small entrance.

In addition, an additional forty bat boxes will be placed along the road from the powerhouse to the water intake.

After the construction is completed, local plant species will be planted in all temporary work areas to compensate for the lost habitat. After a while, when the trees grow, they will be useful for the bats as well.

Compensation

Compensation is not recommended regarding bats.

Final Result

Although certain habitats will be lost, as expected, it will have a minor impact on the bats' species in the Ecologically Appropriate Area of Analysis. It is assumed that the creation of equivalent roosts, together with the development of additional forest food habitats along the roads will result in the achievement of no net loss regarding the bats' species.

Additional information on this issue is provided in Annex N4 – the Biodiversity Impact Assessment Report (SLR).

5.4.2.7.2 Birds (Aves)

5.4.2.7.2.1 Introduction

The report was prepared for Bakhvi 1 HPP planned on Bakhvistskali River in Ozurgeti and Chokhatauri municipalities. The survey covered the project area and its surroundings.

The ornithological survey was conducted in summer 2020 and in autumn 2021, in particular:

- The survey covered the birds' breeding period – August 2020, 3 working days;
- The Birds' migration period – October 2021, 2 working days.

5.4.2.7.2.2 Survey Goal

The survey goal was to describe and assess the birds species through the project territory of Bakhvi 1 HPP and its surroundings. Specific tasks of the monitoring were to verify and update information on seasonal bird species, territorial distribution, their habitats, numbers or densities, as well as local migration within the project area and its surroundings.

Out of 403 species of birds in Georgia, about 110 species of birds have been identified in the project area. 38 species were observed within the field surveys. Most of the found birds are species related to forests, shrubs, fields and water. This applies to both resident and nesting birds. According to the nature of presence, birds are distributed as follows: 33 species are year-round residents, 19 species – migrant, may occur on this territory during migration -autumn and spring; 39 species - breeding bird; visit the territory only in breeding and migration season; 3 species - year-round visitor, non-breeder, present throughout the year; 2 species – occasional visitor and 4 species are observed only in winter and migration season.

The species composition of the ornithofauna in the project area is more or less described and evaluated. Based on the available data, in terms of birds' conservation, we can conclude that the ornithofauna is diverse in the project impact zone. From nesting birds, forest small passerines are the dominant group. Following 38 birds' species were detected during the field survey: Red-backed Shrike (*Lanius collurio*), Grey Wagtail (*Motacilla cinerea*), Isabelline Wheatear (*Oenanthe isabellina*), White Wagtail (*Motacilla alba*), Eurasian Chaffinch (*Fringilla coelebs*), Willow Warbler *(Phylloscopus trochilus),* Northern Hause-Martin *(Delichon urbicum),* Barn Swallow (*Hirundo rustica),* Eurasian Jay (*Garrulus glandarius*), Common Rosefinch (*Carpodacus erythrinus*), Eurasian scops owl (*Otus scops*), European bee-eater *(Merops apiaster),* Common Buzzard *(Buteo buteo menetriesi),* European Honey-Buzzard *(Pernis apivorus),* Eurasian Sparrowhawk (*Accipiter nisus)*, Northern Goshawk (*Accipiter gentilis)*, White-throated Dipper *(Cinclus cinclus),* Eurasian Blackbird *(Turdus merula),* Long-tailed Tit *(Aegithalos caudatus),* European Robin *(Erithacus rubecula),* Great Tit *(Parus major),* Blue Tit *(Parus caeruleus),* Coal Tit *(Parus ater),* Hooded Crow *(Corvus corone),* Spotted Flycatcher *(Muscicapa striata),* European Goldfinch *(Carduelis carduelis),* European Greenfinch *(Carduelis chloris),* Wood Nuthatch *(Sitta europaea),* Hause Sparrow *(Passer domesticus),* Greater Spotted Woodpecker *(Dendrocopos major),* Blackcap *(Sylvia atricapilla),* Common Redstart *(Phoenicurus phoenicurus),* Black Redstart *(Phoenicurus ochruros)* and Winter Wren *(Troglodytes troglodytes).*

It should be noted that in the upper part of the project territory (toward Bakhmaro), at the HPP headwork and in its environs, there are favorable or/and inhabiting habitats of the Caucasian Grouse *(Lyrurus* *mlokosiewiczi)*. However, this territory is not a critically important habitat for this species. In addition, none of the surveys identified this species and therefore, the project-related impact is not expected on this species.

In frames of the field surveys implemented by the international consulting company SLR, 57 species of birds were detected by the fieldworks, their list is given in the table below. Besides the species that could be seen directly, it was concluded that the birds of prey also visit the area irregularly from mountainous areas and can be seen in the study area. Although these birds of prey are less expected to nest within the study area, they may hunt or fly over the project territory. Such species are: bearded vulture lammergeyer *Gypaetus barbatus*, Griffon vulture *Gyps fulvus* and Golden eagle *Aquila chrysaetos*.

The list of birds species identified through the study area

Birds' species	Birds' species
Booted eagle *Aquila pennata*	Common Sandpiper *Actitis hypoleucos*
Common Buzzard *Buteo buteo*	Common Cuckoo *Cuculus canorus*
Eurasian Sparrowhawk *Accipiter nisus*	Eurasian Eagle Owl *Bubo bubo*
Northern Goshawk *Accipiter gentilis*	Tengmalm's owl *Aegolius funereus*
Tawny Owl *Strix aluco*	European Nightjar *Caprimulgus europaeus*
Lesser spotted woodpecker *Dendrocopos minor*	Greater Spotted Woodpecker *Dendrocopos major*
Black woodpecker *Dryocopus martius*	
Tree Pipit *Anthust trivialis*	Eurasian Wryneck *Jynx torquilla*
Grey Wagtail *Motacilla cinerea*	White Wagtail *Motacilla alba*
Hedge Accentor (Dunnock) *Prunella modularis*	White-throated Dipper *Cinclus cinclus*
Common Redstart *Phoenicurus phoenicurus*	European Robin *Erithacus rubecula*
Northern wheatear *Oenanthe oenanthe*	Black Redstart *Phoenicurus ochruros*
Whinchat *Saxicola rubetra*	Common stonechat *Saxicola torquatus*
Mistle Thrush *Turdus viscivorus*	Song Thrush *Turdus philomelos*
Ring Ouzel *Turdus torquatus*	Eurasian Blackbird *Turdus merula*
Blackcap *Sylvia atricapilla*	Common rock thrush *Monticola saxatilis*
Caucasian Chiffchaff *Phylloscopus lorenzii*	Common Whitethroat *Sylvia communis*
Common Chiffchaff *Phylloscopus collybita*	Green warbler *Phylloscopus nitidus*
Red-breasted Flycatcher *Ficedula parva*	Winter Wren *Troglodites troglodites*
Coal Tit *Parus ater*	Great Tit *Parus major*
Wood Nuthatch *Sitta europaea*	Blue Tit *Parus caeruleus*
Eurasian Tree-creeper *Certhia familaris*	Kruper´s Nuthatch *Sitta kruperi*
Common Raven *Corvus corax*	Eurasian Jay *Garrulus glandarius*
Linnet *Carduelis cannabina*	Eurasian Chaffinch *Fringilla coelebs*
European Greenfinch *Carduelis chloris*	European Goldfinch *Carduelis carduelis*
Fire-fronted Serin *Serinus pusillus*	Eurasian Siskin *Spinus (Carduelis) spinu*
Hawfinch *Coccothraustes coccothraustes*	Eurasian bullfinch *Pyrrhula pyrrhula*
Common Rosefinch *Carpodacus erythrinus*	Red Crossbill *Loxia curvirostra*
Corn Bunting *Miliaria calandra*	Rock Bunting *Ebberizacia*

It is considered that one bird species - Caucasian Chiffchaff is the endemic species of the Caucasus. As for the species of the conservation status, the only species is Tengmalm's owl *Aegoliusfunereus*. Other species of the conservation value, three species of the above-mentioned birds of prey (bearded vulture / lammergeier*Gypaetus barbatus*, Griffon vulture *Gyps fulvus*, Golden eagle *Aquila chrysaetos*) do not nest within the study area and they are visitors.

Additional information on this issue is provided in Annex N4 – the Biodiversity Impact Assessment Report (SLR).

5.4.2.7.2.3 Target Birds' Species through the Study Area

Within the study period, special attention was drawn to the dominant species that were found during the fieldworks and the presence of which was confirmed by literary sources.

The main targeted nesting and resident species are passerines, Piciformes, Charadriiformes and Pelecaniformes, including: Peregrine Falcon (*Falco peregrinus*), Common Wood-Pigeon (*Columba palumbus*), Common Cuckoo (*Cuculus canorus*), White Wagtail (*Motacilla alba),* Yellow Wagtail *(Motacilla flava),* Citrine Wagtail *(Motacilla citreola),* Wood Nuthatch (*Sitta europaea),* Greater Spotted Woodpecker (*Dendrocopos major*), Eurasian Green Woodpecker (*Picus viridis*), Middle Spotted Woodpecker (*Leiopicus medius*), European Robin *(Erithacus rubecula),* Great Tit *(Parus major),* Winter Wren *(Troglodytes troglodytes),* European Goldfinch *(Carduelis carduelis),* European Greenfinch *(Carduelis chloris),* Hooded Crow *(Corvus corone),* greenish warbler *(Phylloscopus trochiloides),* Common Chiffchaff *(Phylloscopus collybita),* Hedge Accentor (Dunnock) *(Prunella modularis),* Spotted Flycatcher *(Muscicapa striata),* Red-breasted Flycatcher *(Ficedula parva).*

5.4.2.7.2.4 Globally and Nationwide Endangered Species

From the birds observed and described in the project area, the following species are to be protected: Levant sparrowhawk *(Accipiter brevipes),* Caucasian Grouse *(Lyrurus mlokosiewiczi)* and Long-legged Buzzard *(Buteo rufinus).* All species are included in the Red List of Georgia with the status Vulnerable (VU). One of the species - Caucasian Grouse is also included in the IUCN Red List with the status Near Threatened (NT). None of the protected species was observed through the study area. The species observed in almost all sites are as follows: White-throated Dipper, European Goldfinch, European Greenfinch, Eurasian Jay, Hooded Crow, Barn Swallow, House Sparrow, European bee-eater, Great Tit, Coal Tit, Blue Tit, Eurasian Chaffinch, Winter Wren, White Wagtail, Common Redstart, Eurasian Blackbird, Greater Spotted Woodpecker, Common Chiffchaff. From raptors, the following ones were observed: Northern Goshawk, European Honey-Buzzard, Eurasian Sparrowhawk and about 10 specimens of Common Buzzard. Special attention was focused on those areas where a direct impact on the environment is expected. No nests have been detected in or near these areas. But this territory is a favorable habitat for many small passerines.

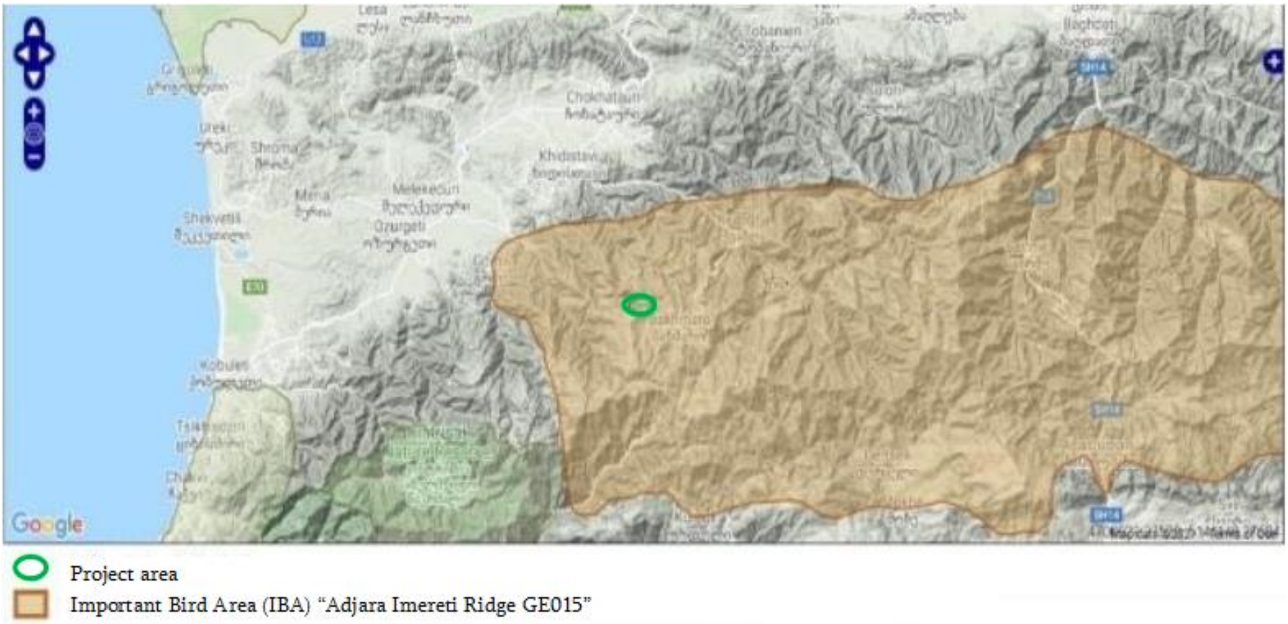
5.4.2.7.2.5 Birds Migration Route through the Project Area

The territory of Georgia is the significant area for migration of the western Palearctic birds. Europe-Africa and Europe-Asia birds' migration routes pass through the territory of Georgia that is significant for many migratory species. They use these routes for annual, regular seasonal migrations between nesting and wintering places (Abuladze A., et al 2011). Bird migration takes place in the territory of Georgia throughout the year. However, two migration periods are sharply defined - spring and autumn migrations. Migratory birds migrate along the Black Sea coast, large rivers (Rioni, Mtkvari and their tributaries), valleys, mountain systems, in particular the Greater Caucasus and its branches. Spring migration starts from the second half of March to the first half of May and the main direction of migration is from south to north. The peak of migration is May 10-20. The autumn migration period is September - late October and the main direction of migration is from north to south. Autumn migration is longer and more active than spring one. The first migrations of autumn appear in early August, and the migration of this season ends in late November (Abuladze A., et al. 2011).

One of the migration routes crosses the river Bakhvitskali and is therefore an important place in terms of bird migration. The period of spring-autumn migrations is especially noteworthy, the diversity of bird species and the number of each species increases significantly in this period. The number of migratory birds varies considerably from year to year. Unfortunately, the available data do not allow us to determine the exact number of seasonally migratory birds within the project area.

The project site is not located within the Special protection areas of birds, the function of whih is to protect and monitor the populations of birds nesting in Georgia. The area coincides with the Important Bird Areas (IBA) of the Adjara-Imereti ridge. (See Map 5.4.2.7.2.5.1.).

Map 5.4.2.7.2.5.1. Project territory on Adjara-Imereti ridge of Important Bird Areas (IBA)



In addition, the project area falls within the Key Biodiversity Area (KBA) of "Bakhmaro".

Map 5.4.2.7.2.5.1. Project area in the Key Biodiversity Area (KBA) of "Bakhmaro".

5.4.2.7.2.6 Field Survey Methods

Before starting the field surveys, materials were obtained from literary sources (Kutubidze, 1996), which were verified by the visual inspection and then by the detailed study of birds species. A list of locally identified species and those ones given in the scientific literature was compiled and GPS coordinates of the location of the recorded birds were kept. In addition, attention was paid to weather conditions, time, number of individuals and flocks, age and sex.

The survey was conducted during the breeding season. The birds' watch was carried out in optimal, sunny and windless weather. We visited all sites of the study area. In each site, attention was drawn to the description of birds distributed through the study area and its surrounding, especially the species protected by the Red List of Georgia and international IUCN Red Lists. We used the walking observation method by using a binocular which means walking and exploring each site. Elevated areas – vantage points were selected from where it is possible to carefully observe the study area as well as the surrounding areas and better identification of birds. The number of vantage points depended on the size of the study area. It was convenient to visually observe the birds from an elevated place, as well as to collect photo material. In addition to the photographs, the birds were identified by their voices. Attention was drawn to the accounting of bird nests, although none of the nests was identified. Bird species were identified by using special textbooks (Birds of Europe: Second Edition by Lars Svensson and Dan Zetterström and Collins Bird Guide. 2Nd Edition). We used a binocular 8x42 "Discovery WP PC Mg" and photo camera Canon PowerShot SX60 HS. We also observed the species that suddenly flew up and we could not collect photo material, however, attention was focused on the identification signs of birds, according to which this or that species can be identified. consequently, the species observed in such cases are provided in the table below (see Table **5.4.2.7.2.6.1.**).

Birds species observed during the field survey:

Pic. 5.4.2.7.2.6.1. Red-backed Shrike *Lanius collurio*

Pic. 5.4.2.7.2.6.2. Grey Wagtail *Motacilla cinerea*

Pic. 5.4.2.7.2.6.3. Isabelline Wheatear *Oenanthe isabellina*

Pic. 5.4.2.7.2.6.4. White Wagtail *Motacilla alba*

Pic. 5.4.2.7.2.6.5. Eurasian Chaffinch *Fringilla coelebs*

Pic. 5.4.2.7.2.6.6. Willow Warbler *Phylloscopus trochilus*

Pic. 5.4.2.7.2.6.7. Northern Hause-Martin *Delichon urbicum*

Pic. 5.4.2.7.2.6.8. Barn Swallow *Hirundo rustica*

Pic. 5.4.2.7.2.6.9. Eurasian Jay *Garrulus glandarius*

Pic. 5.4.2.7.2.6.10 Common Rosefinch *Carpodacus erythrinus*

Pic. 5.4.2.7.2.6.11 Common Buzzard *Buteo buteo menetriesi*

Pic. 5.4.2.7.2.6.12 flock of common buzzard *Buteo buteo menetriesi* in the project territory

Pic. 5.4.2.7.2.6.13 European Honey-Buzzard *Pernis apivorus*

Pic. 5.4.2.7.2.6.14 Eurasian scops owl *Otus scops*

Pic. 5.4.2.7.2.6.15 European bee-eater *Merops apiaster*

Pic. 5.4.2.7.2.6.16 White-throated Dipper *Cinclus cinclus*

Pic. 5.4.2.7.2.6.17 Black Redstart *Phoenicurus ochruros*

Pic 5.4.2.7.2.6.18 Spotted Flycatcher *Muscicapa striata*

Pic. 5.4.2.7.2.6.19 White Wagtail *Motacilla alba*

Pic. 5.4.2.7.2.6.20 Buzzard *Buteo sp.*

5.4.2.7.2.7 Impact

Within the period of construction of the HPP's corridor, the impact is mainly expected on the birds' species nesting and inhabiting in the habitats of the project territory. The impact is less expected on visitor and migratory species. Following impacts are expected on birds through the construction corridor.

- Impacts on nesting and resident birds entailed by increased noise and artificial lighting due to deforestation and construction works.
- Degradation/loss of birds' significant nesting and inhabiting habitats. The impact on birds associated with a forest and shrubs is expected if hollow trees are destroyed during the clearing of vegetation, which these birds use as nesting and shelter. However, cutting a large number of trees in the project area is not expected, which somewhat reduces the impact risks.
- Riparian vegetation and water bodies are significant habitats for many waterfowl. Changes in water level will lead to changes in vegetation; and in case of spilling of harmful substances in water and soil, bird species inhabiting near the water bodies will be damaged. Consequently, the habitat of birds will be lost.
- From the described and identified species associated with the vegetation cover near forests, shrubs and rivers will be mainly impacted. However, the impact will be temporary and will not lead to the long-distance migration of birds. It should also be noted that the protected species identified in the area will enter this area only during migrations and, consequently, the impact on them will be negligible.

5.4.2.7.2.8 Mitigation Measures

- Do not use/restrict the use of explosives during construction works, which may be disturbing for birds; also lead to their death and disruption of their habitats.
- It is not recommended to use heavy construction equipment during the bird nesting period (especially from the beginning of April to the end of June). Particularly sensitive areas for birds, in this case, are the forest zone and the watershed sections of the ridges, otherwise, their favorable habitats will be lost and fragmented.
- In order to prevent soil and water contamination, the fuel and oil products must not be spilt in the project territory, which will lead to bird poisoning/death.
- Since the construction works are completed through the HPP area, the construction waste should be removed as soon as possible and the disturbed soil and vegetation cover should be restored.
- Since the construction works are completed, rehabilitating works should be carried out in those sections where the access roads had been arranged. Similar works are especially essential in the environs of floodplains and rivers.

Table 5.4.2.7.2.8.1. Birds species observed in the study area and given in the literary sources

N	Georgian anme	Latin name	English name	Migration seasonality	IUCN	RLG	Bern Conv.	CMS	Observed (habitat types - 1-4) not observed X
1.	ქორი	*Accipiter gentilis*	Northern Goshawk	M	LC		√	√	2
2.	ქორცქვიტა (ან შავთვალა მიმინო, ლევანმიმინო)	*Accipiter brevipes*	Levent Sparrowhawk	BB,M	LC	VU	√	√	x
3.	მიმინო	*Accipiter nisus*	Eurasian Sparrowhawk	YR-R	LC		√		1,2
4.	ძერა	*Milvus migrans*	Black Kite	M	LC		√	√	x
5.	ჩვეულებრივი შავარდენი	*Falco peregrinus*	Peregrine Falcon	YR-R, M	LC		√		x
6.	კრაზანაჭამია (ან ირაო)	*Pernis apivorus*	European Honey-Buzzard	BB,M	LC				1,2
7.	ჩვეულებრივი კაკაჩა	*Buteo buteo*	Common Buzzard	M	LC		√	√	1,2
8.	ველის (ან გრძელფეხა) კაკაჩა	*Buteo rufinus*	Long-legged Buzzard	YR-R, M	LC	VU	√		x
9.	ფეხბანჯგვლიანი კაკაჩა	*Buteo lagopus*	Rough-legged Buzzard	WV,M	LC				x
10.	მდელოს ძელქორი (ან მდელოს ბოლობეჭედა)	*Circus pygargus*	Montagus Harrier	BB,M	LC		√	√	x
11.	მინდვრის ძელქორი (ან მინდვრის ბოლობეჭედა)	*Circus cyaneus*	Hen (or Northern) Harrier	WV, M	LC				x
12.	ჭაობის ძელქორი (ან ჭაობის ბოლობეჭედა)	*Circus aeroginosus*	Western Marsh Harrier	YR-R, M	LC		√	√	x
13.	ჩია არწივი	*Hieraaetus pennatus*	Booted Eagle	M	LC			√	x
14.	მცირე მყივანი არწივი	*Clanga pomarina*	Lesser Spotted Eagle	BB, M	LC				x
15.	ალალი	*Falco columbarius*	Merlin	M	LC		√	√	x
16.	მარჯანი	*Falco subbuteo*	Eurasian Hobby	YR-R, M	LC		√	√	x
17.	ჩვეულებრივი კირკიტა	*Falco tinnunculus*	Common Kestrel	M	LC		√	√	x
18.	ალკუნი	*Alcedo atthis*	Common Kingsfisher	YR-R, M	LC		√		3
19.	ღალღა	*Crex crex*	Corn crake	BB	LC				x
20.	ჩვეულებრივი მექვიშია	*Actitis hypoleucos*	Common Sandpiper	BB	LC				x
21.	გარეული მტრედი	*Columba livia*	Rock Dove	YR-V	LC				x
22.	ქედანი	*Columba palumbus*	Common Wood-Pigeon	M	LC				x
23.	საყელოიანი გვრიტი	*Streptopelia decaocto*	Eurasian Collared-Dove	YR-R, M	LC				x
24.	გუგული	*Cuculus canorus*	Common Cuckoo	BB	LC		√		x
25.	ტყის ბუ	*Strix aluco*	Tawny Owl	M	LC			√	x
26.	ზარნაშო	*Bubo bubo*	Eurasian Eagle Owl	M	LC				x
27.	წყრომი	*Otus scops*	Eurasian scops owl	BB, M	LC				2
28.	ჭოტი	*Athene noctua*	Little Owl	YR-R	LC				x
29.	უფეხურა	*Caprimulgus europaeus*	European Nightjar	M	LC		√	√	x
30.	მაქცია	*Jynx torquilla*	Eurasian Wryneck	BB, M	LC		√		2
31.	ოფოფი	*Upupa epops*	Common Hoopoe	M	LC		√		x
32.	ოქროსფერი კვირიონი	*Merops apiaster*	European bee-eater	BB, M	LC				1,2

33.	ნამგალა	*Apus apus*	Common Swift	BB	LC				1
34.	მწვანე კოდალა	*Picus viridis*	Eurasian Green Woodpecker	YR-R	LC		√		x
35.	დიდი ჭრელი კოდალა	*Dendrocopos major*	Greater Spotted Woodpecker	YR-R	LC		√		1
36.	საშუალო ჭრელი კოდალა	*Leiopicus medius*	Middle Spotted Woodpecker	YR-R	LC				x
37.	მცირე ჭრელი კოდალა	*Dryobates minor*	Lesser Spotted Woodpecker	YR-R	LC		√		x
38.	მინდვრის ტოროლა	*Alauda arvensis*	Eurasian Skylark	M	LC				x
39.	ტყის ტოროლა	*Lullula arborea*	Wood Lark	M	LC				x
40.	სოფლის მერცხალი	*Hirundo rustica*	Barn Swallow	BB,M	LC		√		4
41.	ქალაქის მერცხალი	*Delichon urbicum*	Northern Hause-Martin	YR-V	LC		√		3,4
42.	თეთრი ბოლოქანქარა	*Motacilla alba*	White Wagtail	YR-R	LC		√		1
43.	რუხი ბოლოქანქარა	*Motacilla cinerea*	Grey Wagtail	M	LC		√		2
44.	ყვითელი ბოლოქანქარა	*Motacilla flava*	Yellow Wagtail	BB,M	LC		√		x
45.	ყვითელთავა ბოლოქანქარა	*Motacilla citreola*	Citrine Wagtail	BB,M	LC		√		x
46.	ჩვეულებრივი ღაჟო	*Lanius collurio*	Red-backed Shrike	BB,M	LC		√		2
47.	მიმინოსებრი ასპუჭაკა	*Sylvia nisoria*	Barred Warbler	BB	LC		√		x
48.	შავთავა ასპუჭაკა	*Sylvia atricapilla*	Blackcap	BB	LC		√		2
49.	ჭაობის მეჩალია	Acrocephalus palustris	Marsh Warbler	BB,M	LC				x
50.	ჩვეულებრივი ბოლოცეცხლა	*Phoenicurus phoenicurus*	Common Redstart	BB,M	LC		√		1,2
51.	შავი ბოლოცეცხლა	*Phoenicurus ochruros*	Black Redstart	YR-R, M	LC		√		1,2
52.	ჩვეულებრივი ბულბული	*Luscinia megarhynchos*	Common Nightingale	BB	LC		√		x
53.	შაშვი	*Turdus merula*	Eurasian Blackbird	YR-R	LC		√		1,2,3,4
54.	წრიპა შაშვი (მგალობელი შაშვი)	*Turdus philomelos*	Song Thrush	M	LC		√		x
55.	წყლის შაშვი	*Cinclus cinclus*	White-throated Dipper	YR-R	LC		√		3
56.	ჩხართვი	*Turdus viscivorus*	Mistle Thrush	M	LC		√		x
57.	შოშია	*Sturnus vulgaris*	Common Starling	YR-R, M	LC				x
58.	თოხიტარა	*Aegithalos caudatus*	Long-tailed Tit	YR-R	LC		√		4
59.	გულწითელა	*Erithacus rubecula*	European Robin	BB	LC		√		x
60.	დიდი წივწივა	*Parus major*	Great Tit	YR-R	LC		√		1,2,3,4
61.	მოლურჯო წივწივა	*Parus caeruleus*	Blue Tit	YR-R	LC				2
62.	მცირე წივწივა	*Parus ater*	Coal Tit	YR-R	LC				2
63.	ჩვეულებრივი მგლინავა	*Certhia familiaris*	Eurasian Tree-creeper	M	LC		√		x
64.	ჭინჭრაქა	*Troglodytes troglodytes*	Winter Wren	YR-R	LC		√		1,2
65.	კლდის გრატა	*Emberiza cia*	Rock Bunting	YR-R, M	LC				x
66.	მეფეტვია	*Miliaria calandra*	Corn Bunting	BB	LC				x

67.	ჩვეულებრივი კოჭობა	*Carpodacus erythrinus*	Common Rosefinch	BB, M	LC				1,2
68.	კულუმბური	*Coccothraustes coccothraustes*	Hawfinch	YR-R, M	LC				x
69.	სკვინჩა	*Fringilla coelebs*	Eurasian Chaffinch	YR-R	LC				1,2,3,4
70.	მთიულა	*Fringilla montifringilla*	Brambling	WV	LC				x
71.	წითელშუბლა მთიულა	*Serinus pusillus*	Fire-fronted Serin	YR-R	LC		√		x
72.	მოყვითალო მთიულა	*Serinus serinus*	European Serin	BB	LC		√		x
73.	ჩიტბატონა	*Carduelis carduelis*	European Goldfinch	YR-R	LC		√		2,3
74.	მწვანულა	*Carduelis chloris*	European Greenfinch	YR-R	LC		√		2
75.	შავთავა მწვანულა	*Spinus spinus*	Eurasian Siskin	YR-R, M	LC		√		x
76.	მინდვრის ბეღურა	*Passer montanus*	Tree Sparrow	M	LC				x
77.	სახლის ბეღურა	*Passer domesticus*	Hause Sparrow	YR-R	LC				2,4
78.	მოლაღური	*Oriolus oriolus*	Eurasian Golden Oriole	M	LC		√	√	x
79.	ჩხიკვი	*Garrulus glandarius*	Eurasian Jay	YR-R	LC				2,4
80.	ყორანი	*Corvus corax*	Common Raven	YR-V	LC		√		x
81.	რუხი ყვავი	*Corvus corone*	Hooded Crow	YR-R	LC				4
82.	კაჭკაჭი	*Pica pica*	Black-billed Magpie	YR-R	LC				x
83.	გაზაფხულა ჭივჭავი	*Phylloscopus trochilus*	Willow Warbler	BB, M	LC				2
84.	ჩვეულებრივი ჭივჭავი	*Phylloscopus collybita*	Common Chiffchaff	BB	LC				2,4
85.	ტყის ჭვინტაკა	*Prunella modularis*	Hedge Accentor (Dunnock)	BB	LC		√		x
86.	ალპური ჭვინტაკა	*Prunella collaris*	Alpine Accentor	YR-R	LC				x
87.	ჭვინტა (მეკანაფია)	*Linaria cannabina*	Eurasian Linnet	YR-R, M	LC				x
88.	მთის ჭვინტა	*Carduelis flavirostris*	Twite	YR-R	LC				x
89.	რუხი მემატლია	*Muscicapa striata*	Spotted Flycatcher	BB, M	LC		√		2
90.	წითელყელა (ანუ მცირე) ბუზიჭერია (მცირე მემატლია)	*Ficedula parva*	Red-breasted Flycatcher	BB, M	LC		√		1
91.	თეთრყელა ბუზიჭერია (თეთრყელა მემატლია)	*Ficedula albicollis*	Collared Flycatcher	M	LC		√	√	x
92.	ჩვეულებრივი მეღორღია	*Oenanthe oenanthe*	Northern wheatear	BB, M	LC		√		x
93.	ტყის მწყერჩიტა	*Anthus trivialis*	Tree Pipit	BB	LC				x
94.	წითელგულა მწყერჩიტა	*Anthus cervinus*	Red-Throated Pipit	M	LC		√		x
95.	ჩვეულებრივი ხეცოცია	*Sitta europaea*	Wood Nuthatch	YR-R	LC		√		1,3
96.	ბუქნია-მეღორღია	*Oenanthe isabellina*	Isabelline Wheatear	BB, M	LC				2
97.	კავკასიური როჭო	*Lyrurus mlokosiewiczi*	Caucasian Grouse	YR-R	NT	VU	√		x

98.	წითელნისკარტა მაღრანი	*Pyrrhocorax pyrrhocorax*	Red-billed Chough	YR-R					x
99.	ყვითელნისკარტა მაღრანი	*Pyrrhocorax graculus*	Yellow-billed Chough	YR-R					x
100.	თეთრწარბა (ანუ მდელოს) ოვსადი	*Saxicola rubetra*	Whinchat	BB	LC		√	√	x
101.	თეთრგულა შაშვი	*Turdus torquatus*	Ring Ouzel	YR-R	LC				x

Period of seasonal presense of species on the given territory:
YR-R = Year-round resident; breeder, present throughout the year; YR-V = Year-round visitor; non-breeder, present throughout the year; BB = Breeding bird; visit the territory only for breeding; M = Migrant; may occur on this territroy during migration (autumn and spring)
IUCN - categories are formulated as follows:
EX – Extinct; EW – Extinct in the Wild; CR – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Near Threatened; LC –Least Concern; DD – Data deficient; NE – Not Evaluated

5.4.2.7.3 Reptiles (class: Reptilia)

Based on the latest information, there are more than 7000 species of reptiles, among them about 58 species inhabit Georgia. Reptiles are divided into four orders: SQUAMATA, CHELONIA, CROCODYLIA and RHYNCHOCEPHALIA. Representatives of the first two orders inhabit Georgia. Although there are many secondary water-related reptile species, unlike the amphibians, they develop on the land. There are no nocturnal lizard species in Georgia, except the Caspian bent-toed gecko, which accidentally occurred in Georgia from Azerbaijan. All lizards in Georgia, as well as turtles, have passive and active hours in a day that is especially noticeable in the hottest season. All reptiles of our fauna are characterized by winter hibernation and if winter is warm, separate species (e.g. Caucasian agama, blunt-nosed viper) can be active even in winter months.

The study area is not distinguished by the diversity and endemism of reptiles. Only two species included in the Red List of Georgia are found there – Ajarian lizard *(Darevskia mixta)* [IUCN – Near Threatened (NT)] and Caucasian viper *(Vipera kaznakovi)* [IUCN – Endangered (EN)], which have not been detected during the field survey. Its geographical vertical distribution is to be considered. It is found up to 1000 m above the sea level, while the project zone is located between 1400-1800 m a.s.l., accordingly its presence is less expected, however, its occurrence cannot be excluded, as there are favorable climatic conditions and habitats through the study area.

Caucasian viper - *Vipera kaznakovi* : way of life: Caucasus viper belongs to the terrestrial venomous snakes, basically, feeds on small mammals, lizards, birds. It kills prey with a poisonous bite. Its venom is not deadly for humans, but it is hemotoxic (the chemical composition of venom affects the blood) like other Vipera species. Caucasus viper is very cautious, avoids humans and is not aggressive. It selects forest edges, sunny, shrubbery and grassy areas for inhabiting; the presence of shelters such as stones, small boulders, dry twigs is noteworthy. It prefers the territory with high humidity and inhabits up to 1000 m above sea level. Its head is a sharp triangular shape, with vertical eyeballs. It has a sharply expressed zigzag on the upper part of the body; except colourful forms, there are males from dark grey-to black color and rufous-reddish females – the so called sexual dichromatism. They get such homogenous color from the age of two. Dark-black color (so-called “melanistic coloring”) may have a genetic basis - phenotypic expression of pigment melanin “reaction norm”; such coloring can be stipulated by the intense solar radiation, or high air humidity.

Length of the Caucasus viper varies 40 -70 cm, rarely – 90 cm. Females are longer than males. They are characterized with short-term winter hibernation. They are active in the daytime. After the long-term rainfalls, Caucasus viper warms its body in the sun in the morning and afternoon. This species is characterized by optimal activity in conditions of 30-33^{0}C temperature. After the breeding period, the male selects its inhabiting area, where other specimens may live as well (namely, specimens, which don’t breed anymore). Female specimen stays near the site of breeding that is rich in food and sunny. Females are less active. Vipers rarely change their habitat.

Due to the destruction of its habitats, this species is endangered and included in the Red List of Georgia – EN. (IUCN).

Map 5.4.2.7.3.1. Distribution of the Caucasian viper *(Vipera kaznakovi)*

Source: *http://biodiversity-georgia.net*

Following species are also distributed through the project territory: slow worm (*Anguilis colchica),* Georgian lizard *(Darevskia rudis),* Derjugin's lizard *(Darevskia derjugini),* sand lizard *(Lacerta agilis),* grass snake *(Natrix natrix),* dice snake *(Natrix tessellata)*, smooth snake (*Coronella austriaca*), Aesculapian snake *(Zamenis longissimus).*

Species observed during the field survey:

Pic. 1 Georgian lizard *Darevskia rudis*

E 275402 N 4638207

E 275542 N 4638277

Pic. 2 Derjugin's lizard *Darevskia derjugini*

E 272377 N 4639212

Pic. 3 Ajarian lizard *Darevskia mixta*

E 272203 N 4639122

Table 5.4.2.7.3.1. Species distributed through the study area and its surroundings

N	English name	Latin name	IUCN	RLG	Bern Conv.	Observed (Habitat types 1-4) not observedX
	Grass snake	*Natrix natrix*	LC	LC		x
1.	Dice snake	*Natrix tessellata*	LC	LC	√	x
	Slow worm	*Coronela austriaca*	LC	NE	√	x
2.	Aesculapian snake	*Zamenis longissimus*	LC	DD		x
3.	Caucasian viper	*Vipera kaznakovi*	EN	EN	√	x
4.	Georgian lizard	*Darevskia rudis*	LC	LC		1,4
5.	Derjugin's lizard	*Darevskia derjugini*	NT	LC		2,3
6.	Ajarian lizard	*Darevskia mixta*	NT	VU		2,3
7.	Sand lizard	*Lacerta agilis*	LC	LC	√	x
8.	slow worm	*Anguilis colchica*	LC	LC	√	x

IUCN - categories are formulated as follows:
EX – Extinct; EW – Extinct in the Wild; CR – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Near Threatened; LC –Least Concern; DD – Data deficient; NE – Not Evaluated

In addition, the international company SLR detected several species of reptiles were observed at the water intake of Bakhvi 3 HPP, powerhouse considered by the design of Bakhvi 1 HPP and pebble slopes and marsh areas of proposed water withdrawal site Bakhvi 1 HPP. Information on the observed species is provided in the table and the locations are shown on the map. Time of the survey of reptiles was selected according to the optimal warming time in the sun, or sunny and windless conditions; paths/routes were walked and observation results were recorded. In addition, the surveys were carried out from a car. The reason for this is that reptiles have less time to hide when a car is approaching than when walking, so they are statistically more likely to be seen.

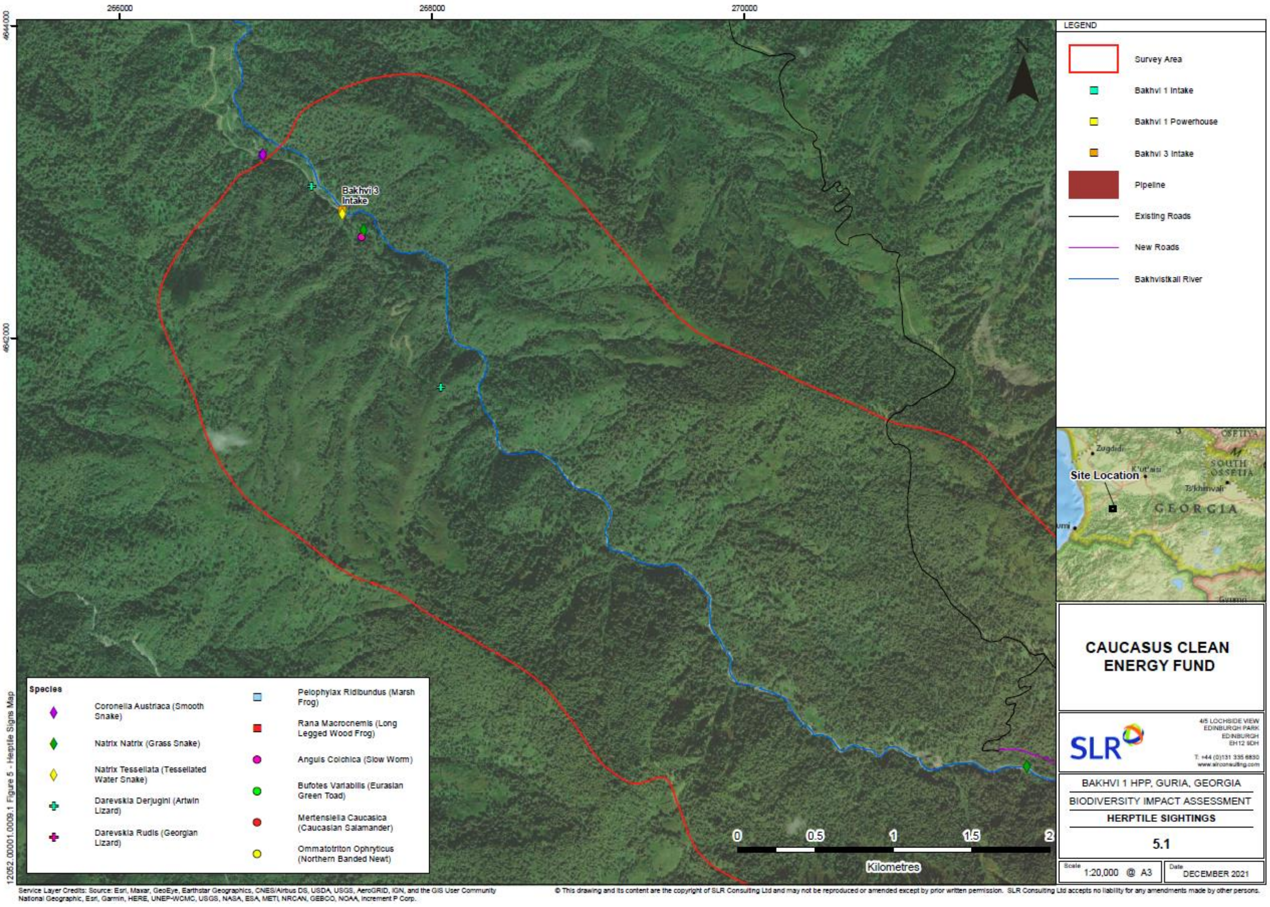
Signs of vitality were found through the transects, such as feces (for lizards) and holes (for reptiles), they were detected by GPS and photos. As for water reptiles, e.g. water turtles and amphibians, water habitats were also studied. This mainly included direct observation by lifting stones and logs, as well as walking along the banks of ponds and streams. The study recorded all species of reptiles and amphibians, regardless of their conservation status.

Reptiles and amphibians detected in June 2021

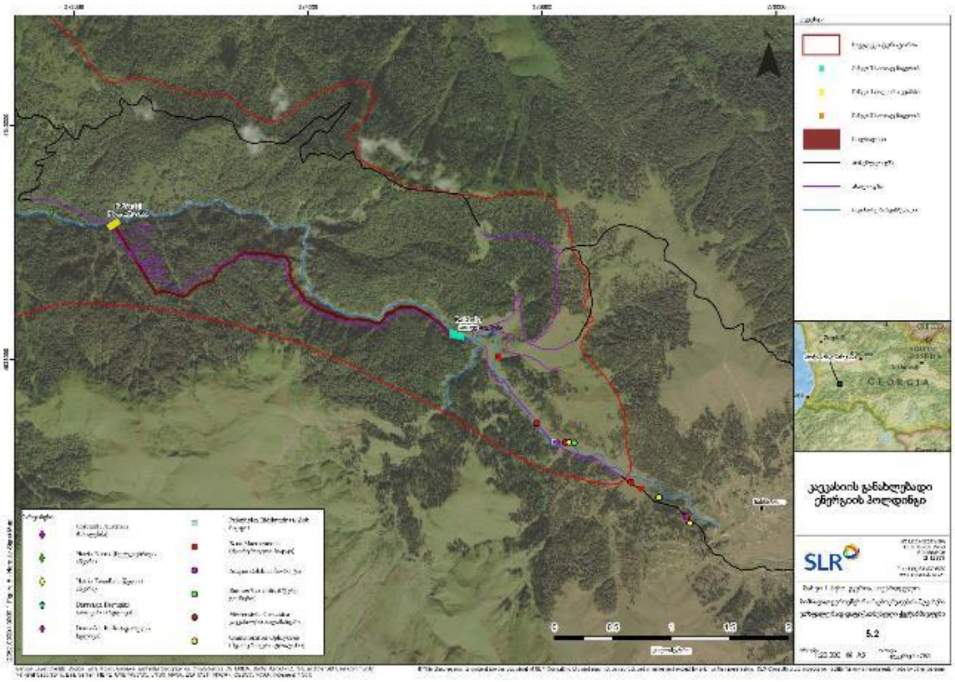
Latin name	Common name	IUCN	RLG
Anguis colchica	Slow worm	NE	LC
Darevskia rudis	Georgian lizard	LC	LC
Darevskia derjugini	Derjugin's lizard	NT	NT
Coronella austriaca	Smooth snake	LC	LC
Natrix natrix	Grass snake	LC	LC
Natrix tessalata	Dice snake	LC	LC
Mertensiella caucasica	Caucasian salamander	VU	VU
Ommatotriton ophryticus	Northern banded newt	NT	NT
Bufotes variabilis	Variable toad	DD	LC
Pelophylax ridibundus	Marsh frog	LC	LC
Rana macrocnemis	Long-legged wood frog	LC	LC

Caucasian salamander found upstream of the proposed water withdrawal site of Bakhvi 1 HPP

Visually observed reptiles



Visually observed reptiles



The list of itigation measures proposed by SLR:

- Removal of vegetation cover and earth works will be started after the hibernation period (October-April/May) in forested areas and clearings. This will generally allow the reptiles to leave the construction area naturally.
- Stone or earth/boulder piles formed in summer as a result of clearing works of working sites will not be removed/cleared until April/May, when reptiles emerge from hibernation and become active again.
- A vehicle speed limit will be set in the project area to reduce the likelihood of killing the specimens lying under the sun while driving on the road.
- Every morning, before the start of the work, ESG team will carry out the first field visit by the electric mountain bike, the ESG team or the relevant expert will be trained on how to remove the reptiles from the project corridor. An environmental officer or relevant expert find reptiles (amphibians and reptiles) in the RoW and remove them from dangerous area by taking appropriate measures. When it is considered that the RoW is free from reptiles, trucks and cars will be allowed to use the road. The team will also inspect the excavation site and trenches before starting work to check if reptiles and animals have fallen into the trenches and they will be safely removed if found.
- Before starting work in the project, all workers will be instructed on the nature conservation issues. They will be instructed that if they find reptiles, they should not even harm or catch them, but should inform the environmental officer about it.
- In frames of construction the power house, road and water intake, it is expected to extract boulders and remove trees. To compensate for the potential loss of a certain part of the reptiles' habitat, 10 winter hibernation sites for reptiles will be created in frames of the project. These winter hibernation sites will be made from wood, stones and other plants. The specification for its creation will be given in the Biodiversity Management Plan and they will be located on the southern or south-western slopes.

- It should also be noted that fencing, which is proposed as a mitigation measure, will be useful for reptiles in general as access to the work area will be limited, which will further reduce the potential risk of crushing the specimens.
- In frames of the project, the program to raise awareness of wildlife in schools will be funded. This will be a program that includes training on reptiles. Raising awareness through teaching and learning will further reduce the killing of reptiles.
- Reptiles will be recorded during inspection of the RoW and excavations by the ESG personnel, this information will be annually collected and attached to the report.

5.4.2.7.4 Amphibians (class: Amphibia)

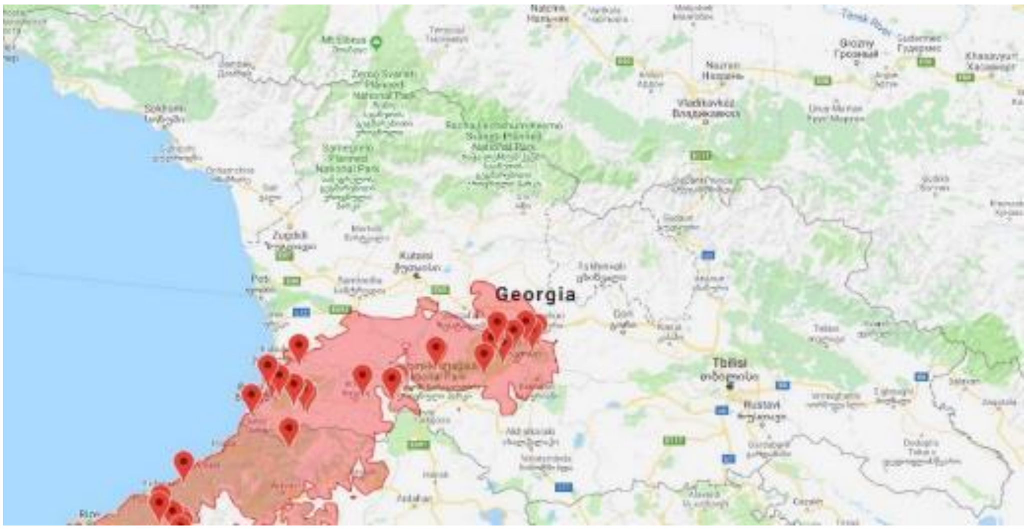
Amphibians are the smallest class from vertebrates, which includes about 3400 species. They are united in 3 orders: limbless (Apoda), salamanders (Caudata or Urodela) and frogs (Anura).

There are only 12 species of amphibians belong to the last two orders; number of separate species is quite high (e.g. frogs, toads).

The study area is not distinguished by the species diversity and endemism, but there can be found Caucasian parsley frog and Caucasian toad that are endemic species of the Caucasus (IUCN-[NT]) and Caucasian Salamander *(Mertensiella caucasica)* included in the Red List of Georgia as Vulnerable [VU] species, as well as in the International Red List IUCN-[VU]. These species were not detected during the field surveys.

Caucasian salamander - *Mertensiella caucasica* VU (IUCN): is a relict species, endemic of the western Lesser Caucasus. The sub-species *M. c. janashvilii* (Tartarashvili & Bakradze, 1989) is described from Mtirala Mountain. It consists of two evolutionary species *M. sp. 1* from Mtkvari River basin and *M. sp. 2* from the Black Sea basin; in morphological viewpoint, they don't differ from each other (Tarkhnishvili et al., 2000). Its nearest relative is the gold-striped salamander(*Chioglossa lusitanica*) from north Spain and Portugal. These two taxons separated from each other about 15 million years ago (Veith et al., 1997). Paleontological species M. cf. caucasica, was found in the lower Pliocene of Poland Carpathian Mountains (Sanchiz & Mlinarsky, 1978). It is a medium-sized Salamander, with elongated, narrow body and a very long tail. It inhabits at springs and brooks. It is a nocturnal animal. Female attaches about 10-12 light color eggs of 5 mm each in a hidden humid location at the water surface or at water body. Larvae live in water up to 3 years old. Conservation status: IUCN status - VU, Red List of Georgia - VU

Map 5.4.2.7.4.1 Distribution of the Caucasian Salamander in Georgia



Source: http://biodiversity-georgia.net

Following amphibians are also distributed through the study area: Southern banded newt *(Ommatotriton vittatus),* European tree frog *(Hyla arborea),* European green toad *(Bufo viridis),* Long-legged wood frog *(Rana macrocnemis)* and Marsh frog *(Pelophylax ridibundus).*

Species observed during the field survey:

Pic. 1 Long-legged wood frog *(Rana macrocnemis)*

E 274878 N 4638502

E 271363 N 4639560

Pic. 2 European green toad *(Bufo viridis)*

E 275475 N 4638208

Pic. 3 Caucasian toad *Bufo verrucosissimus*

E 272075 N 4639226

Table 5.4.2.7.4.1 Species distributed and observed on the study territory and in its surroundings

N	English name	Latin name	IUCN	RLG	Bern Conv.	Observed (Habitat types 1-4) not observed X
	Marsh frog	*Pelophylax ridibundus*	LC			x
	European tree frog	*Hyla arborea*	LC		√	x
1.	Long-legged wood frog	*Rana macrocnemis*	LC		√	2,4
2.	European green toad	*Bufotes viridis*			√	4
3.	Caucasian toad	*Bufo verrucosissimus*	NT		√	2,3
4.	Caucasian parsley frog	*Pelodytes caucasicus*	NT			x
5.	Caucasian salamander	*Mertensiella caucasica*	VU	VU		x
6.	Southern banded newt	*Ommatotriton vittatus*	LC			x

IUCN - categories are formulated as follows:
EX – Extinct; EW – Extinct in the Wild; CR – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Near Threatened; LC –Least Concern; DD – Data deficient; NE – Not Evaluated

Mitigation measures proposed by the international consulting company SLR with respect to amphibians are provided below:

- Good international practice in the field will be used during the construction process. Bridges or suitable drainage systems will be used when crossing streams by roads to avoid impeding the water flow.
- A “triton fence” will be installed around the working site, the boundaries of which will be defined in the Biodiversity Management Plan. The fence will form the inaccessible space for the Caucasian Salamander. The area will be manually cleared from the Caucasian Salamander, in addition, hole traps will be also used for this purpose, they will be checked by ESG team on a daily basis. Found individuals will be removed to another appropriate habitat beyond the project Area of Influence (AOI).
- Any piles of stones/wood/mud that will form in the habitat suitable for the Caucasian salamander will be fenced to prevent access of individuals of this species; these piles will not be removed in winter to prevent damage or death of hibernating individuals.
- In case of crossing the streams by roads, solid sediment collectors will be installed to avoid occurring solids in water. Solid sediment collectors should be suitable for the stream and may include using the filters such as hay bale or fibrous cloth or settling basin.
- Creating a habitat near upstream of the impoundment where the water is flowing. Minimum eight deepening or holes with a surface area of 6-8 m^2 will be created where stones will be placed. These holes will be excavated in the areas where they will be filled with the runoff from slopes or the river water will fill them during the flood. This will form a pool-like eutrophic meadow that will be used by the Caucasian Salamander. Detailed information about the location and arrangement of these holes will be provided in BAP.
- Arranging a shelter for the winter hibernation will be useful for the Caucasian Salamander depending on the place of its arrangement. At least three out of 10 winter hibernation sites will be arranged upstream of the water intake near the areas where the Caucasian Salamander is distributed and its potential habitats.
- In the project Area of Influence (AOI), the monitoring of the Caucasian Salamander will be carried out annually for the first five years (in June), including before the construction is launched in June (to study the baseline condition of its distribution), for two years during the construction and then, for two years of the operation. Removal of vegetation cover and earth works will be started after the hibernation period (October-April/May) in forested areas and clearings. This will generally allow the reptiles to leave the construction area naturally.
- Stone or earth/boulder piles formed in summer as a result of clearing works of working sites will not be removed/cleared until April/May, when reptiles emerge from hibernation and become active again.
- A vehicle speed limit will be set in the project area to reduce the likelihood of killing the specimens lying under the sun while driving on the road.
- Every morning, before the start of the work, ESG team will carry out the first field visit by the electric mountain bike, the ESG team or the relevant expert will be trained on how to remove the reptiles from the project corridor. An environmental officer or relevant expert find reptiles (amphibians and reptiles) in the RoW and remove them from dangerous area by taking appropriate measures. When it is considered that the RoW is free from reptiles, trucks and cars will be allowed to use the road. The team will also inspect the excavation site and trenches before starting work to check if reptiles and animals have fallen into the trenches and they will be safely removed if found.
- Before starting work in the project, all workers will be instructed on the nature conservation issues. They will be instructed that if they find reptiles, they should not even harm or catch them, but should inform the environmental officer about it.

- In frames of construction the powerhouse, road and water intake, it is expected to extract boulders and remove trees. To compensate for the potential loss of a certain part of the reptiles' habitat, 10 winter hibernation sites for reptiles will be created in frames of the project. These winter hibernation sites will be made from wood, stones and other plants. The specification for its creation will be given in the Biodiversity Management Plan and they will be located on the southern or south-western slopes.
- It should also be noted that fencing, which is proposed as a mitigation measure, will be useful for reptiles in general as access to the work area will be limited, which will further reduce the potential risk of crushing the specimens.
- In frames of the project, the program to raise awareness of wildlife in schools will be funded. This will be a program that includes training on reptiles. Raising awareness through teaching and learning will further reduce the killing of reptiles.
- Reptiles will be recorded during inspection of the RoW and excavations by the ESG personnel, this information will be annually collected and attached to the report.

Additional information on this issue is provided in Annex N4 – the Biodiversity Impact Assessment Report (SLR).

5.4.2.7.5 Invertebrates (Invertebrata)

The fauna of invertebrates is based on the review of literary sources and the field survey results. The purpose of the implemented field surveys was to determine habitats of invertebrates under the project impact zone and to identify the invertebrate animals distributed on this territory. Special attention was drawn to the species included in the Red List of Georgia and protected by international treaties.

Invertebrates were visually recorded, they are: butterflies, beetles, dragonflies, bees, grasshoppers, spiders, mollusks. Survey methodology includes the following actions:

- Catching and identification of insects;
- Turning over stones and soil;
- Inspection of plants and their residues;
- Photographing;
- Use of scientific literature

<u>According to the literary sources, more than 500 species of insects are distributed through the project region, among them the most significant and numerous orders are</u>: beetles (Coleoptera), true bugs (Hemiptera), butterflies and moths (Lepidoptera), Hymenopterans (*Hymenoptera*), grasshoppers *(Orthoptera),* rove beetles *(Staphylinidae),* mantis (Mantodea), dragonflies (Odonata) and others.

Insects observed during the field survey:

Pic. 1. Silver-washed fritillary*Argynnis paphia*

Pic. 2. Southern hawker *Aeshna cyanea*

Pic. 3. Comma *Polygonia c-album*

<u>The species of Arthropods, butterflies, beetles, dragonflies, grasshoppers distributed through the study area are provided below:</u> *Pentatoma rufipes, Libellula depressa, Pieris napi, Pieris brassicae, Pieris rapae, Cupido argiades, Cupido minimus, Erynnis tages, Polyommatus baeticus, Polyommatus daphnis, Polyommatus icarus, Cercopis intermedia, Cercopis sanduinolenta, Vanessa atalanta, Vanessa cardui, Issoria lathonia, Pieris ergane, Pieris napi, Tettigonia viridissima, Arctia festiva, Arctia villica, Callimorpha dominula, Coscinia striata, Dysauxes punctate, Eilema sororcula, Parasemia caucasica, Parasemia plantaginis, Pelosia muscerda, Phragmatobia fuliginosa, Spilosoma lubricipeda, Spilosoma mendica, Spilosoma menthastri, Spilosoma urticae, Tyria jacobaeae, Cossus cossus, Habrosyne derasa, Sitotroga cerealella, Alcis repandata, Aplocera plagiata, Aplocera praeformata, Asmate clathrata, Asthena albulata, Biston betularia, Cabera pusaria, Calospilos sylvata, Campaea margaritata, Catarhoe arachne, Charissa glaucinaria, Chlorissa cloraria, Chloroclystis v-ata, Cleorodes lichenaria, Colostygia viridaria, Cyclophora porata, Dysstroma truncate, Ectropis bistortata, Ectropis crepuscularia, Ematurga atomaria Eulithis pyraliata, Euphyia picata, Euphyia unangulata, Eupithecia graciliata, Eupithecia plumbeolata , Eupithecia pumilata, Eupithecia selinata, Eupithecia subfenestrata, Eupithecia subfuscata,Geometra papilionaria, Gnopharmia colchidaria, Hydrelia flammeolaria, Idaea aversata, Idaea biselata, Idaea fuscovenosa, Idaea sylvestraria, Lomaspilis marginata, Acronicta rumicis, Aedia funesta, Aedia leucomelas, Agrotis exclamationis, Agrotis segetum, Agrotis ypsilon, Athetis pallustris, Autographa gamma, Autographa jota, Axylia putris, Callopistria purpureofasciata, Caradrina kadenii, Catocala promissa, Cucullia umbratica, Dichonia aprilina, Eilema lurideola, Eugnorisma depuncta, Macdunnoughia confuse, Melanchra persicariae, Noctua orbona, Noctua pronuba, Ochropleura plecta, Pammene fasciana, Pechipogo strigilata, Phlogophora meticulosa, Polia nebulosa, Protoschinia scutosa, Rivula sericealis, Sideridis turbida, Spodoptera exigua, Trichoplusia ni, Xestia c-nigrum, poria crataegi, Colias chrysotheme, Colias hyale, Euchloe belia, Gonepteryx rhamni, Leptidea sinapis, Pieris brassicae, Pieris ergane, Chloethripa chlorana,*

Nola aerugula, Roeselia albula, Furcula bifida, Melitaea cinxia, Melitaea didyma, Melitaea transcaucasica, Mellicta athalia, Neptis rivularis, Nymphalis io, Pararge maera, Pararge megera, Satyrus dryas, Vanessa atalanta,Vanessa cardui, Colocasia coryli, Allancastria caucasica, Iphiclides podalirius, Papilio machaon, Parnassius mnemosyne, Colocasia coryli, Acherontia atropos, Deilephila porcellus, Hyles livornica, Epinotia subsequana, Aeshna cyanea, Calopteryx virgo, Lestes sponsa, Orthetrum ramburi, Acrida oxycephala, Calliptamus italicus, Chorthippus Mantis religiosa, Morimus verecundus, Decticus verrucivorus, Lymantria dispar, Capnodis cariosa, Chrysolina adzharica, Chrysolina sanguinolenta, Saga ephippigera, Polistes gallicus, Bolivaria brachyptera, Oecanthus pellucens, Rhynocoris iracundus, Leptidea sinapis, Anthocharis cardamines, Byctiscus betulae, Aspidapion radiolus, Omphalapion dispar, Perapion violaceum, Protapion apricans, Bruchus pisorum, Buprestis haemorrhoidalis, Acinopus laevigatus, Amara aenea, Anchomenus dorsalis, Badister bullatus, Brachinus crepitans, Calosoma sycophanta, Carabus puschkini, Chlaenius decipiens, Dyschiriodes substriatus, Ocydromus tetrasemus, Arhopalus ferus, Dorcadion niveisparsum, Fallacia elegans, Rhagium bifasciatum, Stenurella bifasciata, Tetropium fuscum, Smaragdina unipunctata, Trichodes apiaries, Anechura bipunctata, Forficula auricularia. და სხვა.

Mollusks observed during the field survey:

Pic. 4. Snail *Helix buchii*

Pic. 5. Snail *Caucasotachea Calligera*

Pic. 6. Slug *Eumilax brandti*

Spiders (Araneae)

species composition of spiders of Georgia's mountain forest zone is quite numerous and diverse, this can be stipulated by the fact that the forest zone is distinguished by the abundance of food and favorable micro-climatic conditions (intense rainfalls, high relative humidity and others). 3 families of spiders of the study area - *Dipluridae, Dysderidae, Sicariidae* are distributed in the forests of the Caucasus, Crimea and Central Asia. The other families - *Micryphantidae, Linyphiidae, Thomisidae, Theridiidae*, *Argiopidae, Lycosidae, Clubionidae, Salticidae, Gnaphosidae* are widespread and are observed everywhere. Following families are distinguished by lack of species - *Oxyopidae, Pholcidae, Dictynidae, Ulobridae, Mimetidae, Sparassidae.* From the typical forest forms following ones are noteworthy: *Araneidae, Araneus diadematus, A. angulatus, A.ceropegus, A. grossus, A.ocellatus, A.circe* and *Mangora acalipha* this latter inhabits on scrubs. The southern form of the Mediterranean Sea - *Argipe bruennichi* from the same family is distinguished by the beautiful coloring. It inhabits in deciduous forest and open areas on the tall grasses. *A.diadematus* is widespread in the forest zone, but frequently, it can be observed in other zones. Endemic species of Georgia *Coelotes spasskyi* – also inhabits in this zone, it can be also observed in the subalpine zone. It inhabits under stones and in decomposing, dried roots of plants. Several four-lungs spider species of *Dipluridae* were found in the forest zone. In the similar environment following ones are observed from Dysdera family - *Dysdera, Harpoactocratea, Harpactea, and Segistria*. Other species are as follows: *Clubiona frutetorum, Steatida bipunctatam, Theridium smile, Theridium pinastri, Pardosa amentatam, Pardosa waglerim, Araneus cerpegus, Araneus marmoreus. Misumena vatia, Pisaura mirabilis, Lycosoides coarctata, Oecobius navus, Alopecosa schmidti, Trochosa ruricola, Araneus diadematus, Micrommata virescens, Diaea dorsata, Agelena labyrynthica, Pellenes nigrociliatus, Asianellus festivus, Araniella dispcliata, dysdera crocata, Phialeus chrysops, Thomisus onustus, Xysticus bufo, Alopecosa accentuara, Argiope lobata, Menemerus semilimbatus, Pardosa hortensis, Larinioides cornutus, Uloborus walckenaerius Mangora acalypha, Evarcha arcuata, Alopecosa taeniopus, Agelena labyrinthica, Gnaphosa sp, Heliophanus cupreus, Linyphiidae sp., Parasteatoda lunata, Synema globosum, Tetragnatha sp, Philodromus sp., Pisaura mirabilis, Runcinia grammica, Neoscona adianta* et.al.

5.4.2.7.6 Highly Sensitive Fauna Sites through the Study Area

None of the sites can be considered highly sensitive within the impact zone of Bakhvi 1 HPP, unless of course the construction is carried out with strong demolition, in violation of the relevant environmental norms.

All sections bordering the headwork construction area are medium sensitive. The upstream flooded sites cannot be considered as highly sensitive areas, because the impoundment area is quite small and mainly covers the riverbed. Small reservoirs may attract the water birds and waterfowls and otter. Those sections of the penstock corridor where deforestation is required (not everywhere) are of medium sensitivity.

The powerhouse location is characterized by the anthropogenic loading, the forest road runs near this site, as well as the access road to the power house coincides with the existing forest road that significantly reduces the removal of tree plants from the environment. Hence, these areas should be considered as medium and below than medium sensitive habitats

5.4.3 Fish Fauna

5.4.3.1 Introduction

The report refers to the assessment of impact on hydrobiological-ichthyological environment due to the construction and operation of Bakhvi 1 HPP planned on Bakhvistskali River on the territory of Chokhatauri municipality of Guria region and the development of preventive measures.

5.4.3.2 Survey Goals and Tasks

The purpose of the survey was to study the hydrobiological-ichthyological baseline condition of Bakhvistskali River and to assess the expected impact due to the HPP construction and operation. Following tasks were set:

- To explore the existing archive material and literary sources;
- Visual audit – characterization of the riverbed in the project territory, marking/detection of sensitive sections (critical) for fish species (e.g. spawning grounds);

- To study of baseline condition of hydrobiont living environment upstream and downstream of the project territory – examination of water quality, the survey of Phyto and zoobenthos organisms, fishing for ichthyological surveys;
- The survey of river water quality implies field and laboratory works. In field conditions, the following is determined: water dissolved oxygen (mg/l), water pH, water temperature(°C), air temperature; in the laboratory: brief water chemical analysis and the content of suspended solids in water (mg/l);
- The study of the food base of ichthyofauna involves the study of species composition of phyto and zoobenthos; determination of biomass of zoobenthos organisms (kg/ha);
- Fishing upstream and downstream of the design headwork, in ichthyological stations;
- Study/analysis of obtained ichthyological material (fish) – size, weight, age. If a caught specimen is not included in the Red List of Georgia, the following factors are determined: sex, stage of sexual maturity, study of the contents of the digestive system;
- To identify the approximate rate of fish biomass in the project section (kg/ha/a);
- To hold interviews with population or/and local amateur fishermen on the fish species through the study area and the amount of their population to obtain additional information;
- Based on obtained results, to determine adverse impact on the fish fauna due to the HPP construction and operation and to develop appropriate mitigation measures.

5.4.3.3 Survey Methodology

The survey works carried out by hydrobiological-ichtyological team includes desktop, field and lab surveys.

5.4.3.3.1 Desktop Survey Methodology and Sources

Initially, the desktop survey implied finding, studying, target sorting and analysis of existing archive materials and relevant scientific literature.

Fish fauna of Bakhvistskali River and probable fish species distributed through the study section were described. Fishing and hydrochemical-hydrobiological sampling locations were defined; appropriate coordinates are also presented.

Hydrological, hydrogeological and hydrochemical features of the river, as well as a geomorphological picture of the banks and bottom of the river, living environment of fish fauna, were described. Negative impact factors on fish fauna and impact sources, as well as their elimination and mitigation measures, were analysed. Other information essential for the study if fish fauna was also assessed.

According to the literature sources, the biological characteristics of the fish species common in the study area, their seasonal behaviour, spawning periods, migration and other important factors of their lifecycle were determined.

The protection of fish species was defined based on statuses granted to them according to the International Union for Conservation of Nature (IUCN) (https://www.iucnredlist.org) and the Red List of Georgia (Decree №190 of the GoG on "Approval the Red List of Georgia", February 20, 2014, Tbilisi, Georgia).

A plan of the field and laboratory works was determined by the desktop surveys.

In the second phase of the desktop surveys, the results of field and laboratory studies were analyzed, the general inhabiting environment of ichthyofauna was assessed, and quantitative evaluation of food organisms (kg/ha) was performed; Based on the relevant data, the total biomass (kg/ha) of the fish was calculated to some extent. Sources of the possible impact on the ichthyological environment due to the construction and operation of the design Bakhvi 1 HPP were identified, appropriate measures were developed to eliminate, mitigate and/or compensate for the damage caused to the environment. Appropriate cartographic material was prepared using ArcGIS and Visio technology.

The current report was prepared based on the data of archive and scientific literature, field and laboratory studies.

5.4.3.3.2 Field Ichthyological Survey Methodology

Field ichthyological surveys are quite complex, accordingly, the following works are planned:

Visual Assessment - The hydrological, hydrogeological and hydrochemical characteristics of the river were investigated the upstream and downstream of the design headwork; according to the landscape of the river valley, geomorphological picture of the banks and riverbed and hydrographic data were described; control points with their geographic coordinates were specified to prepare relevant cartographic material.

Fish fauna inhabiting conditions, their positive and negative sides, sensitive areas, source of their generation – natural or anthropogenic were described.

Habitats of ichthyofauna and separate species, as well as fishing, feeding grounds and spawning grounds (if any), were marked. Potential risks of adverse impact on fish fauna were visually assessed.

Anamnesis - is an orientational method to obtain additional information on fish species and distribution of their separate populations in the river;

Persons having at least 5-year fishing experience were interviewed. Information confirmed by three or more persons is deemed as reliable.

Fishing - was carried out in compliance with requirements of the Georgian legislation, by “Catch and Release” principle;

A qualified ichthyologist of the company and a professional fisher jointly selected supposed fishing sections, fishing tools (permitted by the law), time and period of implementing works.

Fishing was conducted in various control points, according to the fish habitats; fishing tools – a cast net and rods were used.

Obtained fish specimens were described and photographed; scale samples were taken for identification of their age and then they were released (‘Catch and Release” principle).

Each specimen of studying fish was granted an appropriate number and the data were registered in a special field record book.

Study of fish food base - means assessment of phyto and zoobenthos species and quantitative composition;

Existing zoobenthos is collected and weighed from 1 m^2 area of the riverbed by using a special net and a dragnet with „kick and sweep“ (Schmidt–Kloiber, 2006) method. Based on the received results, the approximate amount of zoobenthos through the study area is determined (kg/ha).

Determine of fish biomass - includes determination of estimated fish biomass in the study sections. Biomass determination work was carried out using the Leger-Huet's method (1949 & 1964), which is based on the study of the ichthyofauna habitat.

In case of presense of ichthyological material, biomass will be calculated based on the analysis of results obtained from fishing.

Water quality survey - implies field analysis of water samples, water sampling, their preparation and transportation to a stationary laboratory for further analysis (brief water chemical analysis and the amount of water suspended solids).

In frames of the field survey, dissolved oxygen(O_2 mg/l) in water, pH were determined by a special tool (Water Quality Meter AZ-86021 combo pH/EC/DO meter); water and air temperatures (°C) will be measured as well.

5.4.3.3.3 Laboratory Survey Methodology

Laboratory survey involves the determination of morphological-anatomical characteristics of obtained fish fauna specimens; general identification of food - phytobenthos and zoobenthos organisms; determination of water suspended particles and brief chemical analyzes of water samples.

Length, weight, sex, maturity stage of fish were described;

The age of the fish was determined from the scales taken below the dorsal fin, near the midline.

The age identification method according to the scale was carried out based on the literary source - „Правдин И.Ф. 1966. Руководство по изучению рыб. М.: Пищ. Пром-сть. 105 с“, where the age determination methodology is described.

For brief chemical analysis, the samples will be sent to the accredited laboratory of the scientific-research firm Gamma.

Water suspended solids (mg/l) were defined according to ISO 11923-97 standard.

5.4.3.4 Desktop Survey

According to the literary source [1], Table 5.4.3.4.1. presents the list of fish species inhabiting in Bakhvistskali River, their statuses and spawning periods.

Table 5.4.3.4.1. Fish fauna of Bakhvistskali River, protection statuses, spawning and feeding migration periods

##	Latin name	Georgian name	English name	Status in Georgia*	IUCN Status	Spawning periods
1	Salmo trutta fario Linnaes, 1758	ნაკადულის კალმახი	Trout	VU - (Ald)	-	From September to February, mostly in October-November
2	Phoxinus colchicus Berg, 1910	კოლხური კვირჩხლა	Colchic minnow	-	LC	June-July

- VU - Vulnerable;
- LC Least Concern;
- (Ald) - Significant decrease in recent years

Designations used in the Red List of Georgia have the same meanings as the ones indicated in explanations of the IUCN Red list Categories and Criteria (IUCN Red list Categories and Criteria, Version 3.1, 2001) and in the recommendations of the same Union for the regional and national Red Lists IUCN Guidelines for National and Regional Red Lists, 2003).

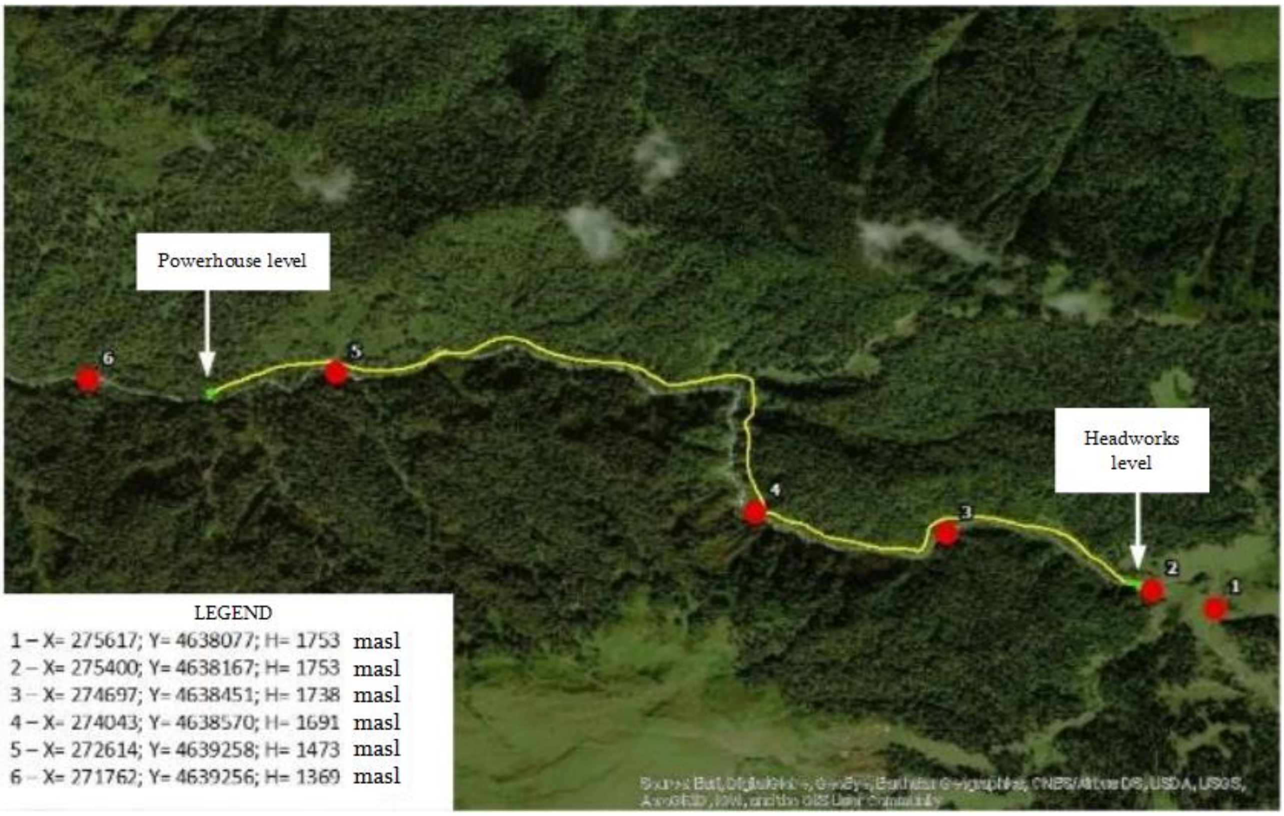
In frames of workin on the report, we also used our previous survey results conducted in October 2019 downstream of the design Bakhvi 1 HPP.

5.4.3.5 Fieldd Surveys

The state of hydrobionts upstream and downstream of the design Bakhvi 1 HPP was studied in the ichthyological survey stations. The fieldworks were carried out in October 2019 and September 2020.

A map of ichthyological stations is provided in Figure 5.4.3.5.1.

Figure 5.4.3.5.1. A map of ichthyological stations



5.4.3.5.1 Visual Assessment

Bakhvistskali River originates from Meskheti ridge, it is a typical mountain river and its riverbed is characterized by complex morphological structure. It feeds on snow, rain and ground waters. Its length is about 42 km, then it joins Supsa River on the left side.

The Bakhvistskali riverbed was visually assessed through the project territory and fish habitats were described.

Bakhvistskali River flows in a V-shaped valley through the project territory of Bakhvi 1 HPP, numerous small tributaries join the river On both sides in this section. The presence of tributaries represent two significant positive factors:

1. The flow of Bakhvistskali River is increased;
2. It is a natural shelter for fish fauna in heavy floods.

The dry riverbed is wide and exceeds 20 m in some sections upstream of the design headwork; the riverbed formed by high waters is visually well-depicted (see Pic. 5.4.3.5.1.1.). There were lots of stones of various sizes, rare boulders, a small amount of gravel and silt in the riverbed. Several small islands and pools were observed. The width of the river varied between 3-4 m, the depth -between 0.2-0.4 m, the basins ranged from 0.6 to 0.7 m.

2 relatively large tributaries are noteworthy, which join Bakhvistskali River from the left side at the design headwork area and upstream in about 2 km. there are lots of small tributaries and dry ravines on both sides of the river.

A tributary joins Bakhvistskali River from the left side, upstream at the alignment of the design headwork. There are sharply steep slopes, a narrow V-shaped valley in a design section of the headwork.

The riverbed is relatively narrow at the environmental flow release zone of the design Bakhvi 1 HPP, the inclination of banks is more than 45° and increases up to 60-70° downstream. The riverbed width is reduced and flows through a V0shaped valley. There are lots of stones and boulders in the riverbed that form rapids, small waterfalls, pools; straight riverbed sections are also observed. The river depth is about 0.3-0.5 m, the water depth was 0,8-1 m in pools.

There were lots of stones and boulders of various sizes in the river downstream from the powerhouse of Bakhvi 1 HPP; a small amount of silt and graves was also observed. Several large and medium islands, small waterfalls, pools were also detected. Rapids were mainly observed in the riverbed.

Dense vegetation cover was observed on both banks of the river.

The riverbed fragments are provided in Pictures 5.4.3.5.1.1..- 5.4.3.5.1.14.

Based on the study of fish habitats, only the presence of a brown trout is assumed within the project territory, as according to the literary data [2], Colchic minnow inhabits freshwater, low water sites of a river.

Based on the research, it can be said that there are flat sections upstream of the design headwork, the riverbed is relatively wide and shallow, the river is less shaded, the so-called "fords" are also observed in Bakhmaro resort. In general, in such habitats, especially during the warmer periods of the year, the temperature of the river rises and the concentration of dissolved oxygen in the water decreases accordingly; due to the absence of rapids and small waterfalls, oxygen concentration does not increase in the river. The relatively optimal living conditions for brown trout during the warmer periods of the year are in habitats different from those described, as this species is quite sensitive to high river temperatures and low concentrations of dissolved oxygen in the water.

Habitats of brown trout are mainly located downstream of the design headwork

- Whirlpools and ponds - are resting areas for fish and rich in food;
- Tributaries – in case of various adverse impacts (high water, increase of water turbidity, etc.), tributaries are a shelter or/and spawning habitat for the fish fauna; in addition, they increase the river flow, which has a positive effect on hydrobionts;
- Rapids and small waterfalls - increase the oxygen content of the river; It should be noted that such habitats create a positive habitat for brown trout (this species is sensitive to low oxygen concentrations);
- Stony-boulder riverbed – creates a habitat for zoobenthos.

In winter, the temperature in the resort Bakhmaro is quite low, which leads to a decrease in the temperature of the river and an increase in the concentration of oxygen in it. In such an environment, positive living conditions are created for brown trout.

Due to its biological characteristics, the brown trout actively starts anadromic spawning migration in winter. The rapid low water, stony-sandy sections of the river are the spawning grounds; while the wide, shallow, sluggish river flows are an ecological niche for fries. According to the literary data [1], the spawning period of the mature individuals of the brown trout is from September to February, mostly in October-November. The active spawning period depends on the climate. The upstream migrating school of fish will presumably appear in winter in Bakhmaro resort.

It should be noted that Bakhvi 3 HPP operates at the village Ukanava, the power plant is equipped with a fish ladder.

Pictures 5.4.3.5.1.1. and 5.4.3.5.1.2. Bakhvistskali riverbed


Pictures 5.4.3.5.1.3. andv5.4.3.5.1.4. sections with small pools


Pictures 5.4.3.5.1.5. and 5.4.3.5.1.6. Bakhvistskali River tributaries


Pictures 5.4.3.5.1.7. და 5.4.3.5.1.8. The left tributary of Bakhvistskali River

Pictures 5.4.3.5.1.9. and 5.4.3.5.1.10. Views of Bakhvistskali River

Pictures 5.4.3.5.1.11 and 5.4.3.5.1.12 Alignment of the design headwork

Pictures 5.4.3.5.1.13 and 5.4.3.5.1.14 Downstream of Bakhvistskali design headwork, October 2019

5.4.3.6 Study of Fish Fauna Habitat

The baseline condition of a habitat of hydrobyonts was assessed during the field surveys. The works included the study of water quality, photographing of the fish food and their specimens.

5.4.3.6.1 Water Quality

River water quality was checked in the project area; In particular, dissolved oxygen (O2 mg/l) was determined in field conditions, pH, water and air temperature were measured. Samples were taken to determine water brief chemical analysis and the amount of Total Solid Sediments (TSS). The samples were sent to the laboratory.

The results of water field survey works in the project territory are given in Table 5.4.3.6.1.1., photo material of the survey is given in Picture 5.4.3.6.1.1.

Table 5.4.3.6.1.1. The survey results of Bakhvistskali River quality in the study area

The content of water dissolved oxygen (O_2), mg/l	Water pH	Water temperature, C°	Air temperature, C°
6,9	7,6	16,8	26,6

The river water quality determined in field conditions – hydrochemical and physical characteristics were in compliance with general inhabiting conditions of fish fauna. However, the oxygen concentration observed in the river 6.9 (O2 mg/l) was equal to the minimum subsistence rate for brown trout; the river water temperature was close to the upper limit. Increase in water temperature causes a decrease in the water dissolved oxygen, therefore, it is probable that during the expedition the individuals of the brown trout were at the riverbanks, shallow water sections and forested habitats. There are such habitats in the environmental flow release section of the project area, in addition, there are many rapids and waterfalls that enrich the river water with oxygen.

Water samples were taken to determine brief water chemical analysis and suspended solids (mg/l)

Picture 5.4.3.6.1.1. Field survey works in Bakhvistskali River

5.4.3.6.2 Fish Food Base

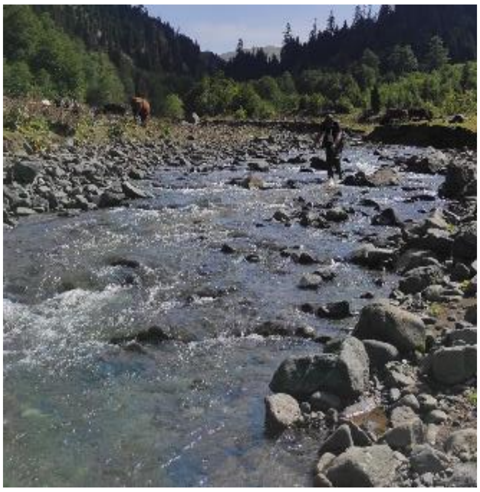
Fish food base was studied to characterize the habitat of fish fauna. The studies were complex, they were conducted by ”Kick and sweep“ (Schmidt–Kloiber, 2006) method and investigation of stones through 1 m² area.

The survey locations coincide with the points on the map of ichthyological stations (Picture 5.4.3.5.1.). Surveys at these locations were conducted in different sections, multiple times.

The obtained food (basically zoobenthos) was recorded and sent to the laboratory for genera identification.

The survey process are provided on Pictures 5.4.3.6.2.1. and 5.4.3.6.2.2.; as well as Pictures 5.4.3.6.2.3., 5.4.3.6.2.4., and 5.4.3.6.2.5.

Pictures 5.4.3.6.2.1. and 5.4.3.6.2.2. The process of obtaining a fish food base

Picture 5.4.3.6.2.3. The process of studying the food base of fish


Pictures 5.4.3.6.2.4. and 5.4.3.6.2.5. The process of studying zoobenthos organisms per 1 m^2

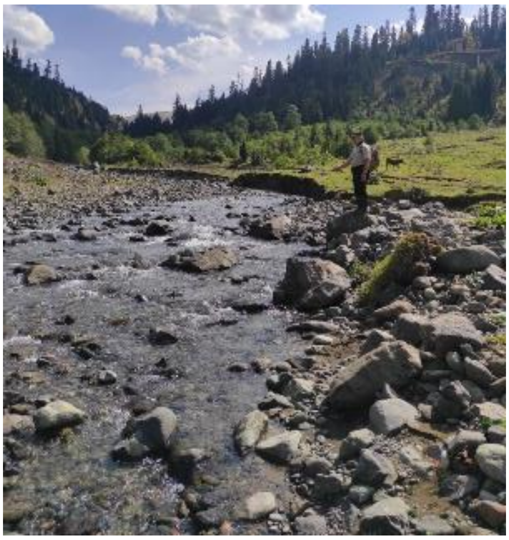

5.4.3.6.3 Fishing

The aim of the fishing was to record the fish species distributed within the project section and to study the baseline condition of their populations.

We used the "catch and release" method in frames of the survey that implies returning the alive ichthyological material (brook trout) in water.

Despite a number of attempts, we could not obtain any ichthyological material.

Picture 5.4.3.6.3.1. Bakhvistskali River, fishing process



Additional Ichthyological Surveys

It should be noted that due to the great interest in the issue of brown trout, the international consulting company SLR conducted an additional ichthyological survey in May 2021. An electrical fish attracting device - EFGI 650 was used for the field surveys. This device is considered to be a high-quality fishing tool for such habitats (fast flow, with an average depth of 0.3 meters to 0.8 meters). Electric fishing in Georgia is regulated by Government Decree N 423 (2013), according to which the use of fishing electrical equipment for scientific purposes is allowed if the electrical equipment does not harm the fish. Fishing nets and rods were also used to increase the likelihood of catching fish.

During each survey session, from the starting point 150 m to 250 m distance was covered in each selected location. The collected fish specimens were identified and photographed before returning them to the river. The aim of this study was to identify the existing fish species and to map their distribution in the study area.

Standard morphological parameters were used to identify the fish species(Kottelat, 2007): a) total length; b) standard length; c) length of a head; d) eye diameter; e) the number of lateral line scales; f) the number of dorsal fins; g) the number of anal fins; h) maximum height, and i) minimum height.

Survey limitations

The project is located in the relatively steep valley formed by the river Bakhvistskali. The terrain of the study area and the density of trees makes it difficult to access the territory. According to the powerhouse design, it was possible to access the proposed location, but it was only possible to reach the upstream at a distance of 500 meters due to the complicated terrain. Reaching to the upstream proposed water intake

site was available by car and on foot, however access to the downstream was only possible at a distance of 500 m, then the terrain became very steep and was not safe.
Satellite and aerial photographs were used for additional assessment of the inaccessible habitat, which could not be directly investigated during the vegetation survey, and these photos were interpolated by matching with the habitat map, which was confirmed in the study area
In addition to the fauna survey data, the habitat requirements of the species were compared with a habitat map compiled by researchers who were well acquainted with the study area and region as they had previously conducted surveys in that area. Thus, it was considered that the complexity of the terrain and the limited access to the entire project area was not a significant obstacle to the collection of baseline data and impact assessments.
The river Bakhvistskali flows through a valley with steep forested slopes from the proposed water intake location to the powerhouse of Bakhvi 1 HPP. This section of the river appeared quite complicated in terms of accessibility due to steep slopes and landslide hazards.

The river section locating between the water intake and powerhouse (And thus will be subject to hydrological changes) is about 4 km in length. It starts at 1 731 m above sea level and the altitude decreases to 1 383 m at the level of the powerhouse. This means a 348 m reduction in altitude over a distance of about 4 km, which gives us an average slope of about 5 degrees, although it varies between the sections from the lower slope to the higher slope.

A favorable spawning area with appropriate sand and gravel was detected upstream of the proposed water intake location, toward Bakhmaro. The riverbed is wide there, in some sections the width exceeds even 20 m, there are dry riverbed sections as well, which are presumably covered with water in flood conditions. There were also some large boulders there in the riverbed, however, cobblestones and gravels were also observed. It was easy to enter the river and its depth was 20-40 cm, rarely up to 1 meter. The given conditions were detected during the field survey, however, obviously, this situation will change, taking into account the parameters such as season and flow velocity.. **Ошибка! Источник ссылки не найден.** (Shot in June 2021). The river habitat upstream from the water intake is provided below.

The section of the river upstream from the water intake location

Facts Revealed during Survey

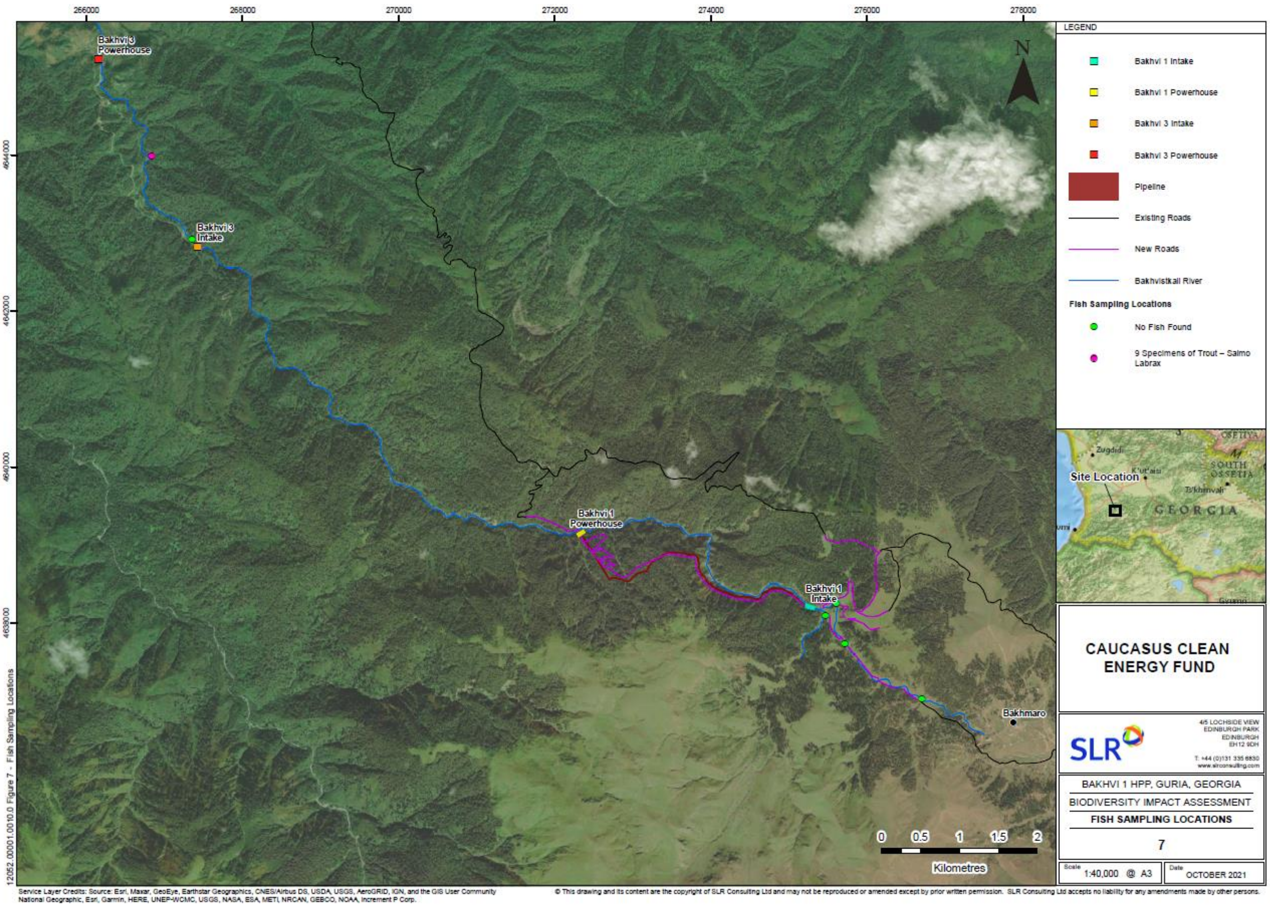
6 locations on the river Bakhvitskali were selected for ichthyologic survey. Out of these 6 locations, fish were found in only one, namely at the 4th location, which is located downstream Bakhvi 3 HPP water intake. Eight out of nine trout individuals were young (6-8 months). Consequently, it can be said that most of the trout appeared last year, in the period from October 2020 to January 2021, which is considered to be the active period of trout spawning. The results of the sampling conducted in May 2021 are shown

in the table. Following the fishing conducted during survey, in October 2021, local fishermen were interviewed to obtain more information on the presence of fish in the area.

Results of fish survey conducted in May, 2021

Location	Description of the location	Results of fishing conducted in May, 2021	Information delivered by local fishermen
1	Upstream Bakhvi 1 HPP intake	No fish was found	Small number of brook trout is upper part of Bakhvistskali river. One trout was caught in June, 2021 on Bakhvi 1 HPP intake area. Trout migrate in September/October and supposedly in May too.
2	Upstream Bakhvi 1 HPP impoundment	No fish was found	
3	In about 100-150 m upstream Bakhvi 1 HPP impoundment	No fish was found	
4	Between Bakhvi 3 HPP powerhouse and intake	Trout 9 individuals – *Salmo trutta*	Fishermen do not fish in this area, however, they confirmed presence of brook trout. Fishermen try not to fish in Bakhvistskali river when they can fish in other rivers, where the likelihood of catching the fish is higher, for example: in Supsa or Chkhkaura.
5	Downstream Bakhvi 3 HPP intake	No fish was found	
6	Unnamed left tributary of Bakhvistskali river	No fish was found	

Fish Survey Points



No other fish species have been observed during 2021 surveys neither during desk surveys. Monitoring reports of bakhvi 3 HPP (2018, 2019 and 2020) includes fish surveys, which are carried out in every autumn. The only fish species observed during surveys at Bakhvi 3 HPP is trout *Salmo truta,* for three years monitoring has been carried out at all survey points from Bakhvi 3 HPP intake, which is the most remote upstream survey point. Rest survey points located between bakhvi 3 HPP intake and powerhouse. Desk survey showed that fish had not been observed upstream Bakhvi 3 HPP intake during earlier surveys conducted by gamma in October, 2019 and September, 2020.

It was concluded that within the studied section of the river (from downstream of Bakhvi 3 HPP powerhouse to upstream of the project Bakhvi 1 HPP intake), brook trout *Salmo trutta* is the only fish species. Visual survey results have been obtained up today, prove the hypothesis that natural obstacles existing in Bakhvistskali river, such as boulder blockage, create barriers and integrity is not provided; thus, it was assumed less possible that trout could reach potential spawning section near Bakhmaro from bakhvi 3 intake. If downstream population spawns, which was proved by obtained young individuals, they must be using tributaries, which are relatively closer to Bakhvi 3 HPP intake.

Brook trout inhabits upstream section too, which covers Bakhvi 1 intake. It is assumed that this could be separate population, presented on upstream area. If there are food, spawning, breeding and growing grounds, together with several relatively deep pools (which do not freeze in winter), then population can remain in upper reaches of Bakhvistskali river. Physical properties of Bakhvistskali river will change annually due to high water level and flowing out to shores. Supposedly, it is highly probable that in the past Bakhvistskali riverbed was characterized with integrity and trout could move to Bakhmaro.

Additional information regarding given issues is provided in Annex N4 – Biodiversity impact Assessment Report (SLR).

5.4.3.7 Laboratory Survey

5.4.3.8 Bakhvistskali River Water Quality

Brief chemical analysis of Bakhvistskali river and suspended particles (mg/l) were determined in the accredited laboratory of Scientific-research Firm Gamma.

წყლის ქიმიური ანალიზი # 6366 ლაბ..№1815w

წყლის სახეობა	ზედაპირული
წყლის დასახელება	მდ. ბახვისწყალი
წყალპუნქტი	
რეგიონი	
დებიტი($მ^3$/დღე)	-
პასპორტი	
ფერი	-
სუნი	
შეტივნ.ნაწ. (მგ/ლ)	2,8
სიმღვრივე (FTU)	1.79
pH	7.30
ტემპერატურა	-
მშრ.ნაშთი(მგ/ლ)	55.372
ელგამტარობა(სიმ/მ)	0.00790

	მგ/ლ	მგ–ექვ
სიხისტე		0.993
თავ. ტუტიანობა		N.D.
გახსნ. O_2	-	
თავ. CO_2	-	
ჟ.ქ.მ.(მგ/ლ O)	0.880	
საერთო N	-	
ორგ. C	-	
ჯამური SiO_2	-	
H_3PO_4	-	
H_3BO_3	-	
H_2S	-	
ნარჩენი Cl	-	

კათიონები			
იონი	მგ/ლ	მგ–ექვ	მგ–ექვ%
NH_4	N.D.	N.D.	N.D.
*Ca	8.000	0.4000	36.07
*Mg	7.200	0.5926	53.43
Na	2.310	0.1009	9.10
K	0.610	0.0156	1.41
ჯამი	18.120	1.1091	100%

ანიონები			
იონი	მგ/ლ	მგ–ექვ	მგ–ექვ%
Cl	5.672	0.1600	14.35
*HCO_3	53.680	0.8800	78.92
CO_3	N.D.	N.D.	N.D.
SO_4	1.200	0.0250	2.24
NO_2	N.D.	N.D.	N.D.
NO_3	3.100	0.0500	4.48
ჯამი	63.652	1.1150	100%

<*> - 20%-ზე–მეტი; <N.D.> - მგრძნობიარობაზე დაბლა; <-> - არ გაზომილა < - ფონური მნიშვნელობა

მინერალიზაცია (მგ/ლ): 81.772

ს/კ ფირმა "გამა"-ს საგამოცდო ლაბორატორიის ხელ-ლი: ქ. გურჯია

06.10.2020

Based on obtained results, it can be stated that there is positive living environment for fish distributed within the project area.

5.4.3.9 Fish Food Base

The systematic survey and determination of total number (kg/ha) of the fish food base constituent invertebrates (zoobenthos) have been carried out in the laboratory .

Based on survey results it can be stated that:

- There were large number of individuals of benthic organisms of various species and size within the study section. Mostly, small and medium size individuals were observed;
- Within the project section, construction works of Bakhvi 1 HPP have not been started yet; the river actually did not suffer from anthropogenic impact; representatives of various orders and families have been observed from zoobenthos organisms;
- Identical species composition have been observed up and downstream the project headworks; there was not great difference in number and size.
- Table 5.2.1 provides classification of invertebrates presented within the study area; among them following species dominated: stoneflies (Order - Plecoptera Burmeister, 1839) and mayflies (Order- Ephemeropteroidea Rohdendorf, 1968);
- On average 4-5 gr zoobenthos organisms were observed on 1 m^2 of the study area; i.e. during surveys, zoobenthos mass was about 40-50 kg/ha;
- During surveys, sufficient amount of fish food base was found.

Table 5.4.3.9.1. Biological classification of benthic organisms observed in Bakhvistskali river and obtained results

Biological classification	Photo-material of individuals
Class - Insects Order - Trichoptera Suborder - Spicipalpia Family - **Rhyacophilidae** Stephens, 1836	
Class - Insects Order - Trichoptera Kirby, 1813 Family **- Limnephilidae** (with corresponding case of caddisflies)	
Class – (Insects) Insecta; Order: Diptera Suborder: Nematocera infraorder: Blephariceromorpha Family: **Blephariceridae**	
Class - Insects Subclass: Pterygota (- winged insects Pterygota) Branch – Metapterygota Infraclass - Neoptera Superorder - Exopterygota Order - **Plecoptera** Burmeister, 1839 Stoneflies	
Class - Insects Order - Ephemeroptera (Mayflies) Suborder - Schistonota Superfamily - Heptagenoidea Family - Heptageniidae Genus: **Epeorus** Eaton, 1881	

5.4.3.10 Fish Biomass Assessment

Fish Biomass has been defined in a complex way according to Leger-Huet's method and through fishing at ichthyologic stations of the study area.

Additionally fish biomass could not be examined as despite many tries of catching the fish ichthyologic material could not be obtained. .

Construction does not cause anthropogenic impact on Bakhvi 1 HPP project area; accordingly, Leger-Huet's method (1949 & 1964) used for determination of fish fauna biomass, based on additionally conducted hydrobiological-ichthyologic surveys by us, enables to define approximate biomass of fish fauna.

The mentioned method is founded on the conclusion, made in the result of examination of river water quality, biotic and abiotic factors, fish food base and other significant components.

During study of fish resources in Belgian and French rivers, leger and later Huet could establish several significant generalizations in relation with moderate European river zoning issue. Based on this, Huet (1949 and 1964) proposed a simple mode of fish ichtyomass assessment for moderate rivers of Europe.

The following is the main formulae of this method:

$$K = BLk$$

where:

- K calculates annual productivity (harvest) of river water kg/per river km length (we retrieve data to kg/ha!!!);
- L - average river width (m);
- B – Bioproductivity (minor, moderate, rich) ;
- k - coefficient received from external factors (k1+k2+k3);
- B - value (food amount in the given section) is as follows:
    - 1 - 3 water with minor amount of fish food;
    - 4 – 6 with moderate amount;
    - 7 - 10 rivers or their sections especially rich with food.

K ratio is k1 + k2 + k3 received, where

k1 – is average annual temperature data, the value of which is calculated as follows:

average annual temperature ° C	7	10	16	22	28
ratio k1	0.5	1.0	2.0	3.0	4.0

k2 - depends on water acidity and alkalinity and their possible value:

- к2 - for calcium-free waters = 1,0 ;
- к2 - for waters containing limestone= 1,5 .

k3 – sums up fish population type according to the following values:

- Value k3 rheophilic, cold water species = 1,0;
- Value k3 for mixed species schools = 1,5;
- Value k3 for limnophilic, warm water species = 2,0.

Calculations according to Leger-Huet's method (1949 & 1964), were carried out in the following way:

K=LBk; where: L=2 მ; B=3; $K= k_1+k_2+k_3 =0,5+1+1,5 = 3$
(K= 2 * 3 * 3 = 18 kg/km/a)
$K_{ჰა}$=15 : 0,2 = 90 kg/ha/a*
According to results obtained by Leger-Huet's method (1949 & 1964), the approximate fish biomass within the project section is 90 kg/ha/a. It is noteworthy that the given method does not consider illegal fishing and damage caused by other anthropogenic impact.

During biomass calculation it should also be noted that brook trout throughout the year carries out various migrations; among them spawning anadromous migration should be singled out. During spawning, mature (from the age of 2-4) individuals move in the direction of river mouth, as considering their biological features, spawning habitats locate in shallow water, sandy areas with fast flow. Start of upward movement to the river mouth depends on climate factors, according to the reference [1], brook trout breeds from September to February; mostly in October-November.

Another significant factor is post-spawning migration, when fish start movement in the direction of the river stream.

Given factors are significant as during calculation of the biomass, obtained results may be related to the mentioned factors.

5.4.3.11 Anamnesis

Three people were interviewed during field surveys: amateur fisherman in Bakhmaro resort – Merabi (meeting him on his way back after fishing), local resident Nodar Giorgadze and the shepherd .

According to the shepherd, he did not notice fish in 2-3 km upward of the river from the project headwork.

According to Merabi, he could not catch any fish despite numerous tries to catch it with the rod.

According to Nodar Giorgadze, in the corresponding period of spawning, they noticed numerous fish (brook trout) schools were observed in Bakhmaro resort.

Interview Results are provided in the Table 5.4.3.11.1.

Table 5.4.3.11.1. Results of the interview with local population

N	Question	Interview Result
1	What fish species is distributed in the project section of Bakhvistskali river?	**Answer:** Only brook trout is distributed here
2	Could you describe caught fish?	**Answer**: Obtained fish are brook trout and they are characterized with appearance specific to them, I cannot add anything special.
3	How important Bakhvistskali river is for fishermen and if so, why?	**Answer:** During resort season, we saw many people with rods and none with fish.
4	Have you ever caught fish by hand in the mentioned river? If so, in what season of the year?	**Answer:** No
5	Have you noticed spawning sites? If so, where were they?	**Answer:** I have not noticed spawning sites of trout. In general, this fish spawns at the time when I am not in Bakhmaro, accordingly, I could not observe and do not know about it.
6	Have you caught mature (with grains) trout with spawns?	**Answer:** No
7	Have you found young fish with yellow bag or sparkling in yellow anywhere?	**Answer:** No
8	Have you any information what was the mass of the largest fish ever caught in this river?	**Answer:** I have no such information
9	Does poaching take place?	**Answer:** I have not noticed

5.4.3.12 Impact on Hydrobionts

While discussing impact nature and results on fish fauna and its habitat, firstly, it should be considered that hydrobiont of certain species can live only in ecological environmental conditions specific to it; these conditions contain the number of interconnected ecological factor chain.

Factors impacting or causing impact on hydrobionts within the project zone will be distinguished in the given report.

Among natural factors of impact, following is determinant in Bakhvistskali river: physical-chemical values of water, fish food base, geomorphological peculiarities of the riverbed and banks and hydrological characteristics.

As it is shown from previous paragraphs, within the project section of the river, the water quality and food amount is sufficient for living requirements of fish populations distributed in Bakhvistskali river. However, during surveys, water temperature and oxygen dissolved in water were at the limit threshold of conditions, required for the vitality of brook trout. Based on obtained results, it is assumed that within environmental flow passage section of the project area, brook trout individuals can be in habitats with rapids and small waterfalls, as well as in the riverbed with steep slopes and covered with trees and/or Bakhvistskali river tributaries.

As for geomorphological and hydrological state of the historically developed riverbed, in some areas, conditions/sites are observed, which are hindering for fish fauna migration, food cycle and development of spawning areas, so-called "critical points"; they are provided in the paragraph 5.4.3.13.

5.4.3.13 Critical Points

"Critical points" are naturally geomorphologically complex sections of the river, which are presented in very narrow places, blocked with boulders and characterized with rapids, or wide riverbed and shallow water places. These sections create significant barriers for fish spawning and food migration.

In the Biodiversity Survey prepared by SLR, following information is provided in relation with critical points: the riverbed is narrower downstream the headworks and river stream is faster, creating currents, pools and short sections of rapids. During site visits, the river width ranged between 4-8 m, and the depth – 20 cm to 50 cm; Rarely, larger pools were observed with the depth of 1-2 m. Barriers hindering fish movement were observed in the river, especially on sections, where large boulders are blocking the river and making it impassable. Trout can overcome rapids from upstream to downstream direction. However, it is unlikely trout can manage to get from downstream to upstream within this sections. In some sections of the riverbed, small dry river branches are observed. They may be flooded during high-water, providing shelter for trout, in case it is in this section.

Steep river section below intake area

5.4.3.14 Impact on Fish Fauna

Based on the analysis of data obtained from desk and field surveys by the international consulting company SLR, the expected scenarios of impact on ichthyofauna during the construction and operation phases of the project and the relevant mitigation measures were presented.

The only possible change in the hydrological regime during the construction period will be localized and implemented in the water intake area where construction will take place in the river. In the water intake area, a small impoundment will be provided, Through a short section of the river, the riverbed will be temporarily narrowed from one side to implement the construction works. Since the construction of one side of the intake is completed, the river will be diverted to the other side and the other part of the intake will be constructed. This will result in minimum and only temporary interruption of river continuity, so in terms of the brown trout, the only minimum impact will take place upstream of the river Bakhvistskali.

The brown trout in Bakhvistskali River endures the slight increase of sediment, which takes place upstream due to natural processes such as erosion and landslides. Due to the gradual construction of the intake facility, no significant increase in solid sediment in the river is expected. Thus, it is considered that a slight increase in sediment during the construction period is expected, although it is unlikely that this will have a negative impact on the brown trout in this river.

In the construction phase, accidental contamination such as the spill of fuel oil into water, is estimated to have a significant impact on the aquatic environment. However, as the water intake will be built gradually and the direction of the river will be temporarily changed, this will reduce the impact of contamination on the downstream river environment. If a significant spill of fuel and oil takes place, it will be possible to contain it in the riverbed to prevent contaminants from moving downstream. This method of construction will presumably prevent the significant impact of contamination on aquatic species and the habitat downstream of the catchment, outside the project area, in case of spilling. Thus, it is less expected that the polluting events to have a significant impact on the fish population in the river.

The change of water quality is not expected during the project construction period, except sediment and accidental contamination (as discussed above).

The most significant project-related impact will be the change of hydrological regime of Bakhvistskali River that will be entailed by the construction of the Bakhvi 1 HPP water intake, which will divert part of the Bakhvitskali River water into a penstock, through which the water flows into the gorge and meet the Bakhvistskali River downstream the powerhouse of Bakhvi 1 HPP. The project is a run-off the river type HPP with a small impoundment (0,24 ha).

The information below is directly associated with biodiversity and taken from the survey of the baseline hydrological conditions (Bakhvi 1 Scoping Report). It should be noted that the data used for the survey of baseline hydrological conditions have been taken from both data of Bakhvistskali hydrological gauging station and additionally selected regional data. Bakhmaro gauging station located upstream of Bakhvi 1 HPP (catchment area 33.4 km^2) has the available data for 1947, 1949-50, 1953, 1955-57 and 1959-78. Additional data were available from the lower Bakhvi gauging station for the periods of 1940-47 and 1949-86.

For the Bakhvi 1 water intake area, the long-term average flow was calculated and amounted to 2.52 m^3/s^{-1}. In addition, an excess of 95% flow was also calculated and it equals 0.46 m^3s^{-1}, or the flow that exceeds average flow during 18 days in a year.

The demand for environmental flow or minimum flow can be determined by assuming a certain percentage of the average flow.

The environmental flow proposed by the project of Bakhvi 1 HPP is 0.29 m^3/s that is calculated in conditions of annual 5-day minimum flow conditions. This methodology is also consistent with the environmental flow that is 0.348 m^3/s.

The monitoring results of Bakhvi 3 confirmed that in the conditions of this flow, the brown trout can migrate freely between the section of Bakhvi 3 HPP powerhouse and water intake as well as enter the fish pass without obstacles. It should be noted that this section of the river is fed only by the environmental flow left by Bakhvi 3 HPP. In addition, the riverbed is monitored through the section between the Bakhvi 3 water intake and powerhouse, in frames of which, the obstacles that hinder the trout migration through this section of the river are eliminated.

To summarize: the elevation decreases by 360 m in about 4 km between the water intake and powerhouse and the river flows into a steep ravine.

Presumably, there are two separate populations of brown trout in Bakhvistskali River, so the environmental flow was estimated on the basis that the ecological continuity of the river could be restored over time (naturally or artificially). Considering the narrowness of the riverbed in the section between the water intake and powerhouse and the fact that an additional 0.33 m^3/s average flow will enter from the tributaries, it is estimated that this flow will be sufficient for the fish migration (upstream and downstream).

In heavy rains, it is expected that the water from the intake will add to the environmental flow that will be useful for the sediment downstream transportation, removal of gravel and creating/maintaining spawning habitat suitable for fish species. Seasonal change of the environmental flow is not currently proposed.

In the low flow conditions, as well as in winter, the water intake will form the impoundment (2-3 m depth) that will not freeze. This impoundment can become a suitable shelter for brown trout and beneficial.

Overall, it is considered that the proposed environmental flow 0.29 m^3/s is sufficient for the presence of fish population in the river.

5.4.3.15 Mitigation Measures

Prevention

Numerous prevention measures have been developed within the project, which were discussed above in the context of the risk assessment. This included the prevention of contamination, maintaining the continuity of the river during construction, and ensuring the environmental flow required for fish migration (if the connection between downstream and upstream is restored in the future.

A fish pass will be arranged behind the water intake.

The water intake will create 0.24 ha area impoundment with 2-3 m depth. This impoundment may become a shelter for the brown trout in winter (and even in other seasons). As a result, fishing will be completely prohibited upstream and downstream of the water intake, in 200 m radius. This will prevent overfishing of the collected brown trout.

Mitigation

The construction of a fish pass is proposed to reduce the impact on brown trout at a minimum. Although it is assumed that there is a natural obstacle for the fish migration between the water intake and Bakhvi 1 powerhouse, the current population in Bakhvistskali river will still migrate in the river. In the future, this obstacle can be removed naturally or artificially and the connection restored. The engineering design of the water intake facility envisages the construction of a fish pass. If the project also considers the arrangement of a natural type fish pass, it is a better alternative but will depend on the feasibility study to be carried out prior to its construction. Any type of fish pass will have a positive impact on the fish population in the future.

The surveillance camera (CCTV) will be installed at the intake area for monitoring. The consultations with fishermen showed that poisonous and illegal electrical devices were used to catch fish in the river. The surveillance cameras may hinder similar actions or make it possible to identify the perpetrators filmed by the camera.

Compensation

As it is considered that there are natural obstacles in Bakhvistskali River, the riverbed management can be one of the compensation approaches; the purpose of this action will be to restore the continuity of the Bakhvitskali River over time. Implementing such work is expensive and difficult to plan, but this is an alternative that will be taken into consideration in the project.

Monitoring

The fish monitoring program will be carried out. Six locations will be monitored, including Bakhvi 1 powerhouse (the spillway upstream and downstream), Bakhvi 1 water intake (the water intake upstream and downstream), two more locations upstream of the water intake toward Bakhmaro. Monitoring will be carried out by electric fishing devices and other relevant ways. Monitoring will be carried out annually in autumn. Local fishermen will be also involved in the monitoring to define where they are fishing, what season of the year and how much/what size of fish they catch. Then this information can be used to estimate the effectiveness of a fish pass and to study the status of the brown trout population through the river study section.

Additional information on this issue is provided in Annex N4 – the Biodiversity Impact Assessment Report (SLR).

5.4.3.16 Conclusions and Recommendations

In May, 2021, International Consulting Company SLR and earlier in October, 2019 and in September, 2020 by Hydrobiological-Ichthyologic group of Gamma consulting LTD studied baseline conditions of hydrobionts within Bakhvi 1 HPP project section. The survey aimed at examination, assessment of impact on hydrobionts during HPP construction and operation phases and development of mitigation measures as required.

Following conclusions are made based on surveys:

- According to literary sources, Bakhvistskali river fish fauna was described. Considering given data, the riverbed within the HPP project zone has been assessed; based on existing habitats, only brook trout (*Salmo trutta fario* Linnaes, 1758) is distributed within the study section, which is protected under the Red List of Georgia.
- Presence of fish fauna within the project area is implied by identification of trout traces by zoologist of Gamma Consulting LTD and expert of the international consulting company SLR, as fish is the main food for this species;
- The riverbed within the project section has been visually assessed; it is stony-gritty and with boulder bed, as well as rapids and currents are observed here, the riverbed is characterized with pools and small waterfalls in this section; the river was joined by tributaries and dry ravines from both sides; their presence cause increase of water flow in the river that is positively reflected on habitats of hydrobionts; in case of flash flood or/and increase of turbidity, tributaries also serve as shelters for fish fauna;
- There were several areas blocked with boulders observed during the study of the project area, which supposedly cause natural fragmentation of brook trout habitat; in the result, 2 independent populations are present in Bakhvistskali river downstream and upstream.
- Field surveys were carried out to determine water quality: in water samples taken for lab surveys, according to results of brief chemical analysis and determination of the suspended particles in water, within the study section of the river water quality met general environmental conditions required for hydrobiont existence. During field surveys, river temperature and concentration of

dissolved oxygen in water were at the limit threshold required for brook trout vitality. Accordingly, it is assumed that this species is distributed downstream and in tributaries.

- Food base of fish fauna has been studied according to “kick and sweep“ (Schmidt–Kloiber, 2006) method and based on examination of stones at the river bottom; According to the obtained results, within the project section of the river, food organisms were diverse and abundant for vitality of fish fauna. Mainly medium and small zoobenthos individuals were observed;
- Lab surveys defined invertebrate species classification with dominance of mayflies (Order - Ephemeropteroidea Rohdendorf, 1968) stoneflies (Order - Plecoptera Burmeister, 1839);
- According to the results of sampling made during field surveys, number of invertebrates was 3-4 gr per 1 m^2 on Bakhvi 1 HPP project area;
- Potential biomass of fish fauna has been assessed; according to the results of Leger-Huet's (1949 & 1964) method, potential biomass of fish within the project section is 90 kg/ha/a. It is noteworthy that the given method does not consider illegal fishing or other damage caused by anthropogenic impact. Ichthyologic material could not be obtained in the result of fishing; accordingly, fish biomass could not be determined based on analysis of the results;
- Local fishermen were interviewed; according to them, brook trout schools were observed during corresponding spawning period;
- Based on river habitat survey, it is assumed that during spawning brook trout migrates to the river mouth;
- Mitigation measures for impact on fish fauna due to HPP construction and operation have been developed, the performance of which is mandatory;
- During HPP operation, from direct impacts riverbed blockage and change of hydrological mode should be highlighted. It is necessary to design the fish pass and ensure the proper operation of it. Besides, established environmental flow should be released downstream permanently;
- The issue of fish occurrence in the intake is not less important; arrangement of fish excluder is necessary as the form of mitigation measure;
- Survey of sufficiency of environmental flow and other significant factors is necessary through monitoring works; if required, additional mitigation measures will be developed.

Recommendations:

- It is necessary to design a fish pass structure corresponding to fish species (brook trout) to ensure fish migration;
- In order to avoid fish injury or death in the intake, fish excluder structure should be installed at headworks;
- It is necessary to provide continuous flow of the water flow in the fish pass and on the section of environmental flow;
- Performance of riverbed management plan, the aim of which is restoration of Bakhvistskali river flow integrity over time.

- General instruction should be provided for personnel on-duty about damage to fish fauna and fish due to improper operation of hydraulic structures at headworks.

5.5 Socio-Economic Environment

5.5.1 Population and Demographics

Municipalities that fall within the project area of Bakhvi 1 HPP and number of population on the territory of the resort are given in Tabl 5.5.1.1.

Table 5.5.1.1. Number of population

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Georgia	3,739.3	3,718.4	3,716.9	3,721.9	3,728.6	3,726.4	3,729.6	3,723.5	3,716.9
Guria	115.8	114.9	114.1	113.3	112.4	111.5	110.5	109.4	108.1
Ozurgeti municipality	64.2	63.7	63.3	47.8	47.4	47.0	61.3	60.6	59.9
Chokhatauri municipality	19.4	19.3	19.1	19.0	18.8	18.6	18.4	18.3	18.0

Source: www.geostat.ge

In Chokhatauri municipality, 99.66% of the local population is ethnic Georgian, 0.19% Russian, 0.06% Armenian, and 0.02% Ossetian. As for the ethnic population of Ozurgeti municipality, 97.19% of locals are Georgians, 0.59 Russians, 1.77% Armenians, and 0.17% are ethnic Ukrainians.

The number of IDPs in the region and the municipality is quite high. See the table for more information on these data.

Table 5.5.1.2. Number of IDPs in the region and municipality

	Family	Person
Guria	168	521
Ozurgeti municipality	77	231
Chokhatauri municipality	38	108

Source: http://mra.gov.ge/geo/static/55

Table 5.5.1.3 provides detailed information on births, deaths and natural increase in Georgia, region and municipality during the last few years.

According to the official data of the National Statistics Agency of Georgia, compared to the national data, the birth rate in the Guria region is 2.3%, in the Ozurgeti municipality 0.4% and in the Chokhatauri municipality 1.2%. Compared to the country data, death rate in Guria region is 3.5%, in Ozurgeti municipality 1.9%, and in Chokhatauri municipality 0.6%. The natural increase data of the Guria region is 17.4%, in Ozurgeti municipality 0.09% and in Chokhatauri municipality is 2.8%.

Table 5.5.1.3. Birth rate

	2013	2014	2015	2016	2017	2018	2019	2020
Georgia	49,657	60,635	59,249	56,569	53,293	51,138	48,296	46,520
Guria	1,291	1,577	1,559	1,535	1,471	1,272	1,174	1,075
Ozurgeti municipality	714	731	725	719	846	749	679	592
Chokhatauri municipality	218	242	244	249	258	233	197	199

Source: www.geostat.ge

Table 5.5.1.4. Death rate

	2013	2014	2015	2016	2017	2018	2019	2020
Georgia	48,564	49,087	49,121	50,771	47,822	46,524	46,659	50,537
Guria	1,910	1,820	1,786	1,832	1,861	1,691	1,749	1,774
Ozurgeti municipality	1,031	752	741	750	985	964	935	980
Chokhatauri municipality	337	315	337	338	367	287	323	313

Source: www.geostat.ge

Table 5.5.1.5. Natural increase

	2013	2014	2015	2016	2017	2018	2019	2020
Georgia	1,093	11,548	10,128	5,798	5,471	4,614	1,637	-4,017
Guria	-619	-243	-227	-297	-390	-419	-575	-699
Ozurgeti municipality	-317	-21	-16	-31	-139	-215	-256	-388
Chokhatauri municipality	-119	-73	-93	-89	-109	-54	-126	-114

Source: www.geostat.ge

Regarding the distribution of the number of local population in the region and municipalities according to the social status, detailed information is given in Table 5.5.1.6.

Table 5.5.1.6. Social distribution of the population

	Pension recipient population	Number of recipients of social package	Population receiving subsistence allowance
Guria	26972	5870	22911
Ozurgeti municipality	15032	2858	11487
Chokhatauri municipality	4636	946	5144

Sorce: www.ssa.ge

5.5.2 Natural Resources

The region is rich in natural minerals. Hydrological resources of Guria are represented by groundwater and surface water. Nabeghlavi is the most famous mineral water resource in Guria.

In Ozurgeti municipality, hydrological resources are represented by rivers: sediments and its tributaries (Bzhuzhi, Choloki, etc.), Supsa, Bakhvitskali and others.

The hydrological resource in the territory of Chokhatauri municipality is mainly represented by rivers: Supsa, Gubazeuli, Bakhvitskali and others.

In the territory of the municipalities, forest resources are represented by deciduous trees such as: beech, oak, hornbeam, chestnut, boxwood, fir, spruce and others.

See Table 5.5.2.1 for information on water and forest resources in the region and municipality.

Table 5.5.2.1. Forest and water reservoir areas in region and in the municipality

	Forest (ha)	Reeservoirs (ha)
Georgia	9023	1492
Guria	637	166
Ozurgeti municipality	334	107
Chokhatauri municipality	147	1

Source: www.geostat.ge

Land resources - Distribution of the number of useful lands on the territory of region and municipalities can be seen in Table 5.5.2.2.

Table 5.5.2.2. Distribution of useful lands by purpose

	Useful lands (ha)	Agricultural (ha)	Non-agricultural (ha)
Georgia	84.2289	78.7714	54.575
Guria	30 753	26 909	3 844
Ozurgeti municipality	14 932	13 381	1 551

Chokhatauri municipality	5 051	4 324	727

Source: www.geostat.ge

See Table 5.5.2.3 for more information on arable land, agricultural and perennial crops.

Table 5.5.2.3. Arable, agricultural, greenhouse and perennial crops planting area.

	Agricultural lands (ha)	Arable lands (ha)	Perennial crops (ha)	Greenhouse area (ha)
Georgia	78,7714	377,445	109,567	699
Guria	26 909	13 474	12 366	7
Ozurgeti municipality	13 381	4 987	8 105	5
Chokhatauri municipality	4 324	2 355	1 589	1

Source: www.geostat.ge

5.5.3 Agriculture

Agriculture is one of the leading fields in the region. The locals pursue livestock, beekeeping, horticulture, fishing. Priority agricultural crops in the region are: corn, soybeans, beans, pumpkin, citrus and others.

For age distribution on the involvement of the population in agricultural activities, see Table below.

Table 5.5.3.1. Involvement of the population in agriculture by age (thousand people)

	Below 25	25-34	35-44	45-54	55-64	65 and above
Georgia	**6.195**	**32.160**	**74.555**	**139.744**	**164.993**	**224.562**
Guria	259	1 397	3 406	6 825	9 213	13 818
Ozurgeti municipality	127	665	1 642	3 148	3 941	5 412
Chokhatauri municipality	28	208	564	1 087	1 603	2 896

Source: www.geostat.ge

The locals are involved in the breeding of cattle and small cattle. the area of pasture lands in Guria is 0.35% of the pasture lands of Georgia, in Ozurgeti municipality - 0.09%, Chokhatauri municipality - 0.12%. For information on natural pastures, see Table 5.5.3.2.

Table 5.5.3.2. Natural pastures

	Natural pasture areas (ha)
Georgia	300004
Guria	1 060
Ozurgeti municipality	285
Chokhatauri municipality	378

Source: www.geostat.ge

For information on ownership and leased land in the municipality, see Table 5.5.3.3.

Table 5.5.3.3. Lease and ownership of arable lands

	Leased lands (thousand hectares)	Owned Lands (ha)
Georgia	107464	734 825
Guria	686	30 067
Ozurgeti municipality	192	14 741

Chokhatauri municipality	204	4 846

Source: www.geostat.ge

Both women and men are involved in agriculture. For more information on gender indicators, see Table 5.5.3.4.

Table 5.5.3.4. Gender indicator in agriculture

	Man	Woman
Georgia	443,763	198,446
Guria	23 219	11 699
Ozurgeti municipality	10 289	4 646
Chokhatauri municipality	4 112	2 274

Source: www.geostat.ge

5.5.4 Healthcare

Medical facilities are available to the local population in the provinces and municipalities, including: first aid center, multi-profile clinics, dental clinics and more. As for the villagers, they use the services of a so-called distruct doctor and an ambulance. Most locals are covered by state insurance.

5.5.5 Education and Culture

There are both pre-school and secondary education institutions in the region, including more than 100 general education institutions (including 4 private ones) and 70 pre-school education institutions.

There are 44 schools in Ozurgeti Municipality, including music and sports schools, one vocational college, 43 preschools, 17 libraries, a Fine Arts Center, a State Drama Theater, a Black Sea Arena and 4 museums.

As for Chokhatauri Municipality, 32 public schools, 14 preschools, 33 libraries, Chokhatauri National Theater and 3 museums are available to locals.

As for the higher education institution, it does not exist in the territory of the municipality.

5.5.6 Infrastructure

In the Guria region, internet networks in the municipalities mainly operate through mobile networks (modems) and satellite dishes. 98% of the population have cell phones. Georgian Post service.

Gas supply in the municipalities is provided by SOCAR Georgia Ltd, electricity supply is provided by Energopro Georgia Ltd, and water supply is provided by United Water Supply Ltd.

There are two local newspapers in Ozurgeti municipality. There is a local TV station "Guria", and in Chokhatauri municipality there are print media "Alioni" and "Chokhatauri Matsne".

Municipal transport is available for the population in the region and the municipality. In the territory of both municipalities located in the project area, access to all the TV channels that operate throughout the country is available. Waste management in Ozurgeti and Chokhatauri municipalities is carried out by the Georgian Solid Waste Management Company Ltd, which is responsible for waste collection, registration of volume and disposal at the landfill. As for the resort Bakhmaro infrastructure (electricity supply, gas supply, water supply, road infrastructure, waste management) is more or less in order and works are underway to improve the infrastructure.

5.5.7 Economics

The leading sectors of the economy in Ozurgeti and Chokhatauri municipalities are tourism, livestock, viticulture, fisheries, beekeeping, meat and dairy production and various light industry facilities. The development of the economy in the municipalities is also facilitated by the tourist interest in the region. Family-type hotels operate seasonally in both municipalities.

5.5.8 Tourism

The natural-geographical conditions of the Guria region allow the development of the Black Sea and highland resort areas. There are two resorts in Chokhatauri municipality, Nabeghlavi and Bakhmaro.

Nabeghlavi is a balneological-climatic resort. The healing factor is climate and carbonated hydrocarbonate sodium water. It is rich in both deciduous and artificially cultivated coniferous forests.

Bakhmaro is a mountain resort with a prophylactic and pulmonological profile. Medical indications: Non-tuberculous diseases of the respiratory organs. From October to May, the road to Bakhmaro is often closed due to heavy snow.

5.5.9 Bakhvi 1 HPP Social Program and its Directions

5.5.9.1 Project Target Communities

The target communities of the Bakhvi 1 HPP project are the Mtispiri administrative unit of Ozurgeti Municipality and the resort of Bakhmaro in Chokhatauri Municipality. Mtispiri in turn unites 4 villages - Mtispiri, Vaniskedi, Okroskedi and Ukanava. Mtispiri has a public school, a preschool, a medical dispensary and a library.

Population distribution by villages

Settlement	Household	Population
Mtispiri	57	224
Vanikedi	53	215
Okroskedi	38	112
Ukanava	28	114
Bakhmaro resort	25 (who stays all year round)	45 registered / up to 10,000 vacationers per season

Source: Local self-government

For the company implementing the Bakhvi 1 HPP project, one of the most important issues was the effective involvement of stakeholders in the project development process. Stakeholder engagement is an ongoing process and continues throughout the project life cycle, namely:

1. At the planning / design stage (including public hearing of the EIA)
2. At the construction stage
3. At the operation stage

The list of stakeholders of Bakhvi 1 HPP project looks like this:

1. Ministry of Environment Protection and Agriculture;
2. Ministry of Economy and Sustainable Development;
3. JSC "Georgian State Electrosystem" (GSE;)
4. Agency of Protected Areas;
5. Chokhatauri and Ozurgeti municipalities;

6. State Representative in Guria Region;
7. Residents of local communities;
8. Seasonal visitors / non-permanent residents;
9. ocal business owners;
10. Local NGOs;
11. NGOs working at the central level;
12. International organizations;
13. Interest groups and individual activists;
14. Representatives of scientific circles and others.

The implementation of the project may lead to certain issues. In order to resolve them in a timely and effective manner, a mechanism has been developed to receive and review stakeholder complaints and problematic issues.

The grievance mechanism is available to all interested parties. Only issues related to project activities are subject to consideration. Any request or complaint may be made orally, in writing, by email or by telephone to the Project Environment and Social Affairs Manager.

The grievance mechanism is coordinated by the project's Environment and Social Affairs Manager, who records any incoming complaint into the project's stakeholder claims and grievance database.

The company reviews both signed and anonymous complaints. However, if the author of the claim wants to receive response, he / she must provide contact details. The Environmental and Social Affairs Manager shall notify the complainant in writing of the receipt of the complaint within 10 days; within 30 days the complaint is reviewed and a decision is made.

In order to provide maximum information to stakeholders, the Bakhvi 1 HPP project team held 43 public meetings in Ozurgeti and Chokhatauri municipalities from February to December 2021, attended by a total of 719 people.

It should also be noted that in December 2021, the Bakhvi 1 HPP project implementation team, together with village self-government representatives, went door-to-door with all families in all four villages of the Mtispiri community. During the meetings, detailed information about the Bakhvi 1 HPP project was shared, as well as a detailed questionnaire was filled in for each family, according to which the employment strategy will be implemented in accordance with the experience and work skills of the population.

At the meetings, locals were also presented with the text of a memorandum committing CCEH to implementing various social projects, the need for which was directly voiced by the local population at previous community meetings. By signing the memorandum, the local residents confirm their consent to the implementation of the social projects proposed during the construction of Bakhvi 1 HPP.

Bakhvi 1 HPP has received the consent of about 400 people regarding the social project plan. See the signed memorandum with the local population in Annex N6.

The list of important meetings held in 2021 and the topics of the meeting as well as the stakeholder groups involved are given in the table below.

5.5.9.2 Meetings with stakeholders

#	Date	Place of meeting	Sector	Stackeholder	Number of participants	Objective of the meeting
1	May 5, 2021	Chokhatauri	Local self-government, non-governmental sector, media, local residents	Irakli Kuchava (Mayor of Chokhatauri Municipality), Zaal Mamaladze (Chairman of Chokhatauri Sakrebulo), Sakrebulo members, Irma Gordeladze - (Environmental Organization Eco), Koka Kighuradze (Guria Civic Center), Vakhushti Menabde and Tamaz Trapaidze (Georgian Young Lawyer Association)	40	The purpose of the meeting was to make a presentation about the Bakhvi 1 HPP project and to provide information to the members of the City Council and the general public, to hear their questions and comments.
2	June 4, 2021	Ozurgeti	Local self-government, non-governmental sector, media	Konstantine Sharashenidze (Mayor of Ozurgeti Municipality), Irma Gordeladze - (Environmental Organization Eco), Tamaz Trapaidze (Georgian Young Lawyer Association), Lado Menabde (Guria Moambe, Main Channel)	10	The purpose of the meeting was to make a presentation about the Bakhvi 1 HPP project and to provide information to the Mayor and other stakeholders, to hear their questions and comments.
3	June 5, 2021	Bakhmaro	Local government, population, business	Mindia Zhgheria (Deputy Mayor of Chokhatauri), Davit Sajaia (Head of Resort Bakhmaro), Ingo Schlucius (Pioneer Owner and Tour Operator of Hotel Bakhmaro)	50	The purpose of the meeting was to inform the local population about the Bakhvi 1 HPP project, to hear their questions and comments.
4	June 18, 2021	Ozurgeti	Non-Governmental Sector, Media	Tamaz Trapaidze (Georgian Young Lawyer Association), Ia Mamaladze (Guria News), Nugzar Asatiani (Alioni)	15	The purpose of the meeting was to introduce to the local community the leading ecologist of the British head office of the international research company SLR Consulting, Ms. Nikola Folks, who studied the biodiversity of Bakhvitskali Gorge and Bakhvi 1 HPP area. At the meeting, the objectives of this research and the format of the work were shared with the attendees, as well as interesting questions and comments of the attending public were heard.
5	June 27, 2021	Ozurgeti	Local self-government	Konstantine Sharashenidze (Mayor of Ozurgeti), Aleko Mameshvili (Head of Ozurgeti Property	10	The meeting was initiated by CCEH (Caucasus Clean Energy Holding), which is

				Management Service), USAID Economic Development Program Manager and other staff		the Bakhvi 1 HPP operator, with the interest of the United States Agency for International Development (USAID) economic development program in the Guria region, in particular in the municipality of Ozurgeti. The most promising of the topics discussed at the meeting was the support for the revival of local tea production, and the prospects for the involvement of USAID and CCEH in this process.
6	June 27, 2021	Bakhmaro	Local self-government, population of Bakhmaro and Chkhakaura, business	Zaal Mamaladze (Chairman of Chokhatauri Sakrebulo), Mindia Zhgheria (Deputy Mayor of Chokhatauri), Davit Sajaia (Head of Resort Bakhmaro), Ingo Schlucius (Owner and Tour Operator of Hotel Bakhmaro)	25	The meeting was initiated by CCEH (Caucasus Clean Energy Holding), which is the Bakhvi 1 HPP operator, with the interest of the United States Agency for International Development (USAID) economic development program with Bakhmarot Resort and its further development potential. The most promising of the topics discussed at the meeting was the arrangement of a tourist hiking trail connecting Bakhmaro-Gomi Mountain, and the prospects of USAID and CCEH involvement in the development of this route were discussed.
7	June 28, 2021	Village of Mtispiri	Local self-government	Maia Chavleshvili (Representative of the Mayor of Ozurgeti in Mtispiri Administrative Unit), Roman Vanadze (Assistant to the Representative of the Mayor)	2	The meeting was introductory and the Bakhvi 1 HPP project was presented to the self-government representatives and future plans were shared, as well as issues related to the village and local socio-economic needs were discussed.
8	July 14, 2021	Ozurgeti	Non-governmental sector, small business, local self-government, regional administration	Davit Tenieshvili (bio-farmer, tea producer, Bakhvi village), Kakha Nachkebia (tea producer, Nagomari village), Teimuraz Chanukvadze (Ozurgeti Mayor's Advisor), Lika Glonti (Guria Regional Administration), Tamo Oniani (Young	15	At the invitation of the Caucasus Environmental NGO Network (CENN), CCEH attended a meeting of the Guria Regional Action Group on Climate Action, an EU-funded project. Information about

				Teachers Union), Irma Gordeladze (Environmental Organization Eco)		Bakhvi 1 HPP was shared at the meeting and questions and comments were heard.
9	July 14, 2021	Village of Mtispiri	Local self-government	Maia Chavleshvili (Representative of Ozurgeti Mayor in Mtispiri Administrative Unit), Roman Vanadze (Assistant to the Mayor's Representative), Vladimer Chavleshvili (Majoritarian MP of Ozurgeti Sakrebulo from Mtispiri community)	3	The meeting was of introductory nature and the Bakhvi 1 HPP project was presented to the self-government representatives and future plans were shared. Also, information meetings about Bakhvi 1 HPP with the local population were planned in the villages of Mtispiri administrative unit.
10	July 27, 2021	Ozurgeti	Non-governmental sector	Otar Revishvili (Guria Youth Resource Center)	1	The meeting was introductory. The representatives of the project shared information about Bakhvi 1 HPP and listened to the opinions of the other party.
11	July 28, 2021	Village of Shemokmedi	Small business	Giorgi Maisuradze (Tea Entrepreneur)	2	The meeting was introductory. Project representatives shared information about Bakhvi 1 HPP. CCEH, in partnership with USAID's Economic Development Program, seeks to support local tea production, and in this regard, information was obtained and interesting opinions were heard.
12	July 28, 2021	Village of Bakhvi	Small business	Davit Tenieshvili (bio farmer, tea entrepreneur)	5	The meeting was introductory. Project representatives shared information about Bakhvi 1 HPP. CCEH, in partnership with USAID's Economic Development Program, seeks to support local tea production, and in this regard, information was obtained and interesting opinions were heard.
13	July 29, 2021	Village of Okroskedi	Local population, local self-government	Maia Chavleshvili (Representative of Ozurgeti Mayor in Mtispiri Administrative Unit), Roman Vanadze (Assistant to the Mayor's Representative), Vladimer Chavleshvili (Majoritarian MP of Ozurgeti Sakrebulo from Mtispiri community)	30	The purpose of the meeting was to inform the local population about the Bakhvi 1 HPP project, to hear their questions and comments.

14	July 29, 2021	Village of Mtispiri	Local population, local self-government	Maia Chavleshvili (Representative of the Mayor of Ozurgeti in Mtispiri Administrative Unit), Roman Vanadze (Assistant to the Representative of the Mayor)	20	The purpose of the meeting was to inform the local population about the Bakhvi 1 HPP project, to hear their questions and comments.
15	July 29, 2021	Village of Ukanava	Local population, local self-government	Maia Chavleshvili (Representative of the Mayor of Ozurgeti in Mtispiri Administrative Unit), Roman Vanadze (Assistant to the Representative of the Mayor)	20	The purpose of the meeting was to inform the local population about the Bakhvi 1 HPP project, to hear their questions and comments.
16	July 29, 2021	Village of Vaniskedi	Local population, local self-government	Maia Chavleshvili (Representative of the Mayor of Ozurgeti in Mtispiri Administrative Unit), Roman Vanadze (Assistant to the Representative of the Mayor)	20	The purpose of the meeting was to inform the local population about the Bakhvi 1 HPP project, to hear their questions and comments.
17	July 30, 2021	Village of Melekeduri	Small business	Lana Zhgenti (Tea Entrepreneur)	1	The meeting was introductory. Project representatives shared information about Bakhvi 1 HPP. CCEH, in partnership with USAID's Economic Development Program, seeks to support local tea production, and in this regard, information was obtained and interesting opinions were heard.
18	August 5, 2021	Village of Likhauri	Non-governmental sector, small business, local self-government, media	Konstantine Sharashenidze (Mayor of Ozurgeti), Zaal Mamaladze (Chairman of Chokhatauri City Council), Mindia Zhgheria (Deputy Mayor of Chokhatauri), Representatives of the Ministry of Economy and Sustainable Development of Georgia and the Ministry of Environment and Agriculture, USAID Energy Future Representative	40	Official presentation of the Bakhvi 1 HPP project to the Environmental and Social Advisory Board.
19	August 10, 2021	Online meeting	International organization	USAID Energy Future Support Officer and Representatives	10	The meeting was initiated by CCEH (Caucasus Clean Energy Holding), which aroused the interest of the United States Agency for International Development (USAID) Energy Future Program in the Guria region and the discussion of possible partnership projects between CCEH and

						USAID, which will be directed to energy security and innovative solutions in Ozurgeti and Chokhatauri municipalities.
20	August 11, 2021	Tbilisi	International organization	USAID Energy Future Support Officer and Representatives	5	The meeting was initiated by CCEH (Caucasus Clean Energy Holding), which aroused the interest of the United States Agency for International Development (USAID) Energy Future Program in the Guria region and the discussion of possible partnership projects between CCEH and USAID. The parties agreed on two directions - to support local tea production in the Guria region and to develop a tourist hiking trail connecting Gomi - Bakhmaro - Goderdzi.
21	August 18, 2021	Bakhmaro	Local self-government	Davit Sajaia (Head of Resort Bakhmaro)	3	The purpose of the meeting was to hear about the situation in the resort Bakhmaro and to hear information about the needs in terms of infrastructure.
22	August 18, 2021	Bakhmaro	Small business	Ingo Schlucius (owner of Pioneers of Bakhmaro Hotel, tour operator)	4	The purpose of the meeting was to share the idea of the Gomi-Bakhmaro-Goderdze hiking trail planned by the CCEH and USAID Economic Development Program and to involve local businesses in the issue and ensure their involvement.
23	August 18, 2021	Ozurgeti	Small business	Aleko Mameshvili (Chairman of the Tea Road Association), Davit Tenieshvili (Bio Farmer, Tea Entrepreneur)	4	The purpose of the meeting was to actively involve the Tea Road Association in the tea production promotion project planned by the CCEH and USAID Economic Development Program and to promote the further development of the association.
24	August 19, 2021	Mtispiri	School and preschool	Nana Cheishvili (Director of Mtispiri Public School), Lela Vashalomidze (Kindergarten Manager)	2	The purpose of the meeting was to study the needs of Mtispiri Public School and Kindergarten and to plan support within the social program of the Bakhvi 1 HPP project.

25	August 25, 2021	Ozurgeti	Local self-government	Head of Municipal Cleaning Service	4	The purpose of the meeting was to study the problem of homeless animals in the municipality.
26	August 27, 2021	Tbilisi	Central Government	Irakli Sisvadze, Head of the Forest Registration Department of the National Forest Agency	5	The purpose of the meeting was to plan the process of timber taxation in the project area of Bakhvi 1 HPP and to reach an agreement with the Agency.
27	September 8-9, 2021	Akhaltsikhe - Akhalkalaki	Local government, non-governmental sector, small business, media	Bakhvi 1 HPP Advisory Board Members	12	The purpose of the Bakhvi 1 HPP Advisory Board meeting was to visit the Akhalkalaki HPP under construction included within the CCEH portfolio, to get acquainted with the environmental standards that are being met, as well as to visit social projects implemented in support of the local community under the HPP social program.
28	September 26, 2021	Bakhmaro	Local government, non-governmental sector, small business, media	Members of the Advisory Board of Bakhvi 1 HPP, Caucasus Environmental NGOs Network (CENN), Bakhmaro Pioneers Hotel, 3D Workshop, Local Residents	30	In connection with the World Cleaning Day, the Bakhvar 1 HPP project implementation team planned and carried out the Bakhmaro cleaning action.
29	October 7, 2021	Ozurgeti	Local self-government	Maia Chavleshvili (Representative of Ozurgeti Mayor in Mtispiri Administrative Unit)	1	The purpose of the meeting was to study the persons with disabilities living in Mtispiri administrative unit (Mtispiri, Vaniskedi, Okroskedi, Ukanava) and their needs and to plan support within the social program of Bakhvi 1 HPP project.
30	October 15, 2021	Ozurgeti	Local population	Hunters and fishermen	10	The purpose of the meeting was to meet with local residents who are engaged in hunting and fishing under the law, with Nikola Folks, an expert at SLR Consulting. A so-called Focus group interviews and information obtained were used in the preparation of the Bakhvi 1 HPP Biodiversity Research Report.

31	October 18-19, 2021	Zugidi - Lakhami	Local government, non-governmental sector, small business, media	Bakhvi 1 HPP Advisory Board Members	12	The purpose of the Bakhvi 1 HPP Advisory Board meeting was to visit the Lakhami HPP, which is part of the CCEH portfolio, to get acquainted with the environmental standards by which the HPP was built and operates, as well as to visit social projects in support of the local community. Trees were also planted in Lakhami community during the visit.
32	October 25, 2021	Bakhmaro	Local Government, USAID	David Sharashidze, (Mayor of Chokhatauri Municipality), Mark McCord (USAID Economic Development Program Manager), Ivane Pirveli (USAID Deputy Director for Energy Future Development)	20	Concluding Memoranda of Understanding with CCEH and USAID Economic Development and Energy Futures Programs. Within the framework of the cooperation, tea production in the Guria region will be promoted, Gomi Mountain - Bakhmaro - Goderdzi tourist hiking route will be developed, energy-efficient and innovative solutions will be promoted.
33	October 26, 2021	Ozurgeti	Education Resource Center	Lela Imedashvili (Head of Resource Center)	1	The meeting was introductory. Information on the Bakhvi 1 HPP project was shared, as well as activities to support Mtispiri Public School planned under the project's social program (including agreement on cognitive seminars, scholarships for outstanding graduates enrolled in higher education, and other issues).
34	October 26, 2021	Village of Melekeduri	Small Business, Media, USAID	Aleko Mameshvili (Chairman of the Tea Road Association), Mark McCord (USAID Economic Development Program Manager), Ia Mamaladze (Guria News), Nugzar Asatiani (Alioni)	30	Formal presentation of the Tea Road Association and introduction of the Tea Road Association Development Project and local tea production promotion project planned in cooperation with CCEH and USAID Economic Development Program.
35	October 26, 2021	Villag of Mtispiri	School and preschool	Nana Cheishvili (Director of Mtispiri Public School), Lela Vashalomidze (Kindergarten	10	During the visit, Mtispiri Public School and Kindergarten buildings were inspected, the existing needs were assessed and possible

				Manager), Ivane Pirveli (USAID Deputy Director for Energy Future)		energy efficient and innovative solutions were planned in the framework of the cooperation between CCEH and USAID.
36	November 9, 2021	Villag of Mtispiri	Local population	Locals, members of the Advisory Board	30	The purpose of the meeting was to get acquainted with the biodiversity, climate and cumulative impact research reports of the Bakhvi 1 HPP. Also, the population was provided with information about the social projects planned during the construction of the HPP (employment of locals, management of village roads, support for schools and kindergartens, etc.). Due to the spread of rural terrain, the meeting was held in 2 different locations to give more locals the opportunity to attend the meeting, get information and ask questions.
37	November 10, 2021	Village of Vaniskedi	Local population	Locals, members of the Advisory Board	50	The purpose of the meeting was to get acquainted with the biodiversity, climate and cumulative impact research reports of the Bakhvi 1 HPP. Also, the population was provided with information about the social projects planned during the construction of the HPP (employment of locals, management of village roads, support for schools and kindergartens, etc.). Due to the spread of rural terrain, the meeting was held in 2 different locations to give more locals the opportunity to attend the meeting, get information and ask questions.
38	November 12, 2021	Village of Okroskedi	Local population	Locals, members of the Advisory Board	30	The purpose of the meeting was to get acquainted with the biodiversity, climate and cumulative impact research reports of the Bakhvi 1 HPP. Also, the population was provided with information about the social

						projects planned during the construction of the HPP (employment of locals, management of village roads, support for schools and kindergartens, etc.).
39	November 12, 2021	Village of Ukanava	Local population	Locals, members of the Advisory Board	30	The purpose of the meeting was to get acquainted with the biodiversity, climate and cumulative impact research reports of the Bakhvi 1 HPP. Also, the population was provided with information about the social projects planned during the construction of the HPP (employment of locals, management of village roads, support for schools and kindergartens, etc.).
40	Novemeber 19, 2021	Tbilisi	Central Government	Representatives of the Ministry of Environment and Agriculture, Representatives of the Agency of Protected Areas and WWF Representative - Giorgi Sanadiradze	10	The purpose of the meeting was to get acquainted with the biodiversity, climate and cumulative impact research reports of the Bakhvi 1 HPP. The reports were presented directly by the experts who conducted these studies, namely Ms. Nicolas Folks (SLR Consulting, UK) and Mr. Pierre Biedermann (Alpage Consulting, France).
41	Novemeber 20, 2021	Ozurgeti	Local government, non-governmental sector, small business, media	Bakhvi 1 HPP Advisory Board	12	The purpose of the meeting was to get acquainted with the biodiversity, climate and cumulative impact research reports of the Bakhvi 1 HPP. The reports were presented directly by the experts who conducted these studies, namely Ms. Nicolas Folks (SLR Consulting, UK) and Mr. Pierre Biedermann (Alpage Consulting, France).
42	Novemeber 20, 2021	Ozurgeti	Local self-government, population of Mtispiri, Bakhmaro and Chkhakaura, non-governmental sector, small business, media	Avtandil Talakvadze (Mayor of Ozurgeti Municipality), Mtispiri population, Bakhmaro population, Irma Gordeladze (environmental organization eco - was participating online), Grigol Makharadze (Ozurgeti Center for	70	The purpose of the meeting was to get acquainted with the biodiversity, climate and cumulative impact research reports of the Bakhvi 1 HPP. The reports were presented directly by the experts who conducted these

				Democratic Involvement), Vakhushti Menabde (Georgian Young Lawyer Association)		studies, namely Ms. Nicolas Folks (SLR Consulting, UK) and Mr. Pierre Biedermann (Alpage Consulting, France).
43	November 30 - December 2, 2021	Ozurgeti	Mall business	Tea Road Association Members, Mark McCord (USAID Economic Development Program Manager)	15	Tea Road Association Strengthening training was conducted in collaboration with the CCEH and USAID programs.

Detailed information about the meetings is given in Annex N7: Minutes of the various meetings.

It is also noteworthy that the team of Bakhvi 1 HPP, in order to inform the stakeholders about the project and ensure their involvement, started preparing an information booklet and a monthly newsletter from an early stage and actively disseminating it to the local population and local self-government bodies.

The information booklet informs the reader about Caucasus Renewable Energy Holding, its business goals and other small-scale construction and already operating hydropower plants owned by the company. The main part of the booklet is dedicated directly to the Bakhvi 1 HPP project, its technical parameters, engineering solution and environmental studies, which conclude that the Bakhvi 1 HPP project will not be harmful to the environment. The booklet also discusses the role of the hydropower sector in the Georgian economy and its potential for further proper development. The first version of the information booklet was published in May 2021 and distributed to a wide range of stakeholders (locals, self-government, and public meeting participants - NGOs, media, small businesses, etc.). According to the update of the technical scheme of the project, when the storage area was significantly reduced and minimized from 3 hectares to 0.24 hectares, an updated information booklet was printed in September of this year and delivered to its stakeholders.

As for the newsletter, it is prepared on a monthly basis from July 2021. The purpose of preparing the newsletter is to inform the interested parties about the latest information about the Bakhvi 1 HPP project and the activities carried out by the project team during the current month. The newsletter also contains contact information for the project team so that anyone interested can contact the project team and share their question, opinion or recommendation. The team implementing the Bakhvi 1 HPP project provides door-to-door distribution of the newsletter to the project target villages in Ozurgeti Municipality (Mtispiri, Vaniskedi, Okroskedi, Ukanava), as well as in Chokhatauri Municipality (Bakhmaro and Chkhakauri) and in self-governing bodies (City Hall and Sakrebulo) of both municipalities. Newsletters are also distributed to other stakeholders during public meetings on the Bakhvi 1 HPP project.

For more information on booklets and newsletters, see Annexx N15.

5.5.9.3 Bakhvi 1 HPP Project Environmental and Social Advisory Board

The model of the Advisory Board proposed to the public by the Bakhvi 1 HPP Project Implementing Company (CCEH) can be boldly said to be a new word in the Georgian reality of small and medium HPP planning and construction. The model of the Advisory Board will help the project to conduct the EIA preparation process with maximum openness and listening to the position of different parties, and to work together to develop the best solutions for the environment and people.

The idea of the Environmental and Social Advisory Board for the Bakhvi 1 HPP project was voiced in June of this year, and on August 5, the Ekvtime Takaishvili Museum in the village of Likhauri hosted an official presentation of the Advisory Board to the general public.

The Board has 12 members. Ozurgeti and Chokhatauri municipalities nominate members of the Board with representatives of the local community in equal numbers of 6-6 members, meeting the following criteria:

- Civil society working on environmental and ecological issues
- Representative
- Representative of an organization working on education issues
- Representative of a local SME
- Having relevant qualifications in the field of environmental and social issues
- Representative of the local self-government
- Media with experience of working on environmental and social issues

- Representative

The above-mentioned 5-5 persons from each municipality are also added to the representative of the Mayor of Ozurgeti Municipality in the administrative unit of Mtispiri and the representative of the Mayor of Chokhatauri Municipality in the administrative unit of Bakhmaro. (It is planned to renew the composition of the council members after the elections).

The main goals of the Advisory Board are:

1. Strengthening public confidence in the Bakhvi 1 HPP project
2. Maximum involvement of stakeholders in the project discussion
3. Establish transparent work practices for working on EIA
4. Involvement of stakeholders in the EIA discussion
5. Listen to the recommendations and business criticism of stakeholders and
6. Consideration

Membership in the Advisory Board is an unpaid activity. The decisions developed by the Board are of a recommendatory nature, which are taken into account and put into practice as much as possible by the Bakhvi 1 HPP project implementation team.

Through consultation with local governments, the Company is willing to advise the Advisory Board in the long term, including during the construction and operation phase of the Bakhvi 1 HPP project.

Since its formation to December, the Advisory Board has already managed to do significant work in communicating and sharing information with various stakeholders on public relations and the Bakhvi 1 HPP project. The following specific activities were also carried out by the Advisory Board:

September 2021 - Meeting in Akhaltsikhe and Akhalkalaki, during which they visited the Akhalkalaki HPP under construction included in the portfolio of CCEH - the company implementing the Bakhvi 1 HPP project; Introduction of environmental standards in compliance of which the construction of the HPP is carried out; also, visit social projects implemented in support of the local community within the framework of the HPP social program.

September 2021 - Bakhmaro cleaning action was planned and carried out on the occasion of World Cleaning Day.

October 2021 - Meeting in Zugdidi and Lakhami, during which they visited operating Lakhami HPP included in the portfolio of CCEH - the company implementing the Bakhvi 1 HPP project; Familiarization with the environmental standards, in compliance with which the mentioned HPP was built and operates, as well as visiting the social projects implemented in support of the local community within the HPP social program. Trees were also planted in Lakhami community during the visit.

November 2021 - Meetings with local population in Mtispiri administrative unit (villages - Mtispiri, Vaniskedi, Okroskedi, Ukanava).

November 2021 - Introduction to Bakhvi 1 HPP Biodiversity, Climate and Cumulative Impact Research Reports. The reports were presented directly by the experts who conducted these studies, namely Ms. Nicolas Folks (SLR Consulting, UK) and Mr. Pierre Biedermann (Alpage Consulting, France).

5.5.9.4 Bakhvi 1 HPP Social Program

The Company implemnting the Bakhvi 1 HPP project has the good will to implement various social projects to improve the living standards of the local population in Mtispiri and Bakhmaro administrative units, which will take into account the needs of the local population on the one hand and the project budget on the other.

The company also facilitates the attraction of partners in the Guria region, such as USAID-funded economic development and energy future programs. Activation of this program in Guria region will further increase the number of projects and development opportunities for the local population.

In accordance with the local needs survey and the priorities voiced by the population, the Bakhvi 1 HPP project has already implemented a number of social projects, in particular, at the end of September 2021, Mtispiri Public School and Kindergarten were provided with material and technical assistance:

1. The school was provided with 5 personal computers with full equipment, including various accessories (headphones, amplifiers, etc.)
2. A video monitoring system with 5 cameras was installed in the school
3. The school library was provided with modern literature for school curriculum and extracurricular reading (up to 100 books)
4. Kindergarten was provided with a widescreen smart TV SONY
5. Wireless internet was installed in the kindergarten and the company provided 1 year prepaid subscription service
6. Kindergarten was provided with children's toys and dishes

In accordance with the priorities voiced during the meetings with the local population, the company plans to implement after obtaining the necessary permits and starting the construction works:

1. Employment of local population (according to the demand for construction works and the qualifications of the population);
2. Arrangement of earth roads of the villages within the administrative unit of Mtispiri (Mtispiri, Vaniskedi, Okroskedi, Ukanava);
3. To continue to support Mtispiri Public School and Kindergarten;
4. To support and provide financial support to the graduates of Mtispiri Public School, who will be enrolled in the higher education institutions of Georgia in the specialties of hydropower, engineering or environment;
5. To organize educational seminars and cognitive lessons in Mtispiri Public School in the field of renewable energy, innovation and ecology;
6. To study the needs of persons with disabilities (disabled) living in the Mtispiri administrative unit and to consider the possibility of their assistance;
7. In order to develop the tourist potential of the resort Bakhmaro, it is planned to study and gradually implement the hiking trail project connecting Gomi Mountain - Bakhmaro - Goderdzi;
8. Promoting the development of innovative and energy efficient small projects in Bakhmaro.

These issues were agreed with the local population and the company undertook to implement these social projects in the form of a memorandum, which is signed on the one hand by the director of the company CCEH and on the other hand by the locals living in Mtispiri administrative unit. In December 2021, the Bakhvi 1 HPP project implementation team held door-to-door meetings and received the signatures of up to 400 people.

See the memorandum signed by the local population in Annex N6.

5.5.9.5 Partnership Projects with USAID

As part of the CCEH Partnership with the United States Agency for International Development (USAID) Economic Security Program, two important initiatives will be implemented in the Guria region: 1) Creating a "Guria Tea Road"; 2) Carrying out a feasibility study and creating a 36 km long hiking route that will connect the mountainous areas of Guria, in particular Gomi Mountain and the resort Bakhmaro with the Goderdzi ski resort of Adjara.

The Tea Road initiative includes the development of tourism products, increasing the capacity of tea manufacturers, supporting the Guria Tea Road Association and establishing market links with the tourism industry to position tea in the region in the same way as wine in Kakheti. The route will connect several estates that have the appropriate location, produce authentic products, and most importantly have the ability to host tourists. Visitors will be able to taste tea, enjoy local dishes and most importantly get acquainted with the ethnographic characteristics of Gurian villages.

As part of the CCEH Partnership with USAID's Energy Future Program, the Parties will explore challenges in the region, and plan to raise awareness about energy-friendly programs and campaigns.

Memoranda of Understanding with both USAID programs were signed on October 25, 2021 in Bakhmaro. The ceremony was attended by USAID Georgia Mission Representatives, Davit Sharashidze, Chokhatauri Municipality Mayor, Irakli Kuchava, Chokhatauri Municipality Sakrebulo Chairman, Zaal Mamaladze, Chokhatauri Sakrebulo Deputy Chairman, Davit Sajaia, Head of Bakhmaro Resort, Davit Zhgenti, Representative of the Mayor of Chokhatauri Municipality in the resort Bakhmaro. On October 26, the official presentation of the Tea Road Association took place in the village of Melekeduri.

5.5.10 Cultural Heritage

5.5.10.1 Introduction

Visual study and assessment of cultural heritage was commissioned by CCEH Hydro VI LLC. The aim of the study was to visually study all the areas designated for the construction of the Bakhvi 1 HPP with an installed capacity of 10.9 MW on the river Bakhvitskali and to identify cultural heritage sites, as well as to identify possible archeological remains, as well as to assess negative impact of the project on already known and newly identified sites. The work was performed by Locus Advisors LLC.

The task was to visually study the project areas in the Guria region, Ozurgeti and Chokhatauri municipalities, located around the Bakhvitskali riverbed, as well as the access roads to the planned HPP and areas of temporary and permanent use.

5.5.10.2 Protection of Cultural Heritage in Georgia

Protection of Cultural Heritage Resources in Georgia is based on the Law of Georgia on the Protection of Cultural Heritage, 2007 (last amended in 2020). This law is regulated by the Ministry of Culture, Sports and Youth of Georgia and the National Agency for Cultural Heritage Preservation of Georgia. Under this law, monuments are classified according to their importance. The monuments included in the UNESCO World Heritage List belong to the highest category

The Law of Georgia on Cultural Heritage, 2007, within the framework of which the project is going to operate, includes both - tangible and intangible cultural heritage, and defines them as follows:

Material cultural heritage - any movable or immovable object, documentary material, as well as gardens, parks, landscape architecture zones, historic settlements, historical environment, which is interesting in terms of architectural, artistic, agro-cultural, archaeological, anthropological, ethnographic, monumental or urban planning, or are related to technological progress and has artistic, aesthetic, historical or memorial value, oor are associated with history, evolution, folklore, religion, traditions, and ancient or present civilizations.

Intangible cultural heritage - verbal traditions, expressions and the language itself as a transmitter of tangible cultural heritage. Performing arts, social customs, traditions, skills and knowledge related to traditional crafts, as well as tools, letters, artefacts and cultural contexts recognized as part of the heritage by the community, groups or individuals;

In Georgia, significant cultural heritage resources can be referred to as cultural heritage sites. Cultural heritage sites are protected by law. "Protected by law" means that the monument must be conserved - there must be no change that would diminish the significance of the monument.

A cultural heritage resource can be significant enough to be granted monument status if it has historical and cultural value based on antiquity, uniqueness and authenticity. The resource must be at least 100 years old, there must be no analogue, it must be modern in its original structure, environment, meaning, function and / or properties, creation and evolution.

Georgian legislation recognizes the following types of cultural heritage:

- Archeology;
- Architecture;
- Engineering;
- Urban development;
- Art of garden and park planning and landscape architecture;
- Paleography;
- Monumental fine arts;
- Memorial;
- Ethnographic;
- Visual Art;
- Documentary;
- Related to advances in science, technology and industry.

5.5.10.3 Historical Overview of Guria Region

The Guria region in Georgia includes the southern peripheral part of the Kolkheti Plain and the northwestern branches of the Meskheti Range. It is bordered on the north by Samegrelo-Zemo Svaneti, on the east by Imereti, on the south by the Autonomous Republic of Adjara, and on the west by the Black Sea.

Guria is part of historical Egrisi. It is inhabited mainly by Gurians. The historical center of Guria is the city of Ozurgeti.

Historically, Guria was bordered on the north by the Rioni River, which separated it from Samegrelo, on the south by the Chorokhi River, on the southeast by Adjara from the Chorokh-Adjaristskali confluence to the Fersati Mountain, and by Samtskhe on a small section. It is bordered on the east by Imereti and on the west by the Black Sea.

In terms of historical development, continuous traces of human life from the Lower Paleolithic onwards have been confirmed in Guria. Remains of the Old Stone Age have been found in Khvarbet-Naghobilevi. According to archeological finds, the process of consistent development of cultures is established, which lasted throughout the Bronze Age and beyond. The settlements of the Neolithic period are Anaseuli and Gurianta. Anaseuli I is a monument of Adreneolithic ceramic culture, while Anaseuli II and the Gurianta are a late Neolithic, where along with stone tools are found baked clay pottery, knives made of flint, cobblestone and obsidian, and various ammunition and household items.

Archaeological material from the Neolithic period is also found in Nagomari and Vakijvari. Items found in Melekeduri, Baghdadi, Vakijvari, Shroma and Makvaneti belong to the Bronze Age.

In the Late Bronze-Early Iron Age, the Guria region was an area of Colchian culture. Ureki treasures found in Ureki-Tsvermaghala depict the period of the second half of the second millennium and the first half of the first millennium BC - this is the period when the kingdom of Colchis is strengthening and produces iron products. According to the old calendar, in the VI century, the kingdom of Egrisi, the successor state of Colchis, was formed on the territory of Western Georgia, which included the territory of Guria. The territory of Guria and especially its coast has been used for trade since ancient times. The rivers Supsa (Mogroso) and Natanebi (Isiso) are first mentioned by the authors of the classical period, and in the 4th century AD the confluence of these rivers is marked on the map "Tabula Peutingeriana". These rivers, among others, have connected the eastern provinces of Rome with western Georgia since ancient times. In this way the Byzantines brought raw materials and imported goods.

Guria was a province of Lazika within the Kingdom of Egrisi. This side was uninhabited compared to other regions of Egrisi. Guria was promoted with the feudalization of the country, which was aimed at weakening the influence of Byzantium.

In the first half of the 7th century, as a result of the mixing of Eastern-Georgian ethnic groups in this region, the population of Guria was formed. Kartli, in fact, culturally and ecclesiastically, entered western Georgia through Guria. This period coincides with the strength of the main fortress-city of Guria - Vashnari. Guria has been a part of the Abkhazian Kingdom since the 10th century and was include in the united Georgia since the 11th century.

Guria Saeristavo, formed in the Middle Ages, is first mentioned in historical sources in 1222. The residence of the Guria nobility was Likhauri. Not earlier than 1352, Guria was ruled by a representative of the junior branch of the Dadiani. The descendant of the latter must have been Giorgi Gurieli, who together with Queen Elene built the Likhauri Church in 1422. Their name is also associated with the founding of the Creator Diocese and, presumably, the founding of the Dioceses of Jumati and Ninotsminda.

After the disintegration of the United Georgian Kingdom in the 15th century, Guria, which was part of the Kingdom of Imereti, was in fact an independent principality until the conquest of the Caucasus by the Russian Empire in the 19th century. The Gurian principality was ruled by the Gurian people who had their residence in Ozurgeti.

The history of the Gurian principality is closely connected with the processes related to the disintegration of a united Georgia, in which it took an active part, as well as with the civil wars. During this period, the Gurian principality was under Ottoman influence, but in the early 16th century, as a result of a confrontation with the Ottomans, after the signing of the Guria-Ottoman Treaty, the Ottoman-Gurian border on the Chorokhi River was restored.

From that time on, the Gurian principality established political relations with the Russian state, the Cossacks of Don and Zaporozhye, and the Zhech-Pospolita (Commonwealth of Lithuania and Poland). Guria also actively participated in the anti-Iranian struggle of the kingdoms of Kartli and Kakheti.

From the second half of the 17th century, the Gurian principality was sometimes under the influence of the Odisha principality and sometimes the Ottomans. The situation was aggravated by the unrest in western Georgia, which is why, during the struggle with other Georgian rulers, the Gurians often turned to the Ottomans for help. Other kings of western Georgia also acted, which contributed to the strengthening of Ottoman influence in western Georgia.

At the beginning of the XVIII century, together with the chief of Guria Dadiani and the king of Imereti, he came out against the Ottomans, hoping for Russian help. In response, the Ottomans raided western Georgia. In 1723, Ottoman garrisons were set up in the coastal fortresses of Guria. In the following years, during Guria's active participation in the Russo-Ottoman War (1828-1829), the Ottomans invaded Guria, but the Imereti and Gurian armies soon liberated it.

The history of the Gurian principality in the following centuries is already connected with the periods of the Russian Empire and, later, the Soviet Union.

5.5.10.4 Overview of Historical-Architectural and Archeological Objects in Guria Region

The project area covers only the municipalities of Ozurgeti and Chokhatauri, therefore, in the presented report we will touch only on the cultural heritage monuments in these two municipalities and the objects that have been granted the status of immovable cultural heritage (including national category). However, it should be noted that none of the cultural heritage sites described below are located in the vicinity of the project area and are often tens of kilometers away from it.

The territory of Guria region, compared to other parts of Georgia, is not very rich in historical and architectural monuments, although out of the existing number, eight objects have been granted the status of national importance. The town of Vashnari and the remains of the Ozurgeti baths found in the city of Ozurgeti are among the secular buildings. Important fortifications in Guria are Askani, Bukistsikhe and Likhauri fortresses.

Within Ozurgeti Municipality, the Shemokmedi Monastery Complex, which is the center of the Shemokmedi Diocese, is noteworthy.

Shemokmedi Monastery is located in Guria region, Ozurgeti municipality, in the village of Shemokmedi, 6 km southeast of it, on the left bank of the river Bzhuzhi, on a low mountain. It is 15.7 km away from the Bakhvi 1 HPP project zone.

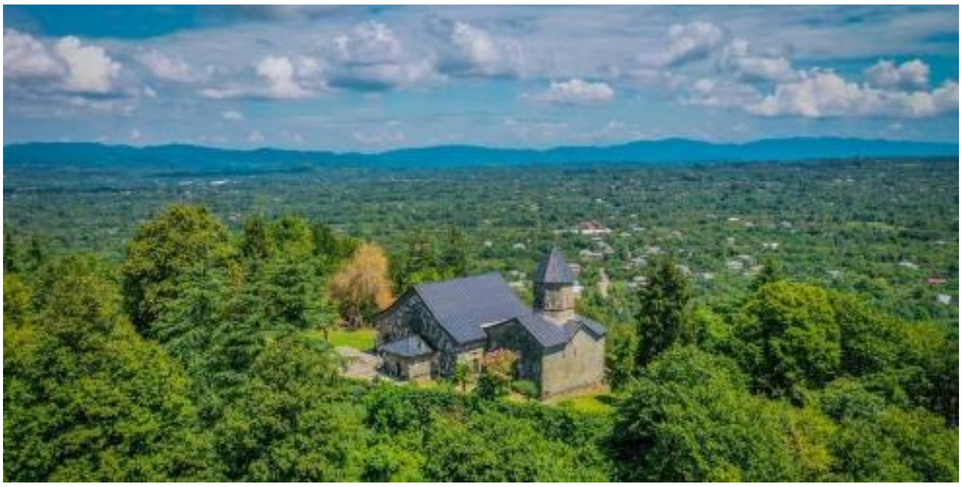
The complex is constructed in the central, highest point of the mountain hill. The complex is surrounded by fence walls, which are built of flat stones on a solution of lime mortar. The Shemokmedi monastery complex includes: Church of the Savior; Domed church "Zarzma"; Bell tower; Cave; Fence and other buildings.

Church of the Savior (10X13 m) is a type of basilica. Traces of paintings of the XVII-XVIII centuries, as well as Georgian and Greek fresco inscriptions are preserved in the interior.

The Church of Zarzma has a dome (9X7 m) and is attached to a three-aisled basilica. The interior is painted. The church was built by Vakhtang I Gurieli. The church is painted. Remains of Georgian Asomtavruli and Greek inscriptions are preserved on the walls.

The bell tower is located in the north-western part of the monastery complex and it is in the western fence of the monastery. The bell tower was built in the XVI century, and was renovated and restored in 1831. The Shemokmedi Church housed a rich collection of icons, crosses, ecclesiastical items and books. The Shemokmedi Monastery also had a rich library.

Architectural complex has been granted the status of a national category cultural heritage monument (it is included in the Register of Cultural Heritage Monuments of Georgia with registration number 3288, 03.10.2007).



Shemokmedi Monastery Complex

Jumati monastery complex is located in the village of Jumati, Ozurgeti municipality. It is 27.6 km away from the Bakhvi 1 HPP project zone.

The Jumati monastery complex includes the Archangel Church, the bell tower and the fence.

The Church of the Archangel is a hall-type building with a gaseous semicircular apse. There is a wall painting in the church dating back to the XVI-XVII centuries. On the north wall there is the image of the wife of the Gurian prince, while on the opposite wall, on the south wall there is the image of the prince of Guria. In the 19th century, on the south side of the temple, there is an equator named after the Virgin Mary. In 1904 the bell tower was built.

The bell tower of the complex is a two-storey building. The complex is surrounded by a stone fence.

Jumati architectural complex has been granted the status of a national category cultural heritage monument (it is included in the Register of Cultural Heritage Monuments of Georgia with registration number 3290, 03.10.2007).

Jumati Monastery Complex and Wall Painting

Likhauri architectural complex is located in the village of Likhauri, Ozurgeti municipality. The Likhauri complex includes: a hall-type church, a bell tower and a boundary fence on the west side of the complex. It is 20.4 km away from the construction area of Bakhvi 1 HPP.

The main building of the complex - the Church of the Virgin Mary must have been built in the second half of the XIII century. The church has a gate built on the west side.

The bell tower is a two-storey building. The building has a domed roof.

According to the Asomtavruli inscription on the west façade of the bell tower, it must have been built in the first half of the 15th century.

Likhauri architectural complex has the status of a real category of cultural heritage of national category (it is included in the Register of Cultural Heritage Monuments of Georgia with registration number 3285, 03.10.2007).

Likhauri architectural complex, church and bell tower

Konchkati Archangel Church is located on a high hill in the village of Konchkati, Ozurgeti Municipality. The temple dates back to the developed Middle Ages. It is 29.5 km away from the Bakhvi 1 HPP project zone.

The church is of the hall type. It is surrounded by the fence. The restoration of the church was carried out in 2013-2014.

Currently, the Church of the Archangel in Konchkati has been granted the status of a cultural heritage monument (it is included in the Register of Cultural Heritage Monuments of Georgia under registration number 3284, 03.10.2007).

Church of the Archangel of Konchkata

Vaniskedi Church is the most, arguably the closest to the project area, however it is still far away and is 10 km northwest of Bakhvi 1 HPP project area.

The Church of St. John the Baptist is located in the village of Vaniskedi, Ozurgeti Municipality. On the interior-exterior of the church there are three construction layers of different periods.

The church must have been originally built in the 11th century. The next construction period is already the XVII century. The nineteenth century is the third period of church construction. The upper parts of the church have large rectangular windows that narrow outwards.

The churche, which was demolished in the 1930s, was rebuilt in 2007.

Currently, Vaniskedi Church has been granted the status of a cultural heritage monument (it is included in the Register of Cultural Heritage Monuments of Georgia with the registration number: 3184 03.10.2017).


Vaniskedi Church, view from the south-west. Wall painting in the interior of the church

Likhauri (Chanieti) Fortress is located in the village of Likhauri, Ozurgeti Municipality, on a high mountain 2 km away from the center. It is 21.33 km away from the project area.

Likhauri Fortress is also referred to as Tamari's Fortress. It is believed to have been built in the 14th - 16th centuries. Likhauri Fortress is a rectangular building in plan, the fence of which includes three towers of different sizes and shapes. To the north of the tower, there is the remains of a building attached to the fence.

Likhauri Fortress has the status of a cultural heritage monument (it is included in the Register of Cultural Heritage Monuments of Georgia with registration number 7407. 05.07.2017).


Likhauri Fortress

Askani Fortress, as well as Vaniskedi Church, is relatively close to the project area, however, it is still far away and the distance is 9.5 km in case of powerhouse and 12.5 km in case of hadworks. Askani Fortress is located between the villages of Ozurgeti Municipality - Askani, Vaniskedi, Mtispiri and Ukanava.

The building consists of several construction layers, the oldest of which is from the 4th century, and the newest - from the 19th century. Pitchers and circular stone pools are preserved on the territory of the inner fortress. There is a pit to the left of the entrance to the fortress, which is said to be the entrance tunnel to Bakhvitskali. The ruins of the palace and the church are preserved on the territory of the fortress. The church was supposed to be a basilica-type building.

The fortress has the status of a cultural heritage monument (it is included in the Register of Cultural Heritage Monuments of Georgia with registration number 3286, 03.10.2017).

Askani Fortress

The closest to the project areas of Bakhvi 1 HPP are the cultural heritage sites in the resort Bakhmaro. Given the distance and location from the project area they can not be adversely affected by the project.

Bakhmaro Resort: Bakhmaro is located on the Adjara-Guria mountain range, at an altitude of 2050 meters above sea level. The area of Bakhmaro is a kind of hollow, surrounded by evergreen spruce and fir trees. The cave area is open from the west side, which facilitates the invasion of sea breezes in the valley.

It is known from the past of Bakhmaro that the territory of Bakhmaro belonged to the feudal lords of Guria. The population used the territory for cattle, summer pastures, for which they paid a certain tax.

According to the Georgian ethnographer Tedo Sakhokia, who visited Bakhmaro in 1895, only a few houses were there. At that time, for the access to Bakhmaro footpaths from Vaniskedi, Metsieti, Vakijviri and Khevi were used.

In 1900, the "Bakhmaro Consumer Health Society" was established, whose function was to manage and improve the cottage. The access road to Bakhmaro and the water supply of the summer cottages were arranged. In 1923, Bakhmaro was declared a resort of republican importance, after which Bakhmaro began to be popularized as a resort.

From the beginning of the XX century, traditional horse racing to mark the end of the season was held in the resort Bakhmaro.

The cultural heritage sites in Bakhmaro are:

Transfiguration Church of Bakhmaro: The church is located in Chokhatauri Municipality, in the central part of the resort Bakhmaro. It is a free cross-domed building. The church is built of wood. The church has a rectangular entrance to the west. It is built in 1997 (without the status of a cultural heritage monument).

Bakhmaro Church

Former Pioneer Camp building in Bakhmaro. One-storey building south of Bakhvistskali River, 20 m away from the road.

The Headworks structure is 3.6 km away from the Former Pioneer Camp building, while the power unit is 8.6 km away. The building was probably built in the first half of the 20th century.

Pioneer Camp building has been granted the status of a cultural heritage monument (entered in the Register of Cultural Heritage Monuments of Georgia with registration number: 7644, March 14, 2019)

Former Pioneer Camp building in Bakhmaro

Residential house in Bakhmaro. According to the available information, the house was built in the 20s of the XX century.

Th building is 2.6 km away from the headworks and 7.6 km away from the powerhouse.

The house stands on an elevated area. The house has the status of a cultural heritage monument (entered in the Register of Cultural Heritage Monuments of Georgia with registration number: 7643 number. 14.03.2019).

Residential house in Bakhmaro

5.5.10.4.1 Archaeological Monuments in Guria

Archaeological findings from the Paleolithic period in Guria region confirm that people have lived here since ancient times. Paleolithic former settlement is found in Khevi village, within Gubazeuli river valley. Following findings were made on the mentioned ancient settlement: parts of nuclei, knives, scrapers. From flint weapon, pointed weapons should be distinguished. There are many monuments of Neolithic-Eneolithic era, they are recorded in different places, such as: Bakhvi, Nagomari, Shroma, Natanebi, Anaseuli, Naruja, Gurianta, Vakijvari, Shemokmedi.

Archaeological findings, including spearheads, sickles, cutters, rubbed handaxes and hand-grinders, suggest that in VIII-VII millennia BC, farming, cattle breeding, hunting, food gathering and fishing should have been the main activities on this site.

Zemo Guria region seems to be densely populated settlement in various epochs. According to archaeological materials, it is clear that resettlement of Zemo Guria region was intensive in Late Bronze-Early iron Age. Remains of Late bronze-Early iron former settlements, as well as treasures and other bronze objects indicate at this fact. It is noteworthy that sometimes, remains of former dwelling are found near copper deposits, such as: Zoti (Gubazeuli river valley), Vakijvari-Korisbude (Ozurgeti district, Natanebi river shore), Vakijvari (Otogvani former settlement) Pampaleti (vakijvari community).

Archaeological excavations conducted at the end of 20th century in Bukistsikhe village of Chokhatauri municipality founded Late bronze and Early Iron Age cultures, antique era former cities, burials, basilica-type churches, etc. were founded. In the result of excavations, six pithos burials were uncovered. Clay dishes and bronze jewelry were discovered in them. There are traces of flames on the dishes, indicating at the fact that they should be used for cooking the food on fire. Following objects are presented: bowls, clay pans, single handler, pot, jug. They are made of burnt clay. Temple pendants, jewels, beads should be singled out the jewelries.

The exposition of Ozurgeti Historical Museum fully presents archeological materials of all periods, exhibiting: Paleolithic artefacts, fragments of early architectural structures, segmental weapons found in the town and surrounding villages, bronze and iron slags, antique silver and gold items, pottery, etc.

Archaeological Material Exhibited in Ozurgeti Historical Museum

Famous archaeological monuments, discovered in Ozurgeti municipality, are described below:

Anaseuli. Anaseuli former settlement represents Neolithic Age settling mounds, which are called “ground fortress”. Distance between them is 1.5 km.

Flint, obsidian and cobblestone were used as raw materials for making weapons in Anaseuli former settlements. Finished tools as well as unfinished and damaged axes, workpieces and production residues were found in Anaseuli former settlements, indicating that the processing of raw materials and the manufacture of weapons took place on the site.

Early Neolithic so-called pre-pottery Neolithic stone inventory is discovered in Anaseuli I: cutters, scrapers, arrowheads, etc., most of which are obsidian. Anaseuli II belongs to the Late Neolithic Age and its archeological material is more diverse. The stone tools are mainly made of flint, there are many cobblestone tools as well. Among the pottery, outcurved, straight-walled and flat-bottomed pottery pieces should be mentioned, most of which are decorated with wavy, notched and hollowed ornaments.

Scientists suggest that iron was melted from magnetic sand in Anaseuli former settlement.

Gurianta – Late Neolithic settlement in the village of Tsikhisperdi, Ozurgeti Municipality, on the right bank of Skurdumi river. Household, agricultural, combat and hunting weapons made of flint, cobblestone and obsidian were discovered. There was a lot of production waste, fragments of unevenly burnt clay pottery. Some of them are decorated with ornament.

Ozurgeti Baths - Archaeological remains of the bath in Ozurgeti town. They were located in the central square of the town. Baths are not completely studied, only individual details were measured. The monument probably belonged to the late antique or early medieval period. Remains of the old structure are spread over 400 square meters and consist of rooms for various designation.

Ozurgeti bath, like other baths found in Georgia, has two floors. The upper floor is dedicated to the bathroom pools. The lower floor - heating system, is better preserved.


Ozurgeti Baths

Vashnari former settlement in Ozurgeti municipality, is situated near Gurianta village. It is Early Medieval Fortress-Town and the period of its construction and power is defined as V-VIII by historians.

Vashnari stopped existence in VIII century, which is supposedly related to invasions of Marwan ibn Muhammad (Murvan Kru (Murvan the Deaf)).

There is only a small part of Vashnari studied. The citadel, three-navel basilica and residues of martyrium is discovered. The eastern part of the inner battlement is faceted in shape and contains square towers. Gurianta basalt and large square bricks were used in the enclosure wall. A water pipe of clay pipes was found on the territory of the fortress.


Vashnari Former Settlement

Gogieti Former Church – Cultural heritage monument located in the village of Gogieti, Ozurgeti Municipality. The medieval church is now in ruins. Part of the floor and the altar survived, as well as stone crosses, fragments of rectangular hewn stone, the rest was made of wood that was dismantled in the 1930s.

5.5.10.5 Methodology of Conducted Cultural Heritage Survey

Visual examination of cultural heritage was conducted by the group of experts. Special attention was drawn to observation of sites, located above the ground, as well as architectural sites and remains located near the project area, the physical or visual borders of which could be crossed by the project areas.

The exploratory field-archeological works were carried out by a proven method: by superficial observation of the exploring routes, recording of the passed routes by GPS system, photo-fixation of the route sections and sites identified on it, by field recording, and recording in field diaries.

Sections, where cultural heritage remains likely to be discovered, were highlighted. Also, special attention was drawn to the slopes and places cut by the road where the terrain shape or erosion allowed to see the stratigraphic exposures and sections.

During the fieldwork, GPS coordinates were taken and oriented on the survey route using the Garmin GPSMAP 64s handheld portable GPS.

Project area landscape data, geographical coordinates, project access roads, construction sites, spoil ground, etc., delivered from Client in KMZ format files, were field-oriented during works not only using Garmin GPSMAP 64s handheld GPS, but GPS Essentials mobile app.

Field photo-fixation was performed with a Nikon D7100 camera (18-105mm lens).

5.5.10.6 Project Area Study Results

For visual examination of the cultural heritage, archaeological exploratory works were carried out on Bakhvi 1 HPP project area. The total area of studied territory was 5.75 km^2 (perimeter: 12.850 m).

Within the framework of planned works, access roads to the project HPP segments were examined: existing road going from Bakhmaro resort to headworks – in total 4.7 km, the project road – totally 1 km; the existing road going from Vaniskedi village to the power house – totally 12 km and the project road – totally 0.7 km.

Areas to be used temporary and permanently for the project purposes have been also studied (in total 0.9 km^2).

Headworks construction camp on the project area, where workers living and office buildings should be located, as well as concrete plant, parking lots for equipment and transportation means, fuel reservoirs, small auxiliary workshops (wood and iron processing) are planned to be arranged here. This area is located on the right side of Bakhvistskali river, where Bakhvistskali is joined by small ravine. The project area is a field with low vegetation, here and there channeled with small water canals, which is inclined from the north to the south. It is surrounded with coniferous forest. The area is 0.03 km^2 (31,995 m^2). No cultural heritage remains have been identified on the area.

The spoil ground site planned at the headworks is a field inclined from the north to the south with low vegetation cover. Rock debris can be observed all over the field. From the east a small stream flows down. The field is surrounded by the dense, coniferous forest from the north. The area is - 0.02 km^2 (18.729 m^2). No cultural heritage remains have been identified on the area.

Project area of the headworks (low-threshold weir, fish pass and other structural components are considered) is located after Bakhvistskali and Baisurastskali river confluence, in the deep riverbed of Bakhvistskali along the river, in the ravine, which from both sides is surrounded by rock mass. The ravine is covered with mixed forest and shrubbery.

The impoundment area to be flooded by the weir according to the project plan is about 0.24 ha (2400 m^2). The total work area covers 26 000 m^2. No cultural heritage remains have been identified on the area.

The existing village road, leading from Bakhmaro to Bakhvistskali valley is the main part of **the project access road to headworks**, which is mostly cut in rocky soil. The road from Bakhmaro resort to the headworks is in total 4.7 km, the project road – in total 1 km. Cultural heritage sites or remains are not observed in the vicinity of the road.

Powerhouse (power house and the substation) area is located on the left bank of Bakhvistskali river. The site is covered with dense, deciduous forest. The soil is very stony, supposedly, it should be former riverbed. Cultural heritage sites or remains are not observed.

The main section of **the project road leading to the powerhouse** coincides with already existing forestry road. It is cut through clayey, in some places rocky soils and leads from Vaniskedi village to Bakhvistskali river valley. The length of the project road is 15 km. A fragment of pottery has been discovered at the end of the road, the surface of which is pinkish, and the inner section is burnt in black and polished. The clay pan is poorly secluded and includes white and grey inclusions; the thickness is - 0.8 cm. No other cultural heritage remains were discovered except mentioned fragments.

Discovered fragments of pottery

Penstock is designed from the headworks to the powerhouse along the left bank of Bakhvistskali river. The project line of the penstock mainly goes along the river-side riverbed line, in most cases, along the former modification line of the existing riverbed, which is filled with stone-grit mass, brought by the river. The length of the penstock is 3.7 km. In the result of visual observation, no cultural heritage sites or remains were revealed.

5.5.10.7 Conclusion

No monuments of historical or cultural significance that are included in the list of UNESCO World Heritage Sites or have been nominated for membership in this list are located in or near the project area.

Field visual examination of the project area did not reveal proven cultural heritage sites or their remnants - either with or without national significance.

The distance and location of the famous cultural heritage sites to the project area is given on the relevant map.

5.5.10.8 Risk Assessment and their Avoidance or Mitigation Measures

Any construction project has some risks to cultural heritage sites and it equally applies to aboveground architectural monuments, as well as archaeological sites, whether it is individual, isolated burial, mound, or former settlement or historical-cultural site with other dedication.

Visual examination of the cultural heritage within the project area did not reveal any areas, which requires pre-construction archaeological excavations or any type of the preliminary studies.

Considering the fact that no visible cultural heritage sites or their remnants were discovered on the project area, risks, actually, equal to zero and the likelihood of the negative impact of the construction project on existing cultural heritage is excluded.

Physical damage and destruction- construction project process cannot damage and destruct any cultural heritage site as it is not located there.

Violation of monument protection zones – the construction area does not cross none of cultural heritage site/monument protection zones. The archaeological monuments located in Bakhmaro resort and Vaniskedi church and Sakire Fortress are the nearest, however, they are in several kilometers from the construction site.

Vibration – heavy equipment operating during construction cannot have negative impact on cultural heritage sites because of their absence.

Explosion- Construction project does not consider rock blasting works, however, even in this case, aftershocks caused by blasting cannot have an impact on cultural heritage monuments, located in several and dozens of kilometers.

Impact due to increased humidity- the impoundment area of HPP is very small to cause the increase of humidity, moreover, there is no architectural sites or their remnants near the project areas, which could be impacted by increased humidity.

Vandalism- it is not expected as there are no cultural heritage sites on or near the project area.

Chance finding - The likelihood of archaeological chance finding is very low, however, prior to the start of construction activities, the construction company should have management plan and procedure for chance finding prepared and approved, which should be included in the environmental management system and must represent one of the operation documents. The mentioned plan must define procedures to be implemented by the project developer team, in case of finding any archaeological artifact, site or any sign, indicating at the presence of archaeological site, during earth works. Besides, the procedure of actions and notifications should be described, according to which the measures envisaged by the legislation of Georgia (Law of Georgia on Cultural Heritage, 2007) will be carried out. In particular, during such a discovery, the construction company is obliged to stop the construction works at the given place, protect the site and invite the specialists from the agency, authorized by the legislation of Georgia to determine the significance of the archeological monument and make a decision on continuing the work. Works can be renewed on the basis of a permit issued by a competent state body.

For reduction of the mentioned risk, it is necessary to train personnel involved in construction in order to raise awareness about cultural heritage issues.

The conclusion of National Agency for Cultural Heritage Preservation of Georgia on planned activities is provided in Annex N9.

6 Environmental Impact Assessment

6.1 General Principles of EIA Methodology

The present chapter provides assessment of the possible environmental impact during the project implementation. In order to assess expected changes in natural and social environment, it is necessary to collect and analyze the information about the current situation in the project impact area. The scale of the expected changes is determined on the basis of obtained information, impact recipient objects – receptors should be identified and their sensitivity will be assessed, which is necessary for determining the importance of the impact. After determination of the impact significance, following is defined: acceptance of the impact; project alternatives with less negative effect; the need for development of mitigation measures and mitigation measures themselves.

The following scheme has been used during the assessment of the environmental and social impact caused by the planned activities:

Stage I: Determination of the major types of the impact and analysis format

Determination of those impacts that may be significant for these types of projects based on the general analysis of the activities.

Stage II: Baseline Environmental Study – Obtainment and analysis of available information

Identification of the receptors, which are expected to be impacted by the planned activities; determination of sensitivity of the receptors.

Stage III: Characterization and assessment of the impact

Determination of the nature, probability, significance and other characteristics of the impact, taking into account the sensitivity of the receptor; Description of the expected changes in the environment and evaluation of their significance.

Stage IV: Identification of mitigation measures

Determination of mitigation, prevention or compensating measures for significant impact.

Stage V: Assessment of the residual impact

Identification of the magnitude of the expected changes in the environment after the implementation of mitigation measures.

Stage VI: Processing of monitoring and management strategies

Monitoring of the effectiveness of mitigation measures is needed to ensure that the impact does not exceed predetermined values, to verify the effectiveness of mitigation measures, or to identify the necessity of corrective measures.

6.2 Impact Receptors

There are following impact types expected during the project implementation:

- Deterioration of ambient air quality;
- Noise propagation;
- Impact on geological conditions, topsoil quality and stability;
- Impact on aquatic environment;
- Impact on biological environment;
- Impact expected during the waste management;
- Visual-landscape alteration;
- Impact on local socio-economic environment;
- Impact on human health and safety risks;
- Impact on the historical-cultural heritage monuments.

Sensitivity of a receptor is related to the magnitude of the impact and to the ability of a receptor to resist change or recover after changes.

6.3 Deterioration of Ambient Air Quality

6.3.1 Impact Assessment Methodology

For the assessment of impact on ambient air quality normative documents of Georgia have been used, which determine the air quality standards. Standards are defined for the protection of health. As the impact on health depends on the concentration of harmful substances, as well as on the duration of the impact, evaluation criteria considers these two parameters.

Table 6.3.1.1. Assessment criteria for the impact on ambient air quality

Ranking	Category	Short-term concentration (< 24 h)	Dust propagation (long-term or frequent)
1	Very low	C <0.5 MPC	Unnoticeable increase
2	Low	0.5 MPC < C < 0.75 MPC	Noticeable increase
3	Medium	0.75 MPC < C <1 MPC	Slightly disturbs the population, though has no negative impact on health
4	High	1 MPC < C <1.5 MPC	Quite disturbs the population, especially the sensitive individuals
5	Very high	C > 1.5 MPC	Population is very disturbed, has negative impact on health

Note: C - Estimated concentrations in the environment, considering the background

6.3.2 Impact Description

6.3.2.1 Construction Phase

During implementation of Bakhvi 1 HPP construction works, the most notable sources for harmful substance emissions into ambient air will be located on construction camps. As it is given in paragraph 4.2.2., three construction camps and two storage areas will be arranged for the construction; from mentioned areas, emission sources will be located on the following sites: construction camp N1 adjacent to the headwork, construction camp N3 adjacent to the powerhouse and the storage area N2.

The distance to the nearest residential zone from the construction camp N1 site is 780 m, and from the camp N3 and the storage area N2 – the distance is more than 5.5 km.

The borders of the nearest residential zone and 500 m standardized zone were deemed to be a reference points during calculation. Calculation results of harmful substance emissions from the camp N1 are provided in the Table 6.3.2.1.1., and quantitative report of harmful substance emission sources and the software printout of the quantitative report of harmful substance emissions is given in Annex N10.

Table 6.3.2.1.1. N1 Results of Harmful Substance Emission Report from the Construction Camp (MPC share)

Harmful Substance	Code	At the Nearest Settlement	At the border of 500 m zone
Nitrogen dioxide	0301	0,0006	0,01
Nitrogen oxide	0304	0,0005	0,0009
Black carbon (soot)	0328	0,0004	0,0008
Sulfur dioxide	0330	0,0004	0,0008
Hydrogen Sulfide	0333	0,0016	0,003
Carbon monoxide	0337	0,0008	0,0016
Kerosene fraction	2732	0,0005	0,001
Saturated hydrocarbons C12-C19	2754	0,0047	0,0097
Suspended Particles	2902	0,02	0,04

Inorganic Dust: 70-20% SiO2	2908	0,0012	0,0022
Sulfur dioxide and hydrogen sulfide	6043	0.0019	0.0038
Carbon monoxide and process dust	6046	0,002	0.0035
Nitrogen dioxide, sulfur dioxide	6204	0,004	0,007

According to the results of the conducted emission calculations (emission calculation and the graphic part is provided in Annex N10), during construction activities, ambient air quality of adjacent areas, both at reference points and at the borders of 500 meter standardized zone, do not exceed the standard limits, stipulated by the legislation.

6.3.2.2 Operation Phase

During HPP operation, there will be no stationary sources of harmful substance emissions into ambient air.

On operation phase emissions are expected only during repair and maintenance works, but they will be limited in time, reversible and smaller in scale than it is expected on construction phase. Accordingly, calculation of harmful substance emissions in this direction and development of the mitigation measures was not deemed necessary.

6.3.3 Mitigation Measures

Following mitigation measures are considered for the construction phase in order to reduce exhaust and dust emissions:

- Ensure proper maintenance of machinery, as well as stationary facilities; transportation means and equipment, the exhaust of which is expected to be significant (due to technical malfunctioning) will not be allowed to the work site;
- Turning off engines or working on minimum rpm, when they are not used (in particular this is related to the equipment, operating on the construction camp);
- Providing optimal speed of vehicles (especially, on earth roads);
- Vehicles and machinery will be located far away from the sensitive receptors (residential zone) as much as possible;
- Restriction of using motorways through the populated zones (population will be informed in advance on intensive movement of transportation means);
- Corresponding measures (e.g.: watering of work sites, following bulk material storage rules, etc.) will be carried out in order to reduce dust emissions in dry weather conditions;
- During the earth works and loading/unloading of materials, precautions will be considered in order to avoid excessive dust emissions (e.g.: throwing material from height during loading/unloading will be restricted);
- Personnel will be instructed prior to wok start;
- Register/recording complaints and providing proper response considering above-listed measures.

Above-mentioned measures will be considered during implementation of significant repair-maintenance works on HPP operation phase.

6.3.4 Impact Assessment

Table 6.3.4.1. Impact summary on ambient air quality caused by emissions

Description of impact and impact sources	Impact receptors	Assessment of residual impact					
		Nature	Likelihood	Impact area	Duration	Reversibility	Residual impact
Construction Stage							
Combustion products, welding aerosols and other harmful substances emitted into ambient air • Source of combustion products – construction and special equipment, transportation, etc. • Source of other harmful substances - Gaseous emissions of chemical substances (fuel - lubricants, etc.), existed on the site.	Population of the nearby settlements, biological environment	Direct, negative	Low	Adjoining territories of the construction camp, construction sites and residential zone.	During construction	Reversible	**Very Low**
Dust propagation • Source - transportation, storage and usage of bulk construction materials, movement of equipment and vehicles, earth works, etc.		Direct, negative	Medium Risk	Adjoining territories of the construction camp, construction sites and residential zone.	During construction, periodically	Reversible	**Medium.** Considering mitigation measures - **low**
Combustion products, welding aerosols and other harmful substances emitted into ambient air	Working personnel	Direct, negative	Medium Risk	construction camp site, construction sites	During construction	Reversible	**Low,** Considering mitigation measures – **very low**
Dust propagation		Direct, negative	Medium Risk	construction camp site, construction sites	During construction periodically	Reversible	**Very low**

6.4 Noise Propagation

6.4.1 Impact Assessment Methodology

Noise propagation levels in Georgia are regulated by technical regulation on "the norms of acoustic noise in the premises of buildings and areas of the residential houses and social/public establishments", approved by the Resolution #398 of the Government of Georgia, dated as August 15, 2017. The noise level should not exceed the values set by these standards. Considering requirements of the mentioned document, following criteria are adopted for assessment of the noise-related impact for the project under discussion:

Table 6.4.1.1 Impact assessment criteria related to noise propagation

Ranking	Category	Residential area	Working, industrial or commercial zone
1	Very low	Acoustic background increased by less than 3 dBA - at residential zone, during the daytime up to <45 dBA, while during night hours up to <40 dBA	Acoustic background increased by less than 3 dBA and up to <70 dBA
2	Low	Acoustic background increased by 3 – 5 dBA, at residential zone, during the daytime up to <50 dBA, while during night hours up to <40 dBA	Acoustic background increased by 3 – 5 dBA and up to <70 dBA
3	Medium	Acoustic background at sensitive receptors increased by 6-10 dBA, at residential zone, during the daytime up to <55 dBA, while during night hours up to <45 dBA	up to <70 dBA, Acoustic background at sensitive receptors increased by 6-10 dBA
4	High	Acoustic background at sensitive receptors increased by more than 10 dBA, at residential zone, during the daytime up to >70 dBA, while during night hours up to <45 dBA	up to >70 dBA, Acoustic background at sensitive receptors increased by more than 10 dBA
5	Very high	Acoustic background at sensitive receptors will increase by more than 10 dBA, at residential zone, during the daytime up to <70 dBA and accompanied by a tonal or impulsive noise, while during night hours up to <45 dBA	up to >70 dBA, accompanied by a tonal or impulsive noise

6.4.2 Impact Description

6.4.2.1 Construction Phase

Construction of HPP infrastructural facilities consider implementation of intensive construction activities, which will supposedlyhave an impact on acoustic background. In order to determine the expected impact, calculation of noise emissions is implemented in the following sequence:

- Determination of noise sources and their characteristics;
- Selection of reference points at the border of protecting areas;
- Determination of noise direction from noise source to the reference point and calculation of acoustic of the environmental elements, affecting the distribution of noise (natural screens, green plantation, etc.);
- Determination of potential noise levels at reference points and its comparison to allowable levels of noise;
- Determination of noise level reduction measures, if necessary.

Stationary sources of noise propagation from planned construction facilities of HPP will be located on construction camps N1 and N3 and storage area N2. The distance from the construction camp N1 to the nearest residential zone border is 780 m, and from the construction camp N3 and the storage area the distance exceeds 5.5 km. Due to the large distances, the risk of impact on acoustic background of the residential zones is at minimum. Considering aforementioned, the noise propagation calculation is carried out for the construction camp N1.

Following facilities were defined as main noise sources on the construction camp N1:

- Excavator - 90 dBA (1 unit);
- Dump truck - 80 dBA (2 units);
- Self-loader - 80 dBA (1 units);
- Concrete plant 90 dBA;
- Crushing-sorting plant of inert materials 93 dBA.

The calculation is carried out for the worst-case scenario, when all above-listed noise generating sources work simultaneously on the construction camp site. Octave levels of the sound pressure in the reference point are calculated by the following formula:

$$L = L_p - 15\lg r + 10\lg \Phi - \frac{\beta_a r}{1000} - 10\lg\Omega, \qquad (1)$$

where,

L_p – Octave level of the noise source capacity;

Φ – noise source direction factor, non-dimensional, is determined through trial and changes from 1 to 8 (depends on spatial angle of sound radiation);

r – Distance from the source of the noise to the reference point;

Ω – Spatial angle of sound radiation, which will be: $\Omega = 4\pi$- when located in the space; $\Omega = 2\pi$- when located on the surface of the area; $\Omega = \pi$ - double ribbed angle; $\Omega = \pi/2$ – triple ribbed angle;

β_a – Sound damping in the air (dBA/km) tabular description.

Average geometric frequencies of the octave lines, H Hz.	63	125	250	500	1000	2000	4000	8000
β_a dBA/km	0	0.3	1.1	2.8	5.2	9.6	25	83

Noise source levels on the noise-generating section are summarized according to the formula:

$$10\lg\sum_{i=1}^{n}10^{0,1Lpi} \qquad \mathbf{(2)}$$

where: L_{pi} - power of i-type noise source.

Following assumptions are performed for calculations:

1) If distance between some noise sources, located on the same site is less than distance to the reference point, sources are combined into one group. Their total noise level is calculated by the following formula: $10\mathbf{lg}\sum_{i=1}^{n}10^{0,1Lpi}$;
2) To assess the total level of noise sources combined into one group, as a distance to accounting point was used their distance from geometric center;
3) For simplicity, the calculations are performed for the sound equivalent levels (dBA) and average value of its octave indicator is taken as sound damping coefficient in the air β_{ave}=10.5 dBA/km;

By putting the data in the second formula, we will obtain the total noise level resulted from simultaneous working of machinery/vehicles within the borders of the construction camp N1 or noise level at the generation point:

For HPP construction camp:

$$10\lg\sum_{i=1}^{n}10^{0,1Lpi} = 10\lg\,(10^{0,1x90}+ 10^{0,1x80}+100^{,1x80}+ 10^{0,1x90} + 10^{0,1x93})= 96.3 \text{ dBA}.$$

By putting the data in the first formula we will obtain noise levels at reference points:

For the construction camp:

$$L_{500} = L_p - 15\lg r + 10\lg \Phi - \frac{\beta_a r}{1000} - 10\lg \Omega, = \; 94{,}6– 15*\lg780-+10*\lg2–10.5*780/1000-10x\lg2\,\pi= \mathbf{40\ dBA}$$

Calculation results are provided in the Table 6.3.2.1.1.

It is noteworthy that noise propagation level calculations are carried out for all worst-case scenarios, when all machineries and equipment operate simultaneously that is actually unlikely to happen. The noise level 40 dBA, obtained in the result of calculation, does not exceed noise propagation level, defined by the Technical Regulation for the night hours More reduction of the noise level (by about 10-15 dBA) is expected due to the presence of the forested area between the residential zone and the construction camp. Accordingly, the noise propagation level at the border of the residential zone will not be more than 30 dBA.

Besides, as it is given in the present report, in exceptional cases, the construction camp may work in two shifts only during the day and accordingly, the noise propagation related risk is actually absent.

Taking into account the distance (5.5 km) from the construction camp N3 and the storage area N2, the calculated noise level does not reach to the residential zone (it is 22 dBA) and accordingly, the impact is not expected.

Table 6.3.2.1.1. Noise propagation calculation results

Main operating machinery-equipment	Noise equivalent level at generation place, dBA	Distance to the nearest receptor, m	Noise equivalent level at the nearest receptor, dBA	Standard[4]
For the construction camp N1:				
○ Excavator ○ Dump Truck ○ Self-loader; ○ Concrete plant; ○ Inert material crushing plant	95	780	40	During the day time – 50dBA. At night hours- 40 dBA

6.4.2.2 Operation Phase

On operation phase, hydraulic units installed in the power house are main sources of noise propagation. Two turbines will be installed in the powerhouse. It should be noted that turbines will be placed in closed cases, which have high noise absorption rate. Noise insulation materials, arranged in the interior and the power house will also reduce the noise propagation (considering the mentioned factors, noise will be reduced by about 15-20 dBA). The noise level at the power houses will be about 70-80dBA. Noise propagation is not expected at the nearest house as the distance will be large. Accordingly, in this regard implementation of mitigation measures will not be required.

4 Sanitary norms for noise at workplaces, in houses and public buildings and in populated areas

In the power houses the noise level will be quite high; , accordingly, the negative impact is expected on the working personnel. In this regard, it is necessary to carry out certain mitigation measures, namely: personnel should be provided with special earmuffs; control room should be arranged using special noise insulating material.

6.4.3 Mitigation Measures

Following mitigation measures will be implemented during the construction phase in order to minimize noise propagation levels:

- Ensure proper maintenance of machinery; prior to the start of each working day, the technical functionality of the machinery will be checked; transportation means and equipment, the noise level of which is expected to be significant (due to technical malfunctioning) will not be allowed to the work site;
- Noise-generating activities will be carried out only during the day. If work implementation at night is decided, the population will be informed in advance about it;
- Prior to the start of noisy activities near the residential zone (transport operations are meant here), the population will be informed and corresponding explanations will be provided;
- Noisy devices and machinery will be located far away from the sensitive receptors (residential houses) as much as possible;
- If required, the personnel will be provided with the protective means (earmuffs);
- In case of the entry of complaints, they will be registered/recorded and properly responded considering above-listed measures.

On operation phase:

- During the large-scaled maintenance/repair works, mitigation measures, considered for the construction phase will be planned and implemented;
- Personnel will be provided with special earmuffs;
- Control rooms of the HPPs will be arranged using special noise insulation material;

6.4.4 Impact Assessment

Table 6.4.4.1. Summary of noise impact

Description of impact and impact sources	Impact receptors	Assessment of residual impact					
		Nature	Likelihood	Impact area	Duration	Reversibility	Residual impact
Construction phase:							
Noise propagation in air: • Noise generated from machinery; construction operations; earth works; , • Noise generated by transport operations;	Population of the nearby settlements, project staff, animals living nearby.	Direct, negative	Medium risk	In about 0.5 km radius from the construction sites.	Medium term-during construction	Reversible	**Medium –** considering mitigation measures **– low.**
Noise propagation in air: • construction operations • Noise generated by transport operations;	Population of the nearby settlements, project staff, animals living nearby	Direct, negative	Medium risk	In about 0.5 km radius from the construction sites	Medium term-during construction	Reversible	**Medium –** considering mitigation measures **– low.**
Operation Phase:							
Noise propagation in air: • Noise generated by operation of hydraulic units; • Noise generated by transport operations; • Noise generated by maintenance/repair works.	Population, working staff, animals living nearby	Direct, negative	Low risk	In about 0.5 km radius from the power house.	Long-term	Medium	**very low.**

6.5 Impact on Geological Environment

6.5.1 Impact Assessment Methodology

Geodynamic processes deal with ongoing gravitational processes on the earth surface, such as landslides, gullying and others, which can be caused or activated in the result of the project implementation. Risks are assessed considering receptors and project activities.

Table 6.5.1.1. Assessment criteria for geodynamic process activation risks

Ranging	Category	Geo hazardous (ravine formation, landslide, rockslide, mudflow) risks
1	Very Low	The project does not include any type of activities at geo-hazardous areas/zones; the project activities practically are not related to the geo hazard causing risks.
2	Low	Preventative measures are considered during works in the geo-hazardous areas/zones that would effectively eliminate geological risks. Activities on the geologically safe areas do not cause erosion, or other changes, which may cause the geo-hazards. Geo-hazard management/effective plan of mitigation measures is developed and is being implemented.
3	Medium	Preventative measures are considered during works in the geo-hazardous areas/zones that would effectively eliminate geological risks. During implementation of the activities on geologically safe areas may cause development of such processes (e.g., erosion) which may cause geo-hazards without effective management. Geo-hazard management/effective plan of mitigation measures is developed and is being implemented.
4	High	Despite the preventative measures on the geo-hazardous areas/zones there is a risk of geo-hazardous processes development, or implementation of the activities caused geo-hazardous processes on the geologically previously safe areas. Geo-hazard management/mitigation measures plan does not exist or is less effective.
5	Very High	Despite the preventative measures on the geo-hazardous areas/zones there is a risk of geo-hazardous process development, or implementation of the activities caused geo-hazardous processes on the geologically previously safe areas. Geo-hazard management/mitigation measures plan do not exist or is less effective.

6.5.2 Impact Description

Construction of hydraulic facilities on mountainous region rivers has some impact on the geological conditions of the project implementation area and its vicinity. In case of Bakhvi 1 HPP project, arrangement of 4.4. m dam will not be related to the creation of large impoundment and a small impoundment will be arranged upstream, which will not exceed the borders of active riverbed. However, its construction is related to some earth works. In particular: preparation of construction site for the weir (for which it will be needed to cut the ground on the slopes), alluvial soils should be removed from the riverbed; arrangement of roads; arrangement of pipeline corridors; arrangement of power house and substation construction sites, etc. In order to accomplish above-listed goals, it will be necessary to change the existing geological environment.

There is the risk of hazardous geodynamic process development during rehabilitation of existing roads and construction and operation of new ones. So, prior to the start of the construction works it is necessary to carry out detailed engineering-geological surveys. On the basis of the survey results, protective engineering structure should be selected, including arrangement of the drainage structure and water diversion trenches.

During HPP construction, the issue of keeping drainage and diversion structures of the roads in proper working condition will be highlighted.

According to the project, arrangement of the reservoir at headwork is not considered. Besides, slopes of the project alignment are formed by rocky soils. Accordingly, destabilization of slopes and related risks of hazardous geodynamic process development are not expected on this section.

Arrangement of the low-pressure pipeline and penstocks is planned in quite complex relief conditions. Special attention should be drawn to crossing of the alignment by small ravines and gullies on low-pressure underground pipeline section, where at crossings water conduits in the form of viaducts with corresponding dimensions will be arranged.

In order to deepen pipes into the ground and arrangement of access road, as well as for the construction of headwork, it will be needed to cut the ground on the slopes, that can activate erosive and rockfall, landslide processes. It is expected that during construction of the pipeline, loose soils and soils without vegetation cover can be exposed to erosion, surface runoff and gullying within the alignment. Landslide processes can be activated by intensive filtration of water into ground, therefore, as soon as the pipeline is arranged, anti-erosion measures, planned in advance, should be carried out on the corresponding section of the route, in order to avoid rapidly progressive geodynamic process development on the slopes. For prevention of above-mentioned processes, on each site, slope stability forecast will be carried out and shelves will be cut down involving engineer-geologist on the basis of corresponding calculations. If required, additional reinforcement of slopes will be provided.

As it is given in the geological survey paragraph, at EIA stage, the right-bank scheme of HPP communications was changed with the left-bank scheme due to high risks of hazardous geodynamic processes. In case of adopted left-bank scheme implementation, there are significantly less high-risk sites in terms of hazardous geodynamic processes, and these risks can be minimized through taking effective mitigation measures.

As it is provided in paragraph 5.2.2.10 of the present report, there is potential landslide threat on some sections of the penstock route (chainage 1+440 – 1+540, chainage 1+740 – 1+800 and chainage 1+860 – 1+910). In addition, the pipeline will cross several natural ravines, where erosive process may develop.

Rockfall risk-bearing sites were also identified witin the project corridor.

Corresponding protective engineering structures will be considered on each section of the pipeline corridor, as required (aqueduct bridge, diversion channels, retaining walls, slope terracing, etc.).

It can be concluded that during construction of the project facilities, the impact related to hazardous geodynamic process development can be assessed as significant. However, in parallel to the construction, by effective implementation of corresponding prevention measures and monitoring, it is possible to reduce significantly the impact scales.

If effective mitigation measures are considered at designing and construction stages, risks of hazardous geodynamic process development will be relatively lower on operation phase.

Impact of Geological Processes on Project Facilities: In addition to the impact on geological conditions, on the other hand, potential impact of ongoing geodynamic processes in the valley on project structures and stability should be taken into account. In this regard, following processes, characteristic to the valley, should be singled out:

- Impact of mudflow events, mainly on headwork site;
- Development of gravitation processes (landslide, rockfall) on relatively highly inclined sites of the corridor;
- Impact of erosive processes.

During construction, mudflow events, developed on upper section of Bakhvistskali river valley or on its tributaries, can pose a threat to facilities constructing within the riverbed, and accordingly, can entail a significant material damage to the project executor company. Headwork location site is main sensitive site to such events. For impact prevention, it is necessary to design water diversion temporary barriers and diversion channels for maximum water flows (according to the practice of developed countries, similar temporary barriers are calculated for 10-year flood flow). Proper operation condition of these facilities and timely maintenance as required is also very important. One of preventive measures for the impact can be restriction of the construction works of similar facilities in mudflow-prone periods.

Risks of development of such events will be considered during designing of all facilities; this will reduce likelihood of damage to structures on operation phase. Weir type and configuration will be selected so that in high flow conditions, the mass with stones and mud can overflow the crest, to minimize the possibility of its damage. In case of mudflow, preventive measures will be considered at ravine crossing sites as well.

Negligence of gravitational processes can pose a threat to headwork and powerhouse, as well as separate sections of the pipeline. In this regard, penstock corridor should be highlighted, as it passes on the slope with high inclination.

The stability of the project facilities can also be threatened by erosive processes of the river. At detailed design phase, bank protective structures should be arranged on all sensitive sections.

In total, it can be stated that the project implementation is planned on areas with quite complex engineering-geological conditions. However, hazardous geodynamic processes, which cannot be stabilized or which are related to high financial expenses, will not be developed. The impact can be assessed as high or moderate. In parallel to the construction and on operation phase, planned mitigation measures, the strategy of stabilization of geodynamic processes and project solutions for protection of the structures will ensure impact reduction and minimization.

6.5.3 Mitigation Measures

Considering potential risks, expected during the project implementation, following measures are worked out for prevention of geodynamic process development and protection of the structures:

Main Measures:

- Recommendations considered during the geological study of the project area will be taken into account during the project implementation;
- Prior to the start of the construction works of certain hydraulic unit facility, boreholes will be arranged on the site and based on the data, obtained from these boreholes, physical-mechanical properties, distribution depth, etc. of forming rocks will be specified. According to this information, specific parameters for foundations of the project structures will be defined
- Construction works will be implemented under the strict supervision of engineer- geologist. If required, additional preventive measures will be carried out on the basis of his recommendations;
- Borders of the work corridor will be protected and felling of trees and vegetation cover will be controlled within these borders;
- Materials and waste will be disposed so that to avoid erosion and their removal from the construction site by surface water runoff. The height of the ground pile will not be more that 2 m; pile sides will have proper inclination angle (45^0); drainage channels will be arranged on the perimeter;
- After completion of the construction works, recultivation and landscaping of the construction sites will be carried out.

Strategy for protection of structures against mudflow events:

- Construction works in or near the riverbed will be restricted during the period, when the mudflow development is expected. During intensive implementation of above-mentioned works, environmental manager/engineer-geologist will control official forecast of National Environmental Agency on weather/disasters expected in the region. Works will be planned considering recommendations, issued on the basis of these forecasts: Preliminary implementation of some preventive measures may be required (e.g.: improvement of temporary barriers and diversion channels, cleaning of the riverbed as far as possible from large boulders, etc.);

- Temporary barriers and diversion channels will be designed for flood flows (10-year flood flow);
- Timely maintenance of the temporary barriers and diversion channels will be provided. Their technical functionality will be checked after each heavy rain or sediment runoff in large amount;
- Low-threshold headwork arrangement is planned. Its structure ensures safe downstream passage of mudflow streams;
- Bank protective structures will be arranged at the power house and at all sensitive sites;

Strategy for prevention of gravitational processes and protection of structures against them:

- Following approaches will be applied for prevention of gravitational processes:
  - Drainage and regulation of uncontrolled water stream – upstream of unstable site, drainage channel will be arranged along the whole length, which divert the water, flowed from upper elevations, from unstable site. A trench with steel lining is planned, which can be arranged and moved even in complex conditions (steep slopes);
  - Reinforcement of the surface layer of the ground, which is posed to the landslide impact, with double wire steel mesh; the steel ropes of the mesh are fixed with anchors into lower layer of the stable rocks, which ensures the double stability of the ground and protection of rocks under the road surface from potential disintegration. Certain amount of rocks (more than 2-3 m^3) requires special attention and it is necessary to fix them with steel rope and anchors. The mesh will be made of high-quality wire, in order to ensure long-term protection against corrosion;
- Analogous measures will be carried out on sites, where signs of similar geodynamic process development are observed after implementation of earth works;
- Wherever there are rockfall development risks, prior to the start of works, the slope will be checked and cleaned from loose boulders and stones, if any;
- Sites with high risks of rockfall will be reinforced with double wire steel mesh.

Strategy for erosion prevention and protection of structures against it:

- Bank protection structures will be arranged on all sensitive sections, including, bank line protection, provided within the shorelines adjacent to headwork and power house;
- Highly inclined slopes and the perimeter of soil grounds will be provided with corresponding drainage systems;

Following mitigation measures will additionally mitigate hazardous geodynamic process development risks on operation phase:

- Foundation of main HPP facilities will be provided on the basis of engineering-geological surveys;
- Retaining walls will be arranged on sensitive sites of the project corridor; during designing of the protective structures, their parameters will be defined on the basis of engineering-geological surveys and hydrological-hydraulic calculations of bottom and bank scouring intensity;

Monitoring over hazardous geological processes/protective structure conditions will be carried out on all sensitive sites, especially during initial 2 years of operation. Personnel with relevant competence (engineer-geologist) will be involved in monitoring; if required in the shortest possible time, corresponding preventive measures (geological study, project development, restoration of protective structures, etc.) will be carried out.

6.5.4 Impact Assessment

Table 6.5.4.1. Summary of the Risks of Geodynamic Process Development

Description of impact and its sources	Impact receptors	Residual Impact Assessment					
		Nature	Probability of occurrence	Influence area	Duration	Reversibility	Residual impact
Construction Phase:							
Geohazards, including development/activation of creep, rockfall, ravine formation, etc. • Removal and storage of soil/slopes; • Felling of trees and vegetation; • Construction works of HPP facilities; • Construction works and transport operations, especially use of heavy equipment.	Land and land resources (plants, animals, water); population; Construction safety	Direct Negative	High/medium risk areas have been identified within the project corridor in terms of the hazardous geodynamic process activation	Some of the construction sites and corridors of transportation roads	Medium term. In some cases – long term	Mainly reversible	Considering the local conditions and effectiveness of preventive/mitigation measures, impact can vary between **medium to high**. Considering the mitigation measures, impact may be reduced to **low** impact
Operation Phase:							
Geohazards, including development/activation of creep, erosion, rockfall, ravine formation, etc: • Existence of the HPP infrastructure and reduced vegetation cover; • Maintenance and repair works and transportation, especially use of heavy vehicles,	Land and land resources (plants, animals, water); population; HPP facility safety	Direct Negative	Medium risk	Objects placed in difficult terrain conditions (headwork, penstock, power houses, road, etc.)	Long term	Mainly reversible	Considering the mitigation measures (including those, considered on designing and construction phases) **low** impact is expected

6.6 Impact on Topsoil and Soil Quality

6.6.1 Impact Assessment Methodology

Impact value on the soil is assessed by the following parameters

- Impact intensity, area and duration;
- Their sensitivity towards given changes;
- Their ability to restore.

Table 6.6.1.1. Assessment Criteria for Impact on Soil and Ground

Ranging	Category	Destruction of the fertile soil layer	Soil/Ground Pollution
1	Very Low	Less than 3% of the project area has been permanently destructed	Soil/ground background conditions have changed unnoticeably
2	Low	3%-10% of the project area has been permanently destructed	The concentration of pollutants have increased with less than 25%, but less than the permitted value, up to 6 months will be needed for the soil/ground quality restoration
3	Medium	10%-30% of the project area has been permanently destructed	The concentration of pollutants have increased with 25-100%, but less than the permitted value, 6-12 months will be needed for the soil/ground quality restoration
4	High	30-50% of the project area has been permanently destructed; small areas are damaged outside of the project area, recultivation of which is possible after completion of the construction works	The concentration of pollutants have increased with more than 100%, or exceeds the permitted value, 1-2 years will be needed for the soil/ground quality restoration
5	Very High	More than 50% of the project area has been permanently destructed; small areas are damaged outside of the project area, recultivation of which is possible after completion of the construction works	The concentration of pollutants have increased by more than 100%, or exceeds the permitted value, more than 2 years will be needed for the soil/ground quality restoration

6.6.2 Impact Descriptin

Topsoil damage and reduction in soil stability is mainly expected during preparatory and construction works, which will be related to equipment movement within the project area, earth works, arrangement of temporary and permanent infrastructure and final disposal of waste rock.

However, as it was mentioned in the description of the baseline environmental conditions, the soil cover is poor (due to local relief conditions – high inclination of slopes) direqctly on the sites of HPP facilities (penstock corridor, powerhouse construction site). In addition, topsoil will be removed from construction banks (N1, N2, N3), storage area N1, spoil grounds and corridors of access roads to the headwork and powerhouse. According to the preliminary calculation, the total amount of the topsoil to be removed is 12 147.4 m^3.

Topsoil removal and recultivation will be carried out in compliance with requirements of the Technical Regulation on “Topsoil Removal, Storage, Usage and Recultivation”, approved by the Decree N424 of the Government of Georgia on December 31, 2013.

Soil/ground quality may be affected by improper management of waste (both solid and liquid), violation of rules for fuel and lubricants and construction materials storage, accidental spill of fuel/lubricants from construction machinery and vehicles. During the construction phase, relatively high risks of soil contamination are expected in the vicinity of the construction camp (parking lot, fuel storage reservoir and other potential sources of soil contamination will be arranged here). It is noteworthy that fuel storage reservoirs will be arranged on the site, covered with water-proof (concrete) layer, at the perimeter of which a concrete barrier will be arranged. Accordingly, in case of accidental spillage, oil products will not be propagated on the area. Lubricants and other substances will be located in the closed buildings.

It should be noted that in case of soil contamination secondary (indirect) impacts are expected, for instance, groundwater contamination due to the movement of pollutants to deep layers of soil, also washing off the pollutants with surface runoff and discharge into the river. Therefore, appropriate preventive measures will be implemented during the activities.

6.6.3 Mitigation Measures

Following environmental requirements should be considered while working on work sites in order to avoid additional damage to soil and soil/ground contamination:

- Topsoil removal-storage will be carried out in compliance with requirements of the Technical Regulation - "Topsoil Removal, Storage, Use and Cultivation", approved by the decree №424 of the Government of Georgia;
- Strict adherence of the boundaries of work sites in order to prevent possible contamination of neighboring areas, damage and compaction of topsoil;
- Determination of routes for vehicles and machinery and restriction of off-road movement;
- In case of identification of fuel/oil leak damage must be fixed immediately. Damaged vehicles will not be allowed on the work sites;
- Strict adherence of the boundaries of work sites in order to prevent possible contamination of neighboring areas, damage and compaction of topsoil;
- Determination of routes for vehicles and machinery and restriction of off-road movement;
- In case of identification of fuel/oil leak damage must be fixed immediately. Damaged vehicles will not be allowed on the work sites;
- In case of spillage of pollutants, spilled material should be localized and contaminated site should be immediately cleaned. Staff should be provided with appropriate means (adsorbents, shovels, etc.);
- In case of large spill contaminated soil and ground for further remediation should be removed from the territory by the contractor holding an appropriate permit for such activities;
- Periodically staff will undergo training;
- After completion of construction works, the area will be cleaned and prepared for recultivation. Special attention will be drawn to the fulfilment of recultivation works on construction camp and spoil ground sites.

Following measures will be implemented during operation phase:

- Means for liquidation of spill consequences will be available at the powerhouse and oil storage areas;
- Control of the fuel/oil storage and usage rules;
- Control over implementation of measures, considered by the waste management plan;

- In case of fuel/oil spill, cleaning of the territory and withdrawal of the contaminated soil and ground for further remediation;
- Personnel will undergo training prior to recruitment and once every year after that.

6.6.4 Impact Assessment

Table 6.6.4.1. Summary of impact on soil/ground

Description of impact and its sources	Impact receptors	Residual Impact Assessment					
		Nature	Probability of occurrence	Influence area	Duration	Reversibility	Residual impact
Construction Phase:							
Impact on integrity and stability of soil. ***Loss of topsoil*** • Vehicle and construction equipment movement; • Earth works, arrangement of various facilities; • Waste management (including waste rock).	Vegetation cover, animals, population	Direct, Negative	Medium	Construction sites and road corridors	Medium or long term	Reversible. In some places - irreversible	Taking into account mitigation measures – **low**
Soil contamination • Spillage of oil or other chemical substances, pollution by waste.	Vegetation cover, surface and ground water, population	Direct, Negative	Medium	Construction site, mainly local spills are expected	Medium-term (Limited to the duration of the construction phase)	Reversible	Taking into account mitigation measures – **low**
Operation Phase:							
Soil contamination • Spillage of oil or other chemical products (e.g. paint, transformer oil), pollution by waste.	Vegetation cover, surface and ground water, population	Direct, Negative	Low	Areas adjacent to powerhouse	Long term	Reversible	**Very low**

6.7 Impact on Surface Water Environment

6.7.1 Impact Assessment Methodology

Impact on aquatic environment includes following:

- Change of river water debit;
- Impact on sediment movement of the river, riverbed dynamic and on stability of the banks;
- Deterioration of river water quality.

Impact is assessed by considering the intensity, impact area and the sensitivity of riverbed/banks of the river.

Table 6.7.1.1. Assessment criteria for the impact on surface water

Range	Category	Change of river water debit	Impact on sediment movement	Deterioration of river water quality
1	Very Low	Change of the debit is unnoticeable, does not impact on the water habitat/fish fauna. Water use is not changed	The change of the solid run-off is practically unnoticeable, there is no impact on the river-bed or on the banks of the river	Background concentration of the substances and water turbidity has insignificantly changed
2	Low	The river debit on certain sections has changed with 10%, impact is temporary (e.g., it will be restored after completion of construction works) or is seasonal (e.g., expected only during low-water period), does not impact on water habitats/ fish fauna. Water use has changed temporarily or slightly.	Solid run-off has changed with 1-5% in the tailrace/lower reaches of the water intake along the whole length of the river or on its certain sections, which may cause some impact on sensitive areas, but the existing erosion processes has not been activated significantly.	Concentration of the substance or water turbidity has changed by less than 50%, but does not exceed maximum permissible concentration
3	Medium	The river debit on certain sections has changed with 10-30%, impact is temporary (e.g., it will be restored after completion of construction works) or is seasonal (e.g., expected only during low-water period); certain impact on sensitive water habitats/fish fauna is expected. Water use has changed temporarily and slightly.	Solid run-off has changed with 5-10% in the tailrace/lower reaches of water intake along the whole length of the river or on its certain sections, which cause some impact on sensitive areas, noticeable activation of the erosion processes is expected, or development of the erosion processes on the erosion hazardous areas.	Concentration of the substance or water turbidity has changed by less than 50-100%, but does not exceed maximum permissible concentration

4	**High**	The river debit on certain sections has changed with 30-50%, which is irreversible by character, significantly impacts on water habitats, impact on fish fauna is expected, noticeably impacts on water use.	Solid run-off has changed with 10-15% in the tailrace/lower reaches of water intake along the whole length of the river or on its certain sections, which cause significant impact on sensitive areas, existing erosion processes has significantly activated or erosion is being developed on erosion hazardous areas.	Concentration or turbidity of the water has changed by more than 100%, or exceeded maximum permissible concentration
5	**Very High**	The river debit on certain sections has changed with more than 50%, impact is irreversible, lack of flow significantly impacts on water habitats, there is an impact on fish fauna, water use has significantly changed.	Solid run-off has changed with >15% in the tailrace/lower reaches of water intake along the whole length of the river or on its certain sections, which significantly impacts the lower flow of the river, including sensitive areas, existing erosion processes has significantly activated, erosion developed on erosion hazardous or on previously stable areas.	Concentration or turbidity of the water has changed by more than 200% and exceeded maximum permissible concentration

6.7.2 Construction Phase

Prior to basic construction works on construction phase, temporary cofferdams and diversion channel are considered to be arranged on construction sites in the riverbeds. Water inflow will be fully released downstream through them. If required sites, adjacent to the construction sites will be cleaned from time to time from accumulated sediments. Above-mentioned temporary infrastructure will be arranged so that the potential negative environmental impact will be minimal. The selected project solutions will be targeted at prevention of the following hazards:

- Blockage/hindrance of the migration route for organisms living in the water (fish, invertebrates);
- Loss of the physical space and habitat;
- Hindrance of the sediment movement and flow mode;
- Creating a barrier and ponding;
- Impact on water quality.

According to the project on construction work organization, it is considered to arrange two concrete plants and the inert material crushing and sorting plant. Water for preparation of the concrete mixture and operation of crushing and sorting devices will be taken from Bakhvistskali river. Considering low water amount to be withdrawn compared to river flows, the risk of impact on the hydrological mode of the river is at minimum.

Accordingly, on the construction stage the impact related to changing of river water debit and restriction of sediment movement in the riverbed is less expected and it is not needed to carry out additional mitigation measures in this direction.

On construction phase, risks of surface water quality deterioration should be highlighted. Facilities, bearing pollution risks, will be mainly concentrated on construction camps, located in large distance from Bakhvistskali river shoreline. According to the project, the biological treatment facility is planned for treatment of household-fecal wastewater, generated on the camps; as for wastewater, generated during inert material crushing and sorting, they will be discharged into the river after treatment. Wastewater will be treated using settlers.

As it is given in the present report, shed-like storage facilities will be arranged on the territory of construction camps for disposal of bulk materials, and fuel storage reservoirs will be installed on the enclosed sites with water-proof surfaces; Thus in case of accidental spill, the risk of oil product distribution on the area is minimal. Special storage facilities will be arranged for keeping lubricants and other liquid material. In addition, water-diversion channels are planned to be arranged on the perimeter of the construction camp sites. Considering all aforementioned, the risk of storm water contamination is at minimum.

Deterioration of the surface water quality will cause various type indirect impacts, especially, worsening of living conditions of fish and invertebrates living in the rivers, change of the state of groundwater quality, etc.

Surface water pollution risk during the construction phase depends on the performance of the measures envisaged by environmental management plan, as well as on the quality of monitoring over waste management and the functionality of the equipment. The soil/ground and ground water protection against pollution is also important in this direction. In case of proper implementation of the corresponding environmental measures, risks of impact on surface water within the project impact zone will be minimized.

6.7.3 Operation Phase

During operation, negative impact on surface water is expected: impact related to changes in river debit (reduction of natural runoff) and impact on water quality, if oil product spill takes place.

Water diversion first to the intake and then to the penstock may cause the impact on Bakhvistskali river water flow on section between headwork and the powerhouse tailrace channel, which will be about 4.3 km long. Downstream passage of mandatory environmental flow is an important mitigation measure for minimization of the impact.

6.7.3.1 Change of Natural Flow and Necessary Environmental Flow

Bakhvi 1 HPP project impacted section of Bakhvistskali river valley is in significant distance from settlements; besides, due to complex relief conditions of the valley, the human activity within the valley is not intensive. During the audit, there were no facts of water consuming observed within the project section of the valley. However, reduction of water flow will change the existing ecological balance to some extent. Negative impact on biological environment, especially on fish and water related animals will take place.

As it is known, there is no officially approved methodology for environmental flow calculation in Georgia up today and the minimum environmental flow for all existing, constructing and project HPPs are set at 10% of the multi-annual average flow with 50% provision. In the process of determining the minimum environmental flow for Bakhvi 1 HPP, the methodologies of several European countries (Switzerland, Austria, Spain, Italy, etc.) were analyzed and the amount of minimum environmental flow was determined by the hydrological and geomorphological conditions of the project river, as well as the biological environment.

It is noteworthy that the minimum environmental flow, defined as 10% of the average multi-annual flow of the river, is almost identical to the minimum environmental flow, obtained according to the methodology, recognized in many European countries (Switzerland, Spain, Italy, Austria, etc.). According to the methodology introduced in the Switzerland, the minimum environmental flow is calculated as Q_{347}, that is less than 10% of average multiannual flow. The water amount required for water consumers, existing downstream of the headworks, is added to the minimum flow determined according to the Swedish methodology. For the given case, there are no water consumers of Bakhvistskali river presented downstream the headworks. According to the Austrian methodology, the minimum environmental flow is determined by providing the wet perimeter of the river flow and sufficient water amount for fish fauna inhabiting in it, which is possible by narrowing the riverbed and ensuring a single-channel stream on the project impacted section.

Considering aforementioned, the minimum environmental flow was determined according to the existing methodology in the country through Bakhvi 1 HPP hydropower calculation and consideration of hydrological characteristics of bakhvistskali river within the project section; in particular: 10% of the average multi-annual flow of Bakhvistskali river, equaling to 0.29 m^3/s.

It should be noted that the environmental flow for Bakhvi 2 HPP, planned downstream the project section of Bakhvi 1 HPP is defined as 0,27 m^3/s, and for Bakhvi 3 HPP - 0,348 m^3/s.

Based on hydrological data of Bakhvistskali river (see Table 5.3.3.4.1.) the Table 6.7.3.1.1., where following is provided for the project section:

- Inter-annual distribution of average annual Bakhvistskali river flow with 10%, 50% and 95% provisions - m^3/s;
- Necessary environmental flow, which should be passed downstream after HPP commissioning, in average flow conditions with 10%, 50% and 95% provisions - m^3/s;
- Necessary environmental flow, which should be passed downstream – in %, in relation with the natural river flow;
- Interannual distribution of flow, supplied to the hydro-turbines considering the environmental flow and maximum water withdrawal probability - m^3/s.

As it is shown from the table, during the period with average water level, in most period of the year, the amount of environmental flow will not be less than 13% of the average monthly flow. The percentage share of the environmental flow is relatively lower in high-water period, however, during this period, in most cases, excess water overflows downstream the headworks.

During the low-water period, the minimum water flow, required for proper operation of turbines should also be considered. In conditions of mentioned flow, the operator company is obliged firstly to release full inflow downstream, as it does not ensure minimum water flow, required for energetic purposes. Considering the sensitive periods of migration (October-February) of the brook trout, which is inhabitant of Bakhvistskali river project section, the mentioned project detail significantly mitigates the impact, caused by habitat change.

In addition, the environmental flow defined for Bakhvi 1 HPP headworks is almost identical to the minimum flows of Bakhvistskali river. As it is given in Table 5.3.3.2.8.4., 30 days minimum flow of the river within the headworks alignment is 0.26 m^3/s.

Within the project section Bakhvistskali river has 31 tributaries, the total amount of which is 0.308 m^3/s. The locations of tributaries on the project section of the river and calculation of the average multi-annual flows are provided in Table 5.3.3.2.8.3. Flows of tributaries in various river sections will be added to the environmental flow. This is although minor but still positive effect.

The annual runoff of the river within the headwork alignment is 79,9 mln. m^3. The amount of environmental runoff is 25,4 mln. m^3, that is 32% of the annual runoff. Considering the annual runoff (9,7 mln. m^3) on the diversion section, the total amount of the runoff, left in the river reaches 44%.

In total, taking into account the project solutions and natural baseline condition, the impact on hydrological mode and accordingly, on aquatic biological environment can be assessed as medium and irreversible.

Table 6.7.3.1.1. *Intra-Annual Distribution of Annual Water Flows with the Project Provisions.*

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Average Monthly Flow													
Natural Flow, m³/s	0.9	0.8	1.0	4.4	9.8	6.6	3.1	2.1	1.7	1.8	1.6	1.4	**2.9**
Environmental flow, m³/s	0.29	0.29	0.29	0.29/ 0.4	0.29/ 5.8	0.29/ 2.6	0.29	0.29	0.29	0.29	0.29	0.29	-
Environmental flow. % of the natural river flow	32.2	36.5	29.0	6.6/9. 1	3.0/59.2	4.4/ 39.4	9.4	13.8	17.0	16.1	18.1	20.7	10.0
Flow to be used by HPP (turbines) m³/s	0.61	0.51	0.71	4.0	4.0	4.0	2.81	1.81	1.41	1.51	1.31	1.11	
10 % provision average flow													
Natural Flow, m³/s	1.7	1.5	1.6	7.6	15.3	9.8	5.3	3.5	2.7	3.0	2.1	1.9	**4.0**
Environmental flow, m³/s	0.29	0.29	0.29	0.29/ 3.6	0.29/ 11.3	0.29/ 5.8	0.29/ 1.3	0.29	0.29	0.29	0.29	0.29	-
Environmental flow. % of the natural river flow	17.0	19.3	18.0	3.8/ 47.4	1.9/ 73.9	3.0/ 59.2	5.5/ 24.5	8.3	10.7	9.7	13.8	15.3	-
Flow to be used by HPP (turbines) m³/s	1.41	1.21	1.31	4.0	4.0	4.0	4.0	3.21	2.41	2.71	1.81	1.61	-
50% provision average flow													
Natural Flow, m³/s	0.8	0.7	0.9	3.5	8.4	6.3	2.5	1.6	1.4	1.5	1.5	1.2	2.7
Environmental flow, m³/s	0.29	0.29	0.29	0.29	0.29/ 4.4	0.29/ 2.3	0.29	0.29	0.29	0.29	0.29	0.29	-
Environmental flow. % of the natural river flow	36.3	41.4	32.2	8.3	3.5/ 52.4	4.6/ 36.5	11.6	18.1	20.7	19.3	19.3	24.2	-
Flow to be used by HPP (turbines) m³/s	0.51	0.41	0.61	3.21	4.0	4.0	2.21	1.31	1.11	1.21	1.21	0.91	-
95% provision average flow													
Natural Flow, m³/s	0.4	0.3	0.5	1.7	4.8	3.3	1.3	0.8	0.7	0.7	0.6	0.5	1.8
Environmental flow, m³/s	0.29	0.29	0.29	0.29	0.29/0.8	0.29	0.29	0.29	0.29	0.29	0.29	0.29	-
Environmental flow. % of the natural river flow	72.5	96.7	58	17.1	6.0/16.7	8.8	22.3	36.3	41.4	41.4	48.3	58.0	-
Flow to be used by HPP (turbines) m³/s	0.11	0.01	0.21	1.41	4.0	3.01	1.01	0.51	0.41	0.41	0.31	0.24	-

6.7.3.2 Impact on Sediment Movement

In general, significant impact on sediment movement is expected due to the dam operation; as a rule, dams are artificial barriers and sediment is accumulated upstream; in the result, upstream riverbed level is raised and flooding risks of riverbed-side floodplains are increased, and downstream section experiences the deficit of solid sediments; in its turn it affects the dynamics of the riverbed and stability of the banks.

In the regard with the mentioned impact, in case of Bakhvi-1 HPP project the impact is not expected, as the project considers arrangement of the low-threshold weir (height 4.4 m), which will be equipped with spillway and flushing gate and the river solid sediments will be fully passed downstream through mentioned devices. Recurrent maintenance of the headwork and protection of operation conditions are firstly in interests of HPP operator company. As accumulation of sediments in large amounts worsen the operation parameters of HPP, that surely is reflected on amount of generated power. Considering aforementioned, the infrastructure planned at headworks and its properties in proper operation conditions will facilitate to the natural downward movement of sediments to the possible extent.

In addition to the presence of headwork, the ability of the river move sediments from upstream to downstream will be limited due to reduction of natural water flow. However, during high-waters water level will restore natural balance of the sediments.

Considering aforementioned, presence of headwork and change of river hydrological mode should not cause significant impact on riverbed deformation, as reduction of sediments is not expected.

Sediments settled upstream the headworks will be flushed upon accumulation not less than once a year during the spring floods (desirably at the last stage of flood). During flushing, the flushing gate will be completely opened and the entire river flow will be passed downstream together with the accumulated sediments. Flushing of upstream section of the headworks will be carried out in coordination with Bakhvi 2 and Bakhvi 3 HPP operator companies.

6.7.3.3 Surface Water Contamination Risk

In the HPP operation phase, river water contamination may occur in following cases:

- Oil spill on the territory of powerhouse and leachate of pollutants into outlet channel;
- Oil pollution of water discharging from turbines;
- Discharge of waste and sanitary-fecal water into outlet channel or into the river due to poor management.

There will be no significant water pollution sources within the planned headwork. During initial years of operation, it will be significant to carry out monitoring over geological stability (erosive processes) and bank protective structures in order to prevent increase of suspended particle concentrations in water.

Risks of river water pollution with turbine or transformer oil are actually absent, namely: considering technical specifications of the selected turbines, oil occurrence in the outlet channel is possible only in case of emergency situation and in exceptional cases. In spite of that, oil consumption recording issue should be highlighted (in case of leachate, the likelihood of identification of oil content in used water is at minimum due to small concentrations) and in case of above-standard consumption, it is necessary to carry out corresponding technical measures.

According to the project, arrangement of the drainage system for collection of contaminated water is considered in the power house; such water will be collected in sumps, located at the lower elevation of the floor of the building, from where it will be pumped to the oil-trap and after treatment discharged downstream.

Transformers will be arranged at tanks for collection of accidental spill of oils and there is no risk of spill distribution on the site. Corresponding closed containers will be designated for storage of new and used oils. Considering aforementioned, the risk of river water contamination can be deemed as very low.

Impact on water quality during the maintenance works will depend on the volume and type of works. Mitigation measures will be similar to those considered for the construction phase.

6.7.4 Mitigation Measures

Preventive measures for surface water contamination on the construction phase are as follows:

- During arrangement of the construction camp and storage areas, conditions, defined by Technical Regulation on Water Protection Zone, approved by the Decree #440 of the Government of Georgia (December 31. 2013) will be considered;
- Ensure technical functionality of machinery/equipment;
- Arrangement of machinery and potentially polluting material in not less than 50 m from water bodies (where possible). If it is impossible, strict control will be established and safety measures will be carried out to avoid water contamination;
- Prohibit washing of vehicles in the riverbed;
- Biological treatment facilities will be arranged for collection of generated domestic-fecal water; settlers will be considered for industrial wastewater treatment;
- Potentially pollution sites of storm water will be roofed with shed-like structure as far as possible;
- Before starting construction works, project on maximum permissible discharge (MPD) standards for pollutants, to be discharged together with wastewater into the surface water bodies, will be developed and agreed with the Ministry;
- All potentially polluting material should be removed after the completion of works. In case of spillage of oil/lubricants, spilled product should be localized/cleaned;
- The staff will be instructed relevantly.

There are following mitigation measures for natural runoff changes during the operation phase:

- Constant monitoring will be set over the natural river runoff during the construction and operation phases. Besides, control over the environmental flow release at headworks will be established (environmental flow will be monitored daily). Results of monitoring over environmental flow will be submitted to the Ministry of Environmental Protection and Agriculture of Georgia;
- In case of flow equal to or less than the environmental flow in the river, power plant will stop operation and full volume of water flow will be released downstream the headwork;
- During the first 2 years of operation, fish fauna of the project rivers will be monitored and the report will be submitted twice a year to the Ministry of Environment Protection and Agriculture. Additional mitigation measures will be taken, if necessary;
- Within the framework of fish fauna monitoring, geomorphological conditions of the riverbed will be emphasized. The control mainly considers observation on preservation of continuous stream in environmental flow conditions. If required, at critical points, riverbed management measures, including wood debris removal at these points and cleaning (relocation) only from those boulders, which hinder the continuity of the stream;

There are following mitigation measures for limited movement of sediments during the operation phase:

- During floods flush gates will be fully opened in order to ensure downstream passage of sediments;
- Twice a year, after the floods of spring and autumn, passage of sediments in the headwork sections will be monitored;

- According to the results of this monitoring, if it is revealed that the sediment downstream release is limited, appropriate measures will be taken (e.g. cleaning the upstream by excavator, etc.).

There are following mitigation measures to prevent surface water pollution during the operation phase:

- Systematic control over implementation of measures considered by the waste management plan;
- Systematic supervision on fuel/oil storage and usage rules;
- In case of accidental fuel/oil spill, localization of the pollution and implementation of measures to prevent contamination of the surface water;
- Instruction of personnel on environmental and safety issues.

6.7.5 Impact Assessment

Table 6.7.5.1. Summary of Impact on Surface Water

Description of impact and its sources	Impact receptors	Residual Impact Assessment					
		Nature	**Probability of occurrence**	**Influence area**	**Influence area**	**Duration**	**Reversibility**
Construction Phase:							
Contamination of surface water and related water bodies with suspended particles, hydrocarbons and other substances: • Source of contamination with suspended particles - contaminated surface runoff, construction works in or close to the riverbed; • Source of contamination with hydrocarbon/chemical substances - due to their spillage, inflow of contaminated surface water runoff, or their spillage in the water bodies; • Other pollution sources - construction or household solid/liquid waste generated from construction camp.	Population, river inhabitants	Direct. In some cases - indirect Negative	Medium	Bakhvistskali river	Medium term (The impact is limited with the construction phase)	Reversible	In some cases (works in the riverbed) – **Medium,** considering mitigation measures –**Low**
Operation Phase:							
Change of river water flow	Population, river inhabitants and terrestrial animals	Direct Negative	High risk	Bakhvistskali river	Long term	Irreversible	**High,** considering mitigation measures – **Medium**
Impact on sediment movement • Change in the dynamics of the riverbed and banks stability	River inhabitants	Direct Negative	Medium risk	Bakhvistskali river	Long term	Reversible	**Low**
Contamination of surface waters with suspended particles, hydrocarbon and other substances: • Source of contamination with suspended particles: ○ Surface runoff contaminated with suspended particles from non-cultivated areas of HPP;	Population, river inhabitants.	Direct. In some cases - indirect Negative	Low risk	Bakhvistskali river	Short term	Reversible	**Very Low**

• Source of contamination with hydrocarbon/chemical substances: ○ Discharge water pollution with turbine oils; ○ Discharge of surface runoff, contaminated as a result of spillage of chemical substances, into the water bodies; • Solid / liquid household waste, solid / liquid construction waste generated during maintenance works.							

6.8 Impact on Underground / Ground Water

6.8.1 Impact Assessment Methodology

Table 6.8.1.1. Assessment criteria of the impact on underground/groundwater

Ranking	Category	Changes in groundwater debit	Deterioration of water[5] quality
1	Very low	Debit has changed unnoticeably	The background concentration of substances have changed unnoticeably
2	Low	Ground-water levels has declined markedly, though, it has not affected water levels in wells or flow of water	Concentration of substances of the II group[6] is below the permissible limits for drinking water
3	Medium	Ground-water levels and water extraction from wells has declined markedly affecting flow of springs	Concentration of substances of the II group exceeds the permissible limits for drinking water
4	High	Wells are not working temporarily, discharge of water has reduced in surface water bodies, which will cause a seasonal drought and ecological impact	Hazardous substances of I group are observed
5	Very high	Wells are drying, water is not discharging in surface water bodies, there is a great risk of drought and ecological impact	Concentration of substances of the I group exceeds the permissible limits for drinking water

6.8.2 Impact Description

6.8.2.1 Construction Phase

There are no physical or legal representatives of groundwater consumers within or near the project corridor. The area is in large distance from settlements.

Underground water springs are mainly observed on the riparian slopes within the project impact zone.

During construction of HPP facilities, earth works may impact underground water quality, in particular: there are certain risks of groundwater contamination during preparation of foundations.

During preparation of foundations for the project structures, groundwater inflow can be observed. Groundwater removal from pits will be provided using pumps. In case of groundwater inflow, contamination risks are connected to oil product and other substance spill and movement of pollutants to the deeper layers.

In order to prevent groundwater contamination risks soil/ground quality protecting mitigation measures must be implemented, since these two environmental objects are closely related. Timely removal and remediation of the contaminated soil will be especially noteworthy during minimization of risks of pollutant movement to the deeper layers by atmospheric precipitation.

During arrangement of foundations for the headwork and power house, contour drainage will be required, and during construction – dewatering should be carried out.

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[5] Groundwater quality is not regulated by the law of Georgia. Therefore, drinking water standard is used for the assessment

[6] EU Directive 80/68/EEC, December 17, 1979, "Protection of groundwater from contamination by certain hazardous substances"

6.8.2.2 Operation Phase

During HPP operation phase significant reduction of Bakhvistskali river water flow is expected within some sections of rivers (from headwork to powerhouse). This may result in limitation of feeding areas of the ground water horizons that are in hydraulic connection with the river. However, it should be noted that the river has V-shape valley within the project section, slopes in most cases are inclined. Accordingly, Bakhvistskali river role is not significant in feeding of the groundwater. The debit of lateral tributaries that may have more significant role in standing level of the groundwater within the relatively less inclined shoreline, will be preserved in natural condition. Besides, mandatory environmental flow, planned to be released downstream of the headworks, will partly reduce the impact on groundwater.

Small impoundment is considered upstream of the headworks. Considering morphometric parameters of the valley on mentioned section, the impoundment area will not exceed the narrow riverbed-side line. Flooding of areas due to impoundment is not expected.

Groundwater contamination risks during the operation phase will be lower compared with the construction phase. Impact area is generally restricted to areas adjacent to warehouses of the powerhouse. The source of pollution can be accidental spill of oil products (oils) used on the site. According to the project, closed containers will be used for oil storage, and transformers will be placed on oil-collecting tanks that will minimize risks of spilled oil distribution on the area.

6.8.3 Mitigation Measures

In order to reduce the probability of groundwater pollution it is necessary to implement the measures related to the protection of soil/ground and surface water quality, namely:

- Ensure technical functionality of machinery/equipment;
- In case of identification of fuel leakage, malfunctioning will be promptly solved;
- Arrangement of cesspools for collection of sanitary-fecal water;
- Localization of spilled material and immediate cleaning of the damaged area. Personnel will be equipped with corresponding means (absorbents, shovels, etc);
- After completion of works all potentially pollutant material will be removed. In case of fuel/lubricant spillage contaminated site will be localized/cleaned;

On operation phase, the major mitigation measure for reducing this impact on ground water debit is the release of environmental flow downstream of headwork and establishment of systematic control over this process.

6.8.4 Impact Assessment

Table 6.8.4.1. Summary of impact on underground/groundwater

Description of impact and its sources	Impact receptors	Residual Impact Assessment					
		Nature	Probability of occurrence	Influence area	Duration	Reversibility	Residual impact
Construction phase:							
• Change of groundwater flow during arrangement of the construction pits for HPP structures and other earthworks; • Impact on groundwater standing levels.	Surface water with hydraulic connection; vegetation cover.	Direct Negative	Low risk	Area selected for the arrangement of the project structures.	Short-term	Reversible	**Very Low** or not expected
Deterioration of groundwater quality • As a result of earth works; • As a result of pollutants movement into the deep layers of soil, or contamination of surface waters;	Surface water with hydraulic connection; vegetation cover.	Mostly indirect, in some cases direct, negative	Low risk	Construction camp and construction sites,	Short- or mid-term	Reversible	**Medium,** considering mitigation measures – **low**
Operation Phase:							
Impact on groundwater standing levels.	Surface water with hydraulic connection; vegetation cover.	Indirect Negative	Low risk	Project section of Bakhvistskali river	Long term	Irreversible	**Low**
Deterioration of groundwater quality • As a result of pollutants movement into the deep layers of soil, or contamination of surface waters;	Surface water with hydraulic connection; vegetation cover.	Mostly indirect, in some cases direct, negative	Low risk	Mostly powerhouse location area	Mid-term	Reversible	**Very Low**

6.9 Impact on Biological Environment

6.9.1 Impact Assessment Methodology

For the assessment of the impact on biological environment qualitative criteria is introduced for the following categories:

- Integrity of the habitat, where the possible loss or fragmentation of habitats, the impact on natural corridors are estimated;
- Loss of species. Impact on species behavior, where the assessment is implemented on changes in their behavior that are caused due to the physical changes, including visual impact, noise and atmospheric emissions;
- Impact on protected areas.

Criteria established for assessment of impacts on ecological systems is provided in Table 6.9.1.1.

Table 6.9.1.1. Assessment Criteria for impact on biological environment

Category	Impact on habitat integrity	Loss of species. Impact on species behavior	Impact on protected habitats
Very low	Negligible impact on the integrity of the habitat. After the completion of recultivation works, recovery of the habitat in a short period of time (<1 year).	Changes in behavior are unnoticeable; death of not valuable species of small mammals/fish is expected; there is no risk of spreading invasive species.	No impact is observed throughout the areas protected by national legislation or international conventions.
Low	Noticeable impact on the integrity of low-value habitat, including loss of less valuable habitat of 10-20 ha of land. After the completion of recultivation works, recovery of the habitat in two years.	Changes in behavior may be revealed by standard methods; death of unit specimens of not valuable species of small mammals / fish is expected; there is no risk of spreading invasive species.	A temporary, short-term, minor impact is expected throughout the areas protected by national legislation or international conventions, which will not cause a long-term violation of ecological integrity.
Medium	Significant impact on the integrity of locally valuable habitat, its reduction, reduction of valuable habitats, or less valuable 20 - 50 ha of terrestrial habitat loss. After the completion of recultivation works, recovery of the habitat in 2-5 years.	Changes in behavior of endemic and other valuable species may be revealed by standard methods; death of less valuable animal species is to be expected; appearance of invasive species is expected.	A minor impact is expected throughout the areas protected by national legislation or international conventions, though ecosystem will be restored within 3 years.
High	Reduction of locally valuable habitats, or less valuable 50-100 ha of terrestrial habitat loss. After the completion of recultivation works, recovery of the habitat in 5-10 years.	Changes in behavior of protected species may be revealed by standard methods. The death and reduction of protected and valuable animal species is expected; Spread of invasive species.	Impact is expected throughout the areas protected by national legislation or international conventions. Mitigation measures are to be implemented in order to restore the ecosystem. It will need 5 years to be restored.
Very high	Reduction of locally valuable habitats, or less valuable more than 100 ha of habitats loss. After the completion of recultivation works, recovery of the habitat in more than 10 years.	Changes in behavior of an internationally protected species may be revealed by standard methods. Protected or valuable species of animals die and there is a probability of extinction. Spread of invasive species.	There is an impact on the areas protected by national legislation or international conventions.

6.9.2 Impact on Flora

6.9.2.1 Construction Phase

The project implementation is planned in Bakhvistskali river valley, on State Forest Fund area. According to taxation results, carried out within the corridor, the area of the State Forest Fund, got under the project impact is about 22 ha. Lo-threshold weir is planned at the headwork and accordingly, the reservoir will not be arranged upstream. Besides, significant part of the construction infrastructure will be located outside the State Forest Fund areas, which reduces the number of cutting trees and plants to some extent.

According to the detailed survey results within the project corridor, there are no red-listed species of Georgia represented directly within the project corridor. One red-listed species of Georgia is observed outside the project corridor, on adjacent area, namely: Sweet chestnut *(Castanea sativa).*

As it is given in the present report, based on preliminary taxation of timber resources, number of trees and plants to be cut is 3 526 stands, and the volume of timber resources is 6062.27 m^3. Including: beech 2638, spruce 472 and alder 416 stands.

The total area got within the project impact zone is 39.05 ha, from which 9.09 ha area will be subject to permanent loss, and about 29.96 ha area will get under the temporary impact (which will be restored after completion of the construction). Forestation program is planned for compensation of the damage to habitat. Corresponding ligneous plant species will be planted on at least 20 ha area, in order to achieve net growth for the project-related permanent loss of 9.09 ha habitat.

Destruction of vegetation cover, as an important part of the local ecosystem, and arrangement of construction sites will have a significant impact on the integrity of the habitat. In relation with the access road construction, the habitats will be fragmented, which will limit the free movement of animals. This factor will intervene with reproduction, feeding and livelihood habits of species. Habitat fragmentation may have an impact firstly on rodents, amphibians and reptiles.

Engineering works and preparatory activities are main impact causing factor on habitats. These activities consider vegetation removal on the target areas, tree felling, rooting out the understory and removal of herbaceous cover. Considering the specificity of implementing works, expected impacts on habitats can be divided into the following types:

- Habitats destruction (permanent loss);
- Change of habitats structure and fragmentation;
- Spread of weeds in habitats;

Each type of impact is evaluated below.

<u>Destruction of habitats</u> - as a result of the construction works, on the preparatory phase habitats will be permanently lost on those territories, where arrangement of foundations of permanent structures (headwork, power house, pipeline, access roads) is planned. As it was mentioned in characterization of the baseline environment, HPP infrastructural facilities will be constructed in 5 types of habitats (and in SLR survey, number of habitats increased up to 14. This number includes above-mentioned 5 habitats. It is noteworthy that Gamma Consulting LTD assessed habitats directly within the project corridor, and in SLR survey – habitats in more extended area). None of them belongs to the high conservation value habitat category. All habitats within the project impact zone belong to medium sensitivity habitat.

Taking into account above-mentioned and according to the environmental impact assessment criteria, given in Table 6.9.1.1. of EIA report, the impact due to habitat loss will not exceed the average value and the impact caused by habitat loss will be reduced even more.

<u>Change of Habitat Structure and Fragmentation</u> – in addition to habitat loss, change of habitat is expected on some sites. Such impact is expected on areas of the project corridor, where permanent loss of habitat will not take place, however, some impact on vegetation cover is necessary. Such sites are: spoil ground

sites and sections of the corridor, where slope cut or slope reinforcement will be required. Change of habitat structure and impact caused by habitat fragmentation will be related to all habitat types, represented within the corridor.

After completion of the construction works, landscape, presented here, can be restored in 2-5 years by implementation of corresponding reinstatement works. This is proved by the existing situation within Bakhvi 3 HPP project impact zone, where almost all cut slope and adjacent areas are covered by young trees and vegetation.

Habitat fragmentation risks are subject to discussion – fragmentation of wide habitat sections in relatively smaller ones in the result of arrangement of road network or vegetation removal on construction sites. Fragmentation causes reduction of plant resistivity toward parasites; reduces competitiveness of species, existing at the edges of the forest, which easily force species typical to various forest formations out of natural habitats and increase natural hazard. The likelihood of such impact will be relatively high at headwork site and within the access road corridors.

Spread of weeds – implementation of various works and removal of local plant species in different habitats pose the risk of intrusion of invasive and adventive species in the habitats. Intrusion of invasive species will transform a habitat's structure and certainly impact on its ecological processes. In its turn, change of a habitat's floristic component will negatively affect its faunal components as well.

6.9.2.2 Operation Phase

The HPP operation less requires rooting out-cutting of vegetation. Such small-scale works will be conducted only for repair-maintenance works, when the RoWs of the HPP facilities will be recurrently cleaned for the purpose of their safe functioning.

As it was mentioned above, arrangement of the underground penstock is considered by the project that will significantly reduce the impact caused by habitat fragmentation and less hamper movement of terrestrial animals.

On this stage of the activity, in appropriate environmental management conditions (adhering to boundaries of the corridors of the HPP infrastructural facilities, providing geological stability of the adjacent slopes) risks of additional, indirect impact on the vegetation cover will be significantly reduced and at the same time, partial restoration of such significant components, as well as compensation of damage occurred on the construction phase is expected.

6.9.2.3 Mitigation Measures

Mitigation measures against impact on vegetation cover and habitats integrity on the construction phase are as follows:

- Any activity, planned on the areas under the management of State Forest Fund, will be agreed with the Agency, authorized for management of the State Forest Fund;
- Personnel will be instructed on the issues of protection of vegetation cover prior to the works are launched;
- Vegetation resource removal works will be carried out so that to reduce number of cutting trees and shrubs at minimum;
- Boundaries of the working zone should be adhered, in order to avoid additional (excessive) damage of vegetation cover. Working boundaries should be marked in advance;
- Transport road network for HPP construction and further service will be planned so that to avoid crossing of large forest sites and forest fragmentation; the fact that the forestry road passes within the construction corridor will also help the construction organization to achieve this goal;

- Cutting of trees and plants will be carried out under supervision of authorized service specialists;
- To compensate damage of vegetation cover, trees and vegetation will be planted on 20 ha area under agreement with LEPL National Forestry Agency. Local species will be used for the landscaping works;
- Period of earth works (arrangement of foundations) will be limited at maximum and excavated pits will be filled in short terms as far as possible;
- In order to reduce the risk of habitat fragmentation, especially, in frames of the linear construction corridors, artificial overpasses will be arranged as far as possible (wooden boards will be put on the penstock trenches especially, at night);
- After completion of the construction works recultivation of the temporarily used areas will be carried out that will significantly reduce the impact related to the habitat fragmentation;
- Safety measures will be adhered to prevent fires;

Mitigation measures for impact on vegetation cover and habitat integrity on operation phase are as follows:

- Implementation of mitigation measures developed for construction phase during large scale repair and maintenance works;
- Promotion of growing-development of artificially planted trees and vegetation;
- Strict control by the personnel for elimination of illegal cuts and for adhering of the boundaries of the HPP corridor.

6.9.3 Impact on Fauna

6.9.3.1 Construction Phase

Within the section of Bakhvistskali river basin, which covers the project area, considering the existing habitat types and state, it can be stated that fauna is relatively diverse. The fauna is mainly represented by common, widely distributed and numerous species, as well as by species protected under the Red List of Georgia. Accordingly, the negative impact on them and other fauna species may take place on some stage of the construction and on operation phase.

For conservation of biological diversity of fauna, following sections of Bakhvistskali river are deemed to be the especially sensitive sites: headwork location site, penstock site, powerhouse construction site and access road sections to them. Certain amount of trees and plants and shrubs (including those, which are used as shelters during reproduction by bats, Caucasian squirrel (*Sciurus anomalus)* and the boreal owl *(Aegolius funereus))* will be removed on above-mentioned areas.

During the field works, there were signs of vital activity of red-listed species and species protected under international treaties within the project corridor, such as brown bear *(Ursus arctos)* and otter *(Lutra lutra).* It is highly likely that Caucasian squirrel ***(Sciurus anomalus)*** live on this area.

The project HPP corridor is not typical habitat of the inhabiting area of the bear. However, it is favorable area for finding the food and this is proved by population, according to which, the bear was observed several times on areas, adjacent to Bakhvi-3 HPP headwork and diversion system.

Habitat fragmentation due to HPP construction will have minor impact on the conservation status of Caucasian squirrel *(Sciurus anomalus)*. During construction, the Caucasian squirrel will get under the impact of local disturbance factors. On the other hand, this species can easily move and find a new habitat. Besides, it is well adapted to the presence of humans. Sometimes, it can be observed in settlements, freely eating and even stealing the food from waste bins. The project impact on this species will not be significant.

The project area, considering its specificity (riverbed-side, low section of the valley, where quite dense vegetation is represented and accordingly, the area is restricted for flying through with high speed) is less attractive for large bird of prey. During field surveys, no signs (moreover habitats) of red-listed species of Georgia were observed.

During arrangement of access road and pipeline corridors, in addition to the protected species, the impact is expected on those species, which during reproduction period are present within the construction corridor and which reproduce (amphibians, reptiles and small mammals) in existing shelters (hollows, holes, stone piles, water streams, etc.).

Bats are expected to be also sensitive toward the impact, expected in the result of the project implementation.

On construction phase, vibration distribution will take place, which will have the negative impact on animal species on the adjacent areas. Accordingly, during the work implementation it will be necessary to carry out effective mitigation measures and regular monitoring.

Considering aforementioned and the specificity of planned activities, following directions of negative impacts on animal species, distributed within the construction zone should be singled out:

- Nesting areas of certain species may be destructed due to tree felling and earth works. Main receptors can be small birds, bats, which may inhabit in hollow trees;
- Destruction of vegetation cover will have a negative impact on feeding base of animals and their reproduction;
- Cleanup of grass cover on the territory may also limit habitat of various species of amphibians and reptiles;
- Due to increased traffic, existence of humans and change in lighting background disturbance factors will increase for terrestrial mammals, amphibians, birds and bats inhabiting road-side territories and territories in vicinity of project areas. This may have a direct impact on existence of animal population, for instance impact on reproduction (nesting) areas during reproduction season, hunting and wintering areas, migration routes and resting points. Caucasian squirrel and other less valuable animals may be relatively more sensitive toward the impact;
- Construction will be related with increase of noise and vibration, as well as emissions of dust and other harmful substances into ambient air. Almost all species, inhabiting within the corridor will be impacted;
- Trenches arranged as part of earth works will pose some risks to small mammals: they may fall into the ditches which may lead to their injury or death.
- Animal mortality or migration can be also caused by waste, if any in environment, and visual-landscape changes;
- In case of pollutants spill into water or on the soil, populations of fish, amphibians, otter population will be affected, as well as animal inhabiting areas where spill takes place or in immediate vicinity;
- Facts of illegal hunting by personnel may be detected.

Performance of measures, developed for minimization of the impact on animals during construction works will be controlled on especially sensitive sites.

Overall, impact on wildlife during the construction phase may be assessed as medium impact. In case of appropriate implementation of mitigation measures and constant monitoring of impact on terrestrial fauna may be reduced to low level.

6.9.3.2 Operation Phase

Sharp reduction of water level in the river and reduction of forest cover can be deemed as the main sources of negative impact on wildlife during HPP operation. Above-listed species subject to special protection, can be the main impact receptors, part of which will have to migrate to other, analogous ecosystems in the region.

On operation phase, decrease of river runoff can be deemed as the main reason of otter impact. In this regard it is essential to properly implement mitigation measures for the impact on river hydrology and fish fauna.

As for other Red List Species of Georgia, significant impact on them is not expected, as there are many similar habitats and shelters for them within the project implementation region. After completion of construction works and suspension of disturbance sources, many species will return to the significant inhabiting and vital areas. Small impoundment on this section may have even positive impact on populations of otter and other water-related species. On operation phase, the degree of anthropogenic load and disturbance factor (noise, intensive human activities) on mentioned facility of HPP will be insignificant, as automatic control of the headwork is planned.

Shelters of reptiles and bats will be destructed to some extent. Considering above-mentioned the main direction of mitigation measures will be minimization of such risks. In this regard, proper recultivation of temporarily used areas will be highlighted.

Other than that, possible negative impacts on wildlife expected during operation phase of the project include:

- Impact related to noise propagation;
- Impact related to night lighting systems;
- In case of water quality deterioration, impact on water-related animals.

Negative impacts on fish fauna during operation phase should be noted, which is discussed in the following chapter.

6.9.3.3 Mitigation Measures

Following mitigation measures should be carried out on the construction phase to prevent impact on terrestrial animals:

- According to monitoring plan, during planned biological environment survey, determination of impact on animal species living within the project corridors will be focused and if required, additional mitigation measures will be developed;
- During monitoring, in case of identification of species protected under the Red List of Georgia or international conventions (esp. Bern Convention) within the project corridor, this will be notified to the Ministry of Environmental Protection and Agriculture of Georgia and corresponding mitigation measures will be carried out.
- Prior to the construction works access roads, river crossings (esp. headwork location) will be examined in order to identify bird nests, holes and trails of predatory mammals;
- Trees and plants will be removed from the environment on some areas within the project site, including trees that may be used as shelters during breeding by bats and boreal owl, as well as squirrel. Prior to the construction, all cutting trees, the diameter of which will exceed 40 cm, will be thoroughly observed. In case of identification of animal shelter, written notification will be sent to the Ministry of Environment Protection and Agriculture of Georgia and further actions will be taken in compliance with the Law of Georgia on Red List and Red Book, as well as Law on Wildlife. In particular, every activity that may lead to reduction of numbers of endangered animals and deterioration of their living and existing conditions will be suspended (except for special circumstances). Therefore:
    - Identified sensitive areas will be marked (mapped);
    - Situation will be explained to the personnel and any activity threatening living environment of species will be prohibited (approaching holes/hollows, hunting, etc.);
    - Any activity to be carried out within construction works will be conducted as far from the marked territories as possible;

  - Transport movement will be limited near the sensitive areas, speeds will be reduced, bypass roads will be used, where possible
  - In special cases, project implementer shall address the Ministry of Environment Protection and Agriculture in written form and shall carry out further activities basing on instructions provided by the Ministry;
- Personnel employed for the construction will be trained and warned in a proper way on corresponding sanctions, determined for damage to animals;
- Border of the construction corridor will be adhered in order to ensure that earth works do not exceed the marked territories and to avoid additional damage to holes, bird nests and bat shelters. Earth works should be controlled by appropriately qualified personnel;
- Traffic route will be adhered;
- Limited speed of traffic in order to reduce direct impact on animal species (collision);
- Pits, trenches and other must be protected to prevent fall of animals.
- Works, causing excessive animal disturbance will be carried out in the shortest possible time;
- Recultivation of territories adjacent to HPP communications and access roads after the completion of construction works, which will significantly reduce the habitat fragmentation impact.
- In order to prevent poaching, personnel, employed for the construction, will be instructed and corresponding warning will be provided in compliance with the Ministerial Order №95 (27.12.2013) on hunting rules and Technical Regulation – "Fishing and protection of fish stock", approved by the ministerial order №423 of the Government of Georgia.

Additionally, following will be highlighted:

- Proper waste management;
- Mitigation measures for water, soil and air pollution, noise distribution and etc. will be implemented (see relevant chapters).

On operation phase:

- Mandatory environmental flow will be released in tailrace of the headworks;;
- Awareness of staff on illegal hunting/fishing will be raised and monitoring will be established;
- Optimization of night illumination;

6.9.4 Impact on Fish Fauna

6.9.4.1 Construction Phase

According to the results of fish fauna field surveys, there is one fish species within Bakhvi 1 HPP project impact zone – brook trout *(Salmo trutta fario Linnaes, 1758).*
Bakhvistskali riverbed is characterized with high inclination within the project section. Various size boulders in the riverbed form rapids, currents, ponds and waterfalls in the project section. The fact that only brook trout can be observed within the project section is stipulated by the presence of waterfalls in the riverbed. Brook trout can overpass 1,3 – 1,5 m barrier, which is impossible for other fish species.

In the result of examination of fish fauna food base, large number of zoo-benthic organisms was not observed on the project section. This is explained by riverbed scouring in the result of flooding. Reduction of number of invertebrates is temporary. Besides, it should be mentioned that species composition of zoo-benthic organisms is diverse.

Following invertebrates are represented within the HPP project section: Mayflies (order - Ephemeropteroidea Rohdendorf, 1968), stoneflies (order - Plecoptera Burmeister, 1839), Caddisflies (order - Trichoptera Kirby, 1813), larva of insects (order - Diptera; family - Chironomidae);

The ecological environment is optimal for fish fauna on Bakhvi 1 HPP project section. In particular, river water quality is compliant with general habitat standards characteristic to brook trout; food base is diverse and ecological environment creates conditions needed for living and natural reproduction of inhabitant fish;

On construction phase possible impact on fish fauna can be of various types, namely:

- Water level gradual reduction on separate river sections;
- Water contamination; River disturbance, change of turbulence;
- Noise;

Water level gradual reduction on separate sites of the river: During construction of headwork, it will be necessary to divert the river flow to another bank. Accordingly, water level will be gradually changed on some areas of the natural riverbed. In this regard, extremally adverse impact on fish is not expected, however, micro- and macro-invertebrates living here will be subject to significant impact. It should be noted that due to small parameters of the headwork, impact will not spread on large river section and accordingly, the construction works will not have significant impact on fish fauna.

Water contamination: In case of fuel leakage from equipment, operating near the river, water quality and accordingly living conditions of fish may be deteriorated. Earth works may cause getting large amount of ground into the water, leading to its turbulence; the scale of the turbulence will be depended on flow speed and grain size composition of soil. Soil settled in the water will cover stones, which are significant substrata for reproduction of lithophylic fish species.

As it was mentioned, construction works will be carried out in dry riverbed and accordingly, the risk of river water contamination is at minimum. Works of arrangement of cofferdam in the riverbed and water diversion to another bank will be carried out in the short period of time and accordingly, high impact risk on fish fauna is not expected.

Noise: Usage of heavy machinery (loaders, excavators, rock drilling equipment) will cause significant noise, which negatively impact natural life of fish;

In general, it can be stated that the risk of impact on fish fauna during construction of headwork will not be high.

6.9.4.2 Operation Phase

In the HPP operation phase the negative impact on fish fauna can be expressed in the following directions

- If the environmental flow is not ensured, significant negative impact is expected on habitats of water inhabitants;
- Improperly arranged headwork, which is not equipped with effective fish pass, will impede free movement of fish from downstream to upstream;
- In the operation phase there is a minor risk of getting the fish into intake and injury (the risk is controlled using fish excluder);
- The risk of impact on fish fauna due to the deterioration of river water quality is still expected although with low likelihood (mainly the risk of oil spill into the river, during emergency situations);

Potential Impact Caused by River Blockage and River Flow Regime Changes: Bakhvi 1 HPP is run-of-river type HPP. Its operation will not cause artificial distribution of river runoff in time.

It is noteworthy that some project solutions can significantly reduce the impact on fish fauna, caused by changes in the natural regime of the river due to HPP operation; namely: on the one hand, continuous passage of established environmental flow downstream of headwork will be ensured; flows of the small tributaries on the project section will be added to it.

On the other hand, arrangement of a fish passage is considered at the headwork; the design of the fish pass has been selected so that to achieve maximum effect. This will ensure conditions similar to natural conditions for fish migration.

Risks Related to Fish Occurrence in the Intake and Fish Damage/Death: According to the environmental legislation of Georgia, installation of fish protective devices is essential on water intakes of all hydraulic structures. This measure reduces risks of fish entrance into the water inlet of turbine (including protected species), as well as, risks of their death and damage. In order to minimize such impact, the project envisages arrangement of fish excluder, namely: the intake will be equipped with fine screens (diameter of the opening will be 15 mm) and with fish excluder operating on airlift principle.

Water Quality Deterioration and Possible Impact: As it was mentioned above, water quality deterioration is less expected in the operation phase. Such risks can be connected with negligence of service personnel and malfunction of technological equipment.

Taking into consideration aforementioned, on operation phase the impact on fish fauna and accordingly, the expected damage can be assessed as "high". In order to reduce the impact, it is necessary to carry out effective mitigation measures, which will reduce the impact to the degree, lower than moderate.

6.9.4.3 Mitigation Measures

Tangible effective mitigation measures for minimization of impact on fish fauna are as follows:

Construction Phase:

- Relevant measures will be taken during construction works of the headwork, in order to prevent wide spreading of river stream (accordingly water depth reduction) and/or creation of small ponds separately from common stream. Temporary gabions/river sediment will be effectively used for this purpose so that to create single channel deep riverbed;
- Water flow diversion from natural riverbed to artificial riverbed will be provided as long as possible to avoid sudden effect, in order to enable fish adaptation to the new environment;
- Junctions of artificial and natural riverbeds will be arranged so that to avoid creation of artificial barriers for fish migration;
- On headwork construction sites riverbed will be regularly cleaned from wood waste;
- Banks and slopes will be strengthened against negative events (soil getting into water, landslide, mudflow, etc.). All works will be implemented in riverbed with special cautiousness in order to avoid river turbulence;
- While working near the river all measures against noise propagation will be carried out;
  All measures will be taken in order to maintain water quality.

Operation Phase:

- Liquid flow management will be effectively provided. Established environmental flow will be permanently released downstream of headwork;
- According to the project fish pass structure will be arranged at headwork in compliance with international standards. Technical functionality of fish pass will be regularly monitored and wood waste will be removed, which is especially important during spawning and migration periods of fish;
- Technical functionality and operation of fish passage will be effectively monitored;
- In order to minimize the risk of fish damage (death), fish excluders will be arranged on water intake (described below);
- During the first 2years of operation, species of fish fauna will be monitored in order to implement additional mitigation measures if required;

- Within ichthyologic monitoring, the state of the riverbed within the project area will be focused. Monitoring mainly considers checking stream integrity in the environmental flow conditions. If required, at critical points, riverbed management measures will be provided, which considers cleaning of mentioned section from debris and removal (relocation) of boulders, only which hinder the stream integrity.

Additionally, following will be considered:

- All mitigation measures in order to avoid quality deterioration of surface waters (see relevant paragraph);
- The personnel will be instructed on issues related to prohibition of illegal fishing

In adition, following mitigation measuers were proposed by international consultation company SLR in relation with the brook trout:

Fish excluder will be used at Bakhvi 1 HPP intake in order to avoid fish occurrence in the pipe and turbine.

Fishing will be restricted within 200 m radius upstream and downstream of Bakhvi 1 HPP intake.

Consideration of the issue of natural fishway arrangement at Bakhvi 1 HPP intake, instead of fish ladder, if it is possible technically.

Installation of video camera (CCTV) at Bakhvi 1 HPP intake for provision of monitoring. This can be used against illegal fishing;

Within the project framework, management of the riverbed section between Bakhvi 1 HPP intake and the powerhouse should be considered. The mentioned program implementation will support restoration of natural ecological integrity of the river that will have a positive impact on fish population.

Additional information on the given issue is available in Annex 8: Biodiversity Management Plan (SLR).

6.9.5 Impact on Protected Areas

At present, there are no protected areas presented in the region of Bakhvi 1 HPP project implementation. The nearest protected area is Kintrishi National Park (Emerald Network Designated Site Kintrishi - GE0000014) is in about 16 km from the project area (see Figure 6.9.5.1.) and accordingly, there is actually no risk of impact on the biological environment of the protected area.

It is noteworthy that in Guria region new national park arrangement is planned. National park project is implemented by the Ministry of Environmental Protection and Agriculture of Georgia, and the site designated for national park is studied by World Wide Fund for Nature (WWF). The project is implemented by financial support of the financed by Swedish Embassy and participation of the local government.

The project aims at protection of forests existing in Guria, stopping anthropogenic impact, biodiversity conservation and preservation of ecosystem. The project implementation will support improvement of touristic potential of the region. Accordingly, employment of local population and improvement of economic conditions.

National park project activities are launched and at the given stage, baseline study and consultations are carried out. Based on preliminary assumptions, Bakhvi 1 HPP project corridor will get within the borders of the planned national park, however, this fact needs to be verified whenever the borders, proposed for the national park are known.

According to Bakhvi 1 HPP project, about 4300 m long section of Bakhvistskali river will get within the impact zone, where run-of-river diversion-type HPP will be located. A small impoundment will be created upstream the headwork (0.24 ha) and accordingly, only areas directly under HPP facilities will be lost. Considering above-mentioned, taking into account the area of the protected territory, only insignificant part will be lost.

According to the detailed survey results conducted within the project impact zone (survey is carried out by local and international experts), there are no critical habitats identified within the project impact zone. Besides, according to the preliminary taxation of timber resources within the project corridor, no red-listed species will be impacted.

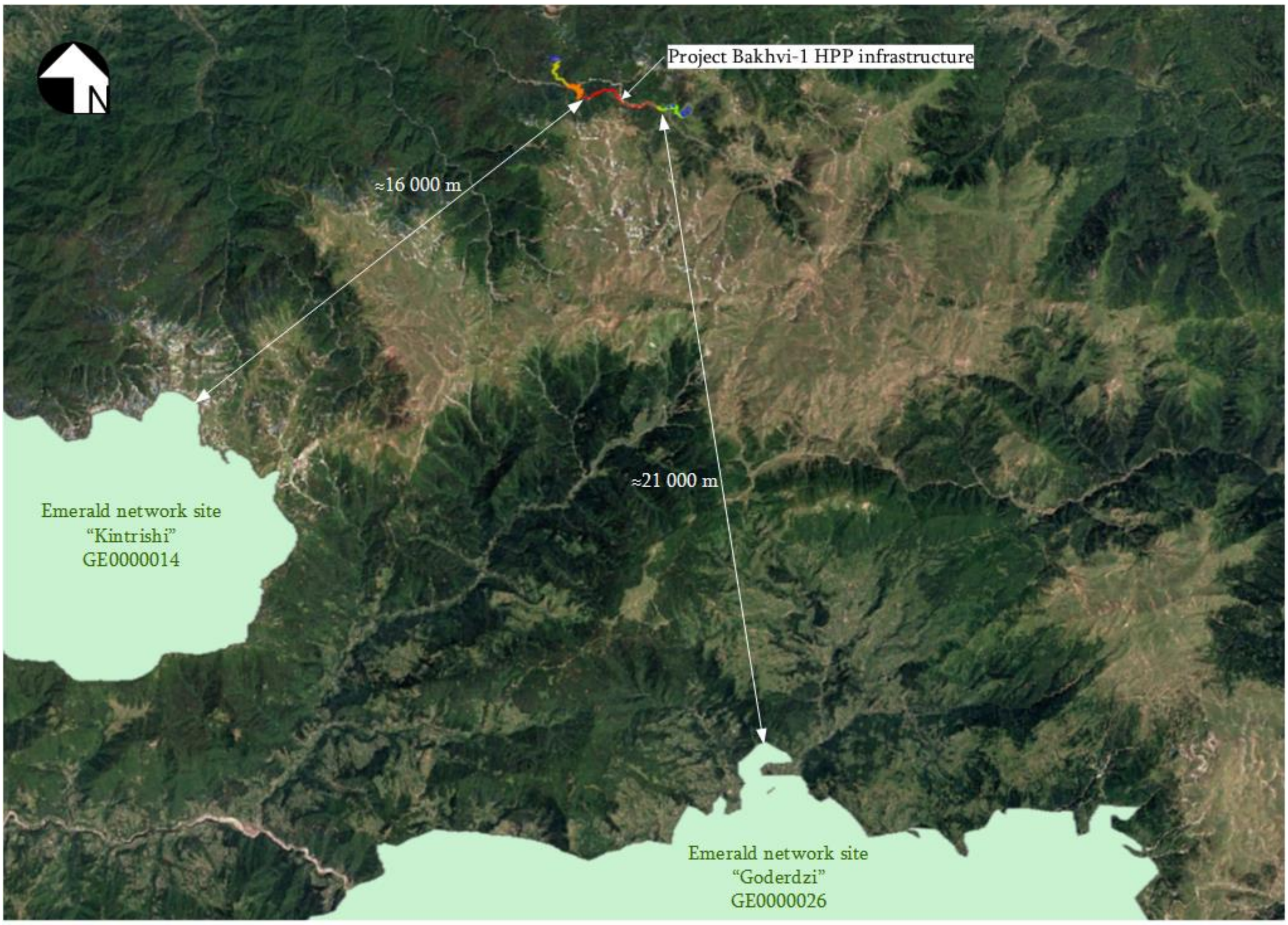
The project area is not a critical habitat for any of animal species, living within the project implementation area. The survey did not reveal any species, which distribution limit area is less than 50 000 km2, however, species, distributed only in Caucasus were identified (assessed area 170 000 km2). It is supposed that distribution limit area of all species identified during field surveys and theoretical study, except Caucasian salamander, exceeds 50 000 km2. Considering the behavior of Caucasian salamander, high risk of impact is not expected, as small tributaries of Bakhvistskali river are habitats for this species, which will not be impacted during construction and operation phases. Moreover, the project implementing company plans to carry out corresponding measures to facilitate to the increase of habitat for Caucasian salamander.

The impact on terrestrial fauna species is mainly expected on construction phase, which will be related to noise and vibration distribution in the valley due to operation of equipment. Temporary loss of animal habitats will take place within the project corridor. Due to this, animal species will migrate from the project area, but the impact will be temporary. After completion of works, species will return to old habitats (which is expected also after completion of Bakhvi 3 HPP construction). On operation phase, risks of negative impact on wildlife are significantly lower, except on aquatic biological environment, namely: river water reduction will have certain negative impact on brook trout population, inhabiting within the project section of the river. In order to reduce the impact, the project envisages arrangement of fish way and fish excluder, and downstream the headwork, passage of minimum environmental flow – 0.29 m^3/s will be ensured; flow (0.308 m^3/s) of tributaries within the project section will be added to it. Considering the fact that established environmental flow is identical to 30-day flow of Bakhvistskali river, the high risk of impact on fish fauna is not expected.

Considering aforementioned and mitigation measures provided in the given report, high risks of negative impact on biological environment of Bakhvistskali river within the project area are not expected and the impact can be minimized through planned mitigation and compensation measures.

Thus, implementation of Bakhvi 1 HPP project should not be discussed as the factor, hindering development of Guria National Park Project. "C-C-E-H Hydro VI" LLC is going to actively cooperate with the Ministry of Environmental Protection and Agriculture of Georgia and WWF; all recommendations will be adhered to, which will be established during development of National Park Management Plan. It should be noted that similar cooperation is a proven approach in Europe. In particular, the cooperation of protected areas and the business sector, which contributes to the implementation of the protected area management plan and increase the benefits for the population of a particular region.

Figure 6.9.5.1. Colocation scheme of the project area and the nearest protected area



6.9.6 Impact Assessment

Table 6.9.6.1. Summary of Impact on Biological Environment

Description of impact and its sources	Impact receptors	Residual Impact Assessment					
		Nature	Probability of occurrence	Influence area	Duration	Reversibility	Residual impact
Construction Phase:							
Damage/Destruction of the Vegetation; Habitat loss/fragmentation: • Direct impact: o Tree felling; o Construction of infrastructure and access roads. • Indirect impact: o Water pollution; o Soil pollution and erosion.	Wildlife, population	Direct and indirect Negative	High risk	• Direct impact area – construction sites and penstock corridor; • Indirect impact area – areas adjacent to work sites	Medium term. In some directions - long-term	Reversible in some cases – irreversible (area under the project facilities)	**Medium or high** - Considering compensation measures - **low**
Impact on terrestrial fauna, including: • Direct Impact: o Direct impact on humans or equipment; o Change of illumination background at night; o Vehicle collision, falling into trenches; o Illegal hunting. • Indirect impact: o Cutting down the vegetation in order to arrange the infrastructure; o Pollution of air; o Acoustic background change; o Possible pollution of surface and ground water; o Soil pollution and erosion; o Visual Impact.	Animal species inhabiting within the project area	Direct and indirect Negative	High risk	Areas adjacent to the camps and work sites, especially while working in the vicinity of riverbed	Duration is limited with the construction phase	Mainly reversible	**Medium or high** - Considering mitigation measures - **low**
Impact on Fish Fauna	Aquatic biological environment of Bakhvistskali river	Mainly indirect, negative	Low or medium risk	The section of the river near the construction sites/camp	Duration is limited with the construction phase	Reversible	**Medium** - Considering mitigation measures - **low**

Operation Phase:							
Damage/Destruction of the Vegetation; Habitat loss/fragmentation	Wildlife, population	Direct Negative	Medium risk	The area of impact is mainly limited within the repair sites for powerhouse	Long term	Reversible	**Low**
Impact on terrestrial fauna, including: • Water debit reduction within the project section; • Illegal hunting; • Soil contamination and erosion; • Visual impact; • Reduced forest cover.	Animal species inhabiting within the HPP communication area	Direct and indirect Negative	High risk	Areas adjacent to the HPP communications	Long term	Mainly reversible	**Medium, low**
Impact on fish fauna • Direct impact sources: o Change of hydrological regime of the river; o Existence of headworks; o Illegal fishing; o Implemented maintenance works. • Indirect impact sources: o Surface water pollution; o Contamination of bottom sediments.	Aquatic biodiversity of Bakhvistskali river	Direct and indirect Negative	• Direct impact – high risk; • Indirect impact – low risk	Bakhvistskali River	Long term	Mainly reversible	**Medium, low**

6.10 Impact Caused by Waste Management

6.10.1 Construction Phase

Under the requirements of "Waste Management Code", article 14, paragraph 1, "Those individuals and legal entities that produce more than 200 tons of non-hazardous waste a year or more than 1000 tons of inert materials or more than 120 kg of hazardous waste, are obliged to develop waste management plan of the company". Waste Management Plan is updated at least every 3 years or in case of significant changes in types and amounts of waste and the processing.

Since non-hazardous and inert waste, as well as hazardous waste is expected to be generated due to the planned activities, waste management plan has been developed for Bakhvi 1 HPP construction and operation phases and is presented in Annex 12.

Violation of rules of waste management may cause number of negative impacts on various environmental receptors, for example:

- Incorrect management of waste (dumping into water, scattering on the site) may lead to water and soil pollution, as well as to deteriorated sanitary conditions and adverse visual changes, negative impact on the health and security of population, etc.;
- Improper disposal of construction waste and waste rock may cause blockage of the roads and may lead to erosion processes, resulting in various indirect impacts, etc.

6.10.2 Construction Phase

On operation phase, insignificant amount of waste is expected to be generated ; waste generation will mainly be related to HPP operation and occasional rehabilitation works.

6.10.3 Mitigation Measures

Measures considered in the waste management plan will be implemented during HPP construction and operation phases, including:

- Spoil grounds will be allocated for disposal of waste rocks. Waste rock will be disposed according to special rules; prior to the use of the spoil ground, a detailed project will be agreed with the Ministry;
- Labeled hermetic containers should be arranged in corresponding places for collection of hazardous waste;
- Special storage facility should be arranged for temporary disposal of hazardous waste:
- Storage facility will be marked and will be protected from the impact of atmospheric precipitation and unauthorized encroachments;
- The floor and walls of the storage facility will have a solid cover; Storage should be equipped with wash stand and tap; Shelves and racks for waste disposal will be arranged;
- Waste will be disposed in the storage only in hermetic packaging with a relevant labeling.
- Appropriately trained personnel will be hired for waste management; they will undergo periodic training and testing.
- This personnel will keep a Register for recording of quantities and types of such waste as well as further management activities.

6.11 Visual-Landscape Impact

6.11.1 Impact Assessment Methodology

Visual-landscape impact assessment is more or less subjective. Impact area and duration, as well as the relative ecological value of the landscape are taken as evaluation criteria.

Table 6.11.1.1. Assessment criteria of visual-landscape impact

Ranging	Category	Impact on visual receptors	Duration of landscape changes and spatial boundaries / landscape quality and value
1	**Very low**	Unnoticeable change in the view	Unnoticeable change in the landscape, or landscape is not valuable
2	**Low**	Some slight change of view is observed from certain points, which is easily adaptable	Insignificant change in the landscape, or landscape restoration takes 1-2 years
3	**Medium**	The view has changed noticeably from many points of view, though it is easily adaptable	Some sites of the natural landscape have changed, or landscape restoration takes 2-5 years
4	**High**	The view has changed noticeably from most of the points, though it is easily adaptable	A large area of natural or high-value landscape has changed, or landscape restoration takes 5-10 years
5	**Very high**	The view has completely changed from every place, hardly adaptable impact on receptors is expected.	A large area of natural or high-value landscape has changed, or landscape restoration is not possible

6.11.2 Visual Change

Some visual-landscape alteration is expected on pre-construction and construction works due to the increase of traffic flows, presence of construction sites, working equipment and personnel, constructing structures, construction material and waste. While characterizing the visual affect, first of all, location of the project areas toward the impact receptors should be considered, in particular, whether there are impact sources within the eyeshot or no.

Considering the location of the area selected for arrangement of construction infrastructure for the headwork, temporary structures will not be visible from any points of resort zone, however, it will be visible from the recreation zone. It should be noted that construction infrastructure will be demobilized after construction and areas will be reinstated. Accordingly, the impact will be temporary and of low significance.

Bakhvi 1 HPP construction corridors are not located within the visual eyeshot of local population and visitors, namely: unlike the first three alternatives, the area selected for headwork is located downstream the confluence of the rivers Bakhvistskali and Baisurastskali, in about 250 m. There is a natural elevated area between the confluence and the headwork, which covers the headwork site from the eyeshot. Thus, headwork structure and other HPP communications will not be visible from any of the points of resort or recreation zone of Bakhbaro resort. Accordingly, on HPP operation phase, the impact caused by visual changes will not be significant. Visitors moving within the valley can be impact receptors, although that is unlikely to happen due to complex terrain conditions of the valley.

Impact is also expected during repair and rehabilitation works. This impact is similar to that on construction phase, but smaller. ''Significance" of the impact depends on the scale and type of works. However, considering corresponding mitigation measures, the impact will not be higher than low significance.

6.11.3 Landscape Change

In order to assess visual change expected during the project implementation, the sensitivity of the landscape within the project corridor is determined. Landscape sensitivity depends on its value and existing state.

The value of the landscape within the project area is defined according to the assessment criteria, given in the Table 6.11.3.1., and the state of the landscape is determined according to the criteria presented in Table 6.11.3.2.

Table 6.11.3.1. Assessment Criteria for Landscape Value

Value	Typical Criteria	Significance Scale	Examples
Especially valued	Rare and high significance. There is no analogous landscape or its replacement is significantly restricted	International, national significance	International or national significance, e.g.: National Park, etc.
High	Rare and high significance. Analogous type landscape is rare	National, regional and local significance,	Conservation Area
Medium	Medium significance	Regional and local significance	Areas, the specificity of which has not been officially established. However, its significance is recognized by various publications and opinions.
Low	Low significance. Its replacement is possible.	local significance	Areas having certain functions and their improvement is defined.
Poor	Low significance.	local significance	Areas subject to restoration.

Table 6.11.3.2. Criteria for assessment of the landscape state

Good	Landscape and constituent components are nearly untouched. It has the high value of naturalness.
Moderate	Landscape and constituent components are partly altered under impact of human agricultural activity. It has the medium degree of naturalness.
Low	Landscape and constituent components are very impoverished under human agricultural activity.

According to criteria provided in the Table, the landscape within Mleta HPP project corridorcan be gnabted to the landscape types with “Moderate Value” and “good state”. Accordingly, it belongs to the low sensitivity landscape type, based on the Table 6.11.3.3.

Table 6.11.3.3. Lanscape sensitivity assessment criteria

Landscape Value	**Landscape Sensitivity**		
Especially valued or high	High	High	Medium
Medium	High	Medium	Low
Low or Poor	Medium	Low	Low
	Good	***Medium***	***Low***
	Landscape State		

Considering aforementioned it can be stated that medium sensitivity landscape gets under impact. According to impact assessment criteria (see Table 6.11.1.1.) “moderate” impact is expected. In order to minimize the impact, it is necessary to carry out corresponding mitigation measures, which are provided in the next paragraph.

On operation phase there is another factor that can cause visual-landscape change; this is reduction of water yield, which will be noticeable along the whole impacted river section.

The impact is also expected during repair and rehabilitation works. This impact is identical to that on construction phase although it has smaller scales. The impact “significance” depends on the scale and type of works.

6.11.3.1 Mitigation Measures

Visual-landscape impact will be mitigated through following measures:

- Reasonable selection of colors and designs for permanent structures on construction and operation phases, so that colors are combined with nature;
- Temporary structures, materials, and waste should be disposed at less noticeable areas;
- Protection of sanitary and environmental conditions during construction and operation phases;
- Recultivation works should be implemented after the completion of construction works;
- Local species should be planted-grown on some sections after completion of construction works.

6.11.4 Impact Assessment

Table 6.11.4.1. Summary of Visual-Landscape Impact

Description of impact and its sources	Impact receptors	Residual Impact Assessment					
		Nature	Probability of occurrence	Influence area	Duration	Reversibility	Residual impact
Construction Phase:							
Visual-landscape impact: • Tree felling in working areas and corridors of access roads; • Construction camps and temporary structures; • Waste rock and other waste disposal; • Construction and transport operations.	Animals, population,	Direct Negative	Medium risk	Areas adjacent to construction camps and sites.	Medium term	Reversible	Considering corresponding mitigation measures - **Low**
Operation Phase:							
Visual-landscape impact: • Change in river debit; • HPP infrastructure; • Maintenance works.	Animal species inhabiting in the vicinity	Direct Negative. In some cases – positive	Medium risk	Areas adjacent to the HPP infrastructure (impact distribution area depends on local relief, i.e. visibility conditions)	Long term	Eventually reversible	**Low**

6.12 Impact on Socio-Economic Environment

6.12.1 Impact Assessment Methodology

Following factors should be considered while discussing the impact on socio-economic environment during the HPP construction and operation:

1. Impact on land ownership and use, limitation of resources;
2. Impact on tourism;
3. Positive and negative impacts associated with employment;
4. Input to economy;
5. Impact on transport infrastructure;
6. Health and safety risks.

Impact is assessed according to three categories - **low impact, medium impact and high impact**. Impact assessment criteria are provided in Table 6.12.1.1.

Table 6.12.1.1. Assessment criteria of the impact on socio-economic environment

Ranking	Category	Socio-economic impact
Positive		
1	Low	– Employment rate in region has increased by less than 0.1%; – Average income of the local population has increased by 10%; – Budget revenues of the region have increased by 1%; – Local infrastructure/power supply has been slightly improved, resulting in improved local population living/subsistence and economic environment.
2	Medium	– Employment rate in region has increased by 0.1%-1%; – Average income of the local population has increased by 10-50%; – Budget revenues of the region have increased by 1-5%; – Local infrastructure/power supply has been noticeably improved, resulting in significantly improved local population living subsistence and economic environment, which contributes to the economic development of the region.
3	High	– Employment rate in region has increased by 1%; – Average income of the local population has increased by more than 50%; – Budget revenues of the region have increased by more than 5%; – Local infrastructure / power supply has been significantly improved, resulting in significantly improved local population living / subsistence and economic environment, which contributes to the economic development of the region.
Negative		
1	Low	– A short time delay in the availability of resources or infrastructure is expected, though it will not affect the income of the local population. In addition, it will not be followed by long-term negative impacts on the economic activity of the local population; – Quality of life of the local population will be lowered for a short period of time, though it will not be followed by long-term negative results; – Health will not be affected; – Impact on safety is negligible; – A long-term, but easily adaptable impact on environment is expected;
2	Medium	– A short time delay in the availability of resources or infrastructure is expected, due to which the local population will have to change their lifestyle for a short period of time. However, it will not have any long-term negative impact on the economic activities of the local population; – Quality of life of the local population will be lowered for a short period of time, though it will not be followed by long-term negative results; – A certain impact on health is expected, but there is no increased mortality risk; – There are some risks related to safety; – Complaints from citizens are expected about some of the impacts; – Local population will increase by 10-30% due to invited specialists.

3	High	– Some resources or infrastructure became inaccessible for local population, due to which the local population will have to change their lifestyle for a short period of time, which will have a long-term negative impact on their economic activities; – Quality of life of the local population will be significantly lowered; – There is a significant impact on health. There is a high risk of increasing mortality rate; – There are some risks related to safety; – Corrupt deals related to employment or nepotism; – People are constantly complaining about the influence of certain factors. In this regard, conflicts arise between residents and staff; – Local population will increase by 30% due to invited specialists. Cultural environment for the local population is significantly changed. Creation of new settlements is expected.

6.12.2 Impact Description

6.12.2.1 Impact on Private Property and Land Use

The project HPP hydraulic facilities will be located on state land plots, particularly, within the borders State Forest Fund. It should be noted that prior to the start of the construction works, corresponding procedures will be carried out with LEPL National Forestry Agency on exclusion of the project areas from the State Forest Fund area. HPP communication corridor will not pass through private land plots. Accordingly, negative impact on private land parcels or property is not expected.

There are no risks of physical or economic resettlement in the result of the project implementation.

6.12.2.2 Impact on Local Climate

According to Bakhvi 1 HPP project, it is planned to arrange low-threshold (4.4 m high) structure at the headwork, upstream of which small impoundment will be created with the surface area if 2400 m^2. At the initial stage of operation, during the very first flood, the upstream section of the headwork will be filled with sediments and impounded area will be significantly reduced. The valley is V-shaped in the section, selected for headwork arrangement; Slopes are represented by rocky sediments. Accordingly, the impoundment created upstream the headwork will not actually exceed active riverbed.

Considering aforementioned, there is actually no risk of impact on local climate due to operation of impoundment upstream the headwork.

However, on the one hand, due to increased public interest toward the project, and on the other hand, according to the provisions of the Scoping Opinion, Bakhvi 1 HPP project implementer company invited international expert – Mr. Peter Biderman, in order to carry out micro- and macro-climate survey.

The international expert has developed a report on macro- and microclimate impact assessment, which is given in Annex13.

According to the given report, in EU, environmental impact assessment (EIA) legislation (EU Directive 2014/52/EU), which is integrated into the legislation of Georgia, requires from each project, subject to EIA, to assess "*project impact on climate (for example: nature and magnitude of greenhouse gases) and project vulnerability toward climate change".* There is no need for any specific assessments on microclimate risk. This legislation applies to all alpine countries of EU (Austria, Italy, Germany, France, Slovenia), which has hundreds of hydraulic structures similar to bakhvi 1 HPP.

The hydropower legislation of Switzerland[7], which is beyond the EU, but located in Alps, does not require any specific assessment related to the climate. Federal Guidelines on Hydropower Issues[8] states that dam

[7] "Loi fédérale sur l'utilisation des forces hydrauliques" (Loi sur les forces hydrauliques1, LFH2) date 22.12.1916, last update January, 2020

[8] Département fédéral de l'environnement, des transports, de l'énergie et de la communication DETEC - Sécurité des ouvrages d'accumulation - Documentation de base relative à la vérification de la sécurité en cas de crue

safety toward climate changes should be monitored regularly, however, it is not required or discussed to assess hydropower schemes in the context of the impact on microclimate.

Russia is one of those rare countries, which developed certain form of regulatory approach for assessment of the reservoir impact on microclimate. This was historically stipulated by the fact that Russia originally built large reservoirs in areas with very cold winters, and consequently microclimate problems arose, namely: icy fog was formed in the vicinity of reservoirs in winter under low temperature or windless weather conditions before the reservoirs froze.

In 1987, Moscow Hydroproject Institute, which is historical and internationally recognized design institute of hydraulic structures, published "Local Climate Change Prediction Recommendations in Reservoir Shorelines and Its Impact on National Economy" (P850-87 / Gidroproekt. M., 1987)"[9]. These recommendations are "Guidelines for assessing the impact of hydraulic structures on the environment"[10]. Paragraph 3.1 of the mentioned handbook discusses "local climate changes", however, the very first sentence states that the overview provided is limited with large reservoirs: examples of Krasnoyarsk (200 000 ha) and Sayano-Shushenskaya (18 000 ha) reservoirs are given, which is 100 000 times larger than the impoundment of Bakhvi 1 HPP (≈0.24 ha).

Spatial and time boundaries for Bakhvi 1 HPP Climate Assessment:

Spatial and time boundaries for Bakhvi 1 HPP climate assessment are as follows:

For assessment of the hydropower scheme impact on macroclimate:

The reference period covers 1986-2005, to ensure the compliance with recommendations of International Panel for Climate Change (IPCC). This means that we consider 1986-2005 period as the starting point for climate change[11] and thus, we are already in climate change period.
Bakhvi 1 greenhouse gas emissions will be considered for 100-year prospect, in compliance with recommendations of International Hydropower Association.
The impact of Bakhvi 1 HPP on global climate will be considered, which means that there are no spatial boundaries defined.

For assessment of the hydropower scheme impact on microclimate:

The assessment is spatially limited to upper basin of Bakhvi river (upstream Bakhvi 3 water intake structure). This intake includes Bakhmaro resort, in relation of which issues on climate impact have been risen. It covers areas that are too far away to discuss microclimate issues.
Time boundaries are limited to the next 30 years, in compliance with recommendations of International Hydropower Association.

Calculation Methodology

Hydropower Scheme Impact on Macroclimate

The methodology is based on the following assessments: (1) greenhouse gas emissions generated by Bakhvi 1 hydropower scheme during the construction and operation phase; and (2) comparison of greenhouse gas emission factors of Georgian electric networks and thermal power plants under the same power generation conditions.

Applied method is based on internationally and publicly available guidelines and tutorials.

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[9] «Рекомендации по прогнозированию изменений местного климата и его влияния на отрасли народного хозяйства в прибрежной зоне водохранилищ» (П 850-87/ Гидропроект. М., 1987)

10 Российское акционерное общество энергетики и электрификации «ЕЭС России» - Департамент научно-технической политики и развития - Методические указания по оценке влияния гидротехнических сооружений на окружающую среду - РД 153-34.2-02.409-2003

[11] This is surely not the precise as the climate change started in 19th century in the result of mass utilization of fossil fuel, however, taking the reference period 1986-2005 enables comparison of various regions and countries for permanent periods, meteorological conditions of which are globally available

Hydropower Scheme Impact on Microclimate

Based on the discussion given below and 96^{th} bulletin of ICOLD, the methodology focuses on two main factors: creation of impoundment and reduction and stream within Bakhvistskali river basin on Bakhvi 1 bypass section.

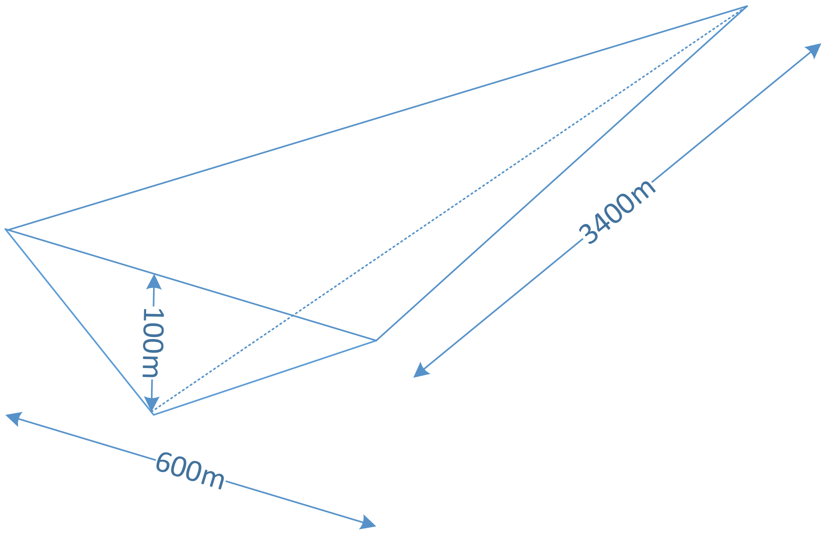
- Albedo change: this impact is assessed by comparison of albedos locally prior and after Bakhvi 1 HPP construction;
- Interaction of water and air temperatures: this impact is estimated relative to the interaction of water surface and air prior and after the construction of Bakhvi 1 HPP.
- Changes in the water evaporation process: This impact is assessed by the relative evaporation of water from the vegetation cover, prior to and after the construction of Bakhvi 1 HPP.

The increasing effect of the wind on the surface of the impoundment, which is also mentioned in ICOLD Bulletin 96^{th} Recommendations, has not been studied as it is not considered relevant in the project context: The impoundment formed at Bakhvi 1 HPP intake is extremely small to influence wind regime.

Risk of Creation of Additional Fog by Bakhvi 1 HPP:

Fog formation above Bakhvi 1 HPP is not expected due to extremely small volume of impoundment.

It is needed to form the fog with the thickness of more than 100 m (since the impoundment is located at a lower 100 m elevation of the resort Bakhmaro, and the fog extends horizontally) and the length of 3,400 m (since the impoundment is in 3 400 m from the center of Bakhmaro resort) above the impoundment that the fog could reach Bakhmaro resort. The simplified scheme below is a calculation of the volume of such fog cloud between the reservoir and Bakhmaro resort: 102 million m^3.



According to the conservative assumption, where the air temperature will be 0 ° C, and the water will reach a saturation of 4.85 g/m^3 at the given temperature, the volume of water contained in the cloud will be 495 m^3: this means 211 mm evaporation from the impoundment, which is 20% of annual evaporation during the night. It takes 331.6 MW/h to evaporate 495 m^3[12], as the maximum solar radiation on Earth is 1,000 W/m^2. The impoundment area of Bakhvi 1 is 2,400 m^2. Therefore, to achieve the required 331.6 MWh needed to evaporate 495 m^3 of water from a given impoundment, 141 hours continuous solar radiation is required, which is, of course, impossible due to the day-night cycle.

Calculations show that Bakhvi 1 impoundment cannot form a fog, which would reach Bakhmaro resort area.

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[12] It takes 0.67 W/h to evaporate 1 gr of water at 25°C water temperature – this is very conservative assumption in case of Bakhvistskali river, the temperature of which in summer is about 10°C.

Fog Reduction Risk in Bakhmaro Due to Bakhvi 1 HPP:

Fog formation above Bakhmaro is occasional phenomenon. Fog formation causes water condensation in the air.

Since Bakhmaro resort area is about 3 km^2, about 900 m^3 water evaporation (caused by the heat source) and re-condensation (caused by cooling effect) is required for formation of very thin fog above Bakhmaro resort, e.g.: 20 m thick (means 60 mln m^3 cloud)[13].

Large amount of heat source is required for such a fog to disappear (to balance the cooling effect): the sun can be a similar heat source (which generally causes the fog to disappear after heating by the sun rays); however, Bakhvi intake and impoundment do not generate any heat that can cause evaporation of fog cloud above Bakhmaro.

So, the risk of impact of natural processes of the fog in Bakhmaro, including the risk of fog reduction due to the project implementation, is considered to be zero.

Increased or reduced Temperature Risk:

The temperature change in Bakhmaro can be caused by Bakhvi 1 HPP project-related activities only if:

- The project emits significant amount of heat in ambient air: this risk is excluded as HPP operation process does not emit the heat unlike the thermal power plant, which generates more heat than power.
- The project changes significantly the possibility of existing surface absorption/evaporation in the vicinity of Bakhmaro – this risk is discussed in paragraph 5.2.1. of Annex 13, where it is stated that the project impact on the regional albedo will be insignificant.

There is no risk of temperature increase or reduction in Bakhmaro resort due to the project implementation.

The increase of the temperature in Bakhmaro resort is expected due to global warming, however, this is not related to Bakhvi 1 HPP construction and operation process.

Risk of Increased or Reduced Humidity:

Bakhvi 1 HPP will not change the precipitation mode in Bakhvistskali river basin or Bakhmaro, accordingly, change of humidification in Bakhmaro will be caused by Bakhvi 1 HPP operation, if:

- Evaporation from water bodies becomes significant source of humidification in the project area – this is not expected as it is described in the paragraph 5.2.3 in Annex 13.
- Atmospheric humidity is changed by altered forest cover, resulted from the project implementation – this is not expected as it is described in the paragraph 5.2.3 in Annex 13.

Accordingly, there is no risk that the project could cause high or low humidity in Bakhmaro resort.

The growth of temperature in Bakhmaro resort due to the global warming will cause increased humidity of air (water content in the air will increase by 7% against the background of a 1°C increase in temperature), however, this is not related to Bakhvi 1 HPP construction and operation.

According to the conclusion of the international expert report, macro and microclimate impact assessments show that:

The construction and operation of the Bakhvi 1 HPP will not have a measurable or significant impact on the macro or microclimate of Bakhmaro, or, more widely, on Bakhvitskali River catchment area.

[13] At 20°C temperature water condenses in the air when the water content in the air reaches 15 grams per m^3 of air.

The Bakhmaro and Bakhvitskali river basins are currently and will continue to experience climate change caused by global warming (independent of Bakhvi 1 HPP) and these changes will have a significant impact on local ecosystems.

In the absence of negative impacts on the macro and microclimate from Bakhvi 1 HPP, no mitigation measures are needed – as it is given in the report of an international expert.

6.12.2.3 Positive and Negative Impact Related to Employment

On construction phase, first of all employment related positive impact should be highlighted. As it was mentioned, about 200 people will be employed on construction; the majority of employees will be local population. This is quite a significant positive impact on the employment of population and for improvement of their social conditions.

However, attention should be paid to the risks of certain types of negative impact related to the employment, in particular:

- Employment expectations and dissatisfaction of local population;
- Violation of workers' rights;
- Job cut and dissatisfaction after completion of construction works;
- Risk of conflict between the local population and non-local employees.

In order to avoid dissatisfaction of the local population and employees, the following measures should be implemented:

- Employment on the basis of relevant testing;
- Signing individual work contract with each employee;
- Every employee will be informed about their work;
- All non-local employees should be informed about local habits and culture;
- While purchasing various materials, preference should be given to local products (including inert material, timber) in order to support local enterprises;
- Grievance mechanism of personnel will be developed and practiced.
- Grievance Book of personnel will be practiced.

It should also be noted that in December, 2021 Bakhvi 1 HPP team carried out workforce survey in Mtispiri community based on door-to-door poll, which considered obtainment of information by the project personel from each family, included in the community; this was needed to ensure consideration of skills of population during employment.

The number of employees at the HPP will not be significant at regional and country level. However, given the very high level of unemployment, the possibility of permanent employment of about 10-15 people should also be assessed as a positive impact.

6.12.2.4 Input to Economy

The implementation of the project of the HPP construction and operation will significantly contribute to social and economic development of the region.

Mainly local resources of construction materials will be used for the construction, which will contribute to the activation of the local production of construction materials.

After HPP commissioning, the state energy system will be supplied with extra power, which is important for the achievement of energy independence of the country.

The direct overall HPP project cost is about 61.031 mln. GEL, which is the significant factor for improvement of the local and state economy. For 25 years, about 10 mln GEL will be paid by the company to the state budget as property tax; corporate tax will be added to it – in the amount of 10.5 mln GEL. In addition, the budget will receive a certain amount in the form of income tax, from salaries paid to personnel, hired by the company, both for the construction and operation phases.

In addition, satellite business (trade, service, transportation, food production, etc.) activities will be activated in order to provide service for the staff employed on the construction, which shall be considered as an additional source of employment.

6.12.2.5 Impact on Local Infrastructure and Impediment of Movement

As it is given in the present report, access roads will be arranged both from upstream and downstream side. The existing forest road will be used for access to the powerhouse, the technical condition of which requires improvement. According to the project, road rehabilitation-extension works are planned, which will have positive impact on local population, as this road is used by them during implementation of forest works. Chokhatauri-Bakhmaro road will be used for access to the headwork, from where the road, outside the recreational zone will be used. Thus, transport operations, planned within the framework of the project will not be carried out by passing through Bakhmaro resort area and the impact is not expected on traffic flows of the resort.

As for risks of overloading of Chokhatauri-Bakhmaro road traffic flows, it should be stated that the impact will not be significant, in particular: significant amount of construction material and machinery will be designated for the powerhouse, which will be transported through the road, planned from downstream. Chokhatauri-Bakhmaro road will be used for transportation of construction materials for the headwork. This will not be related to large-scaled transport operations. Besides, major part of the construction material will be supplied on non-holiday season (prior or after holiday season). Considering all aforementioned, the risk of impact on traffic flows of Chokhatauri-Bakhmaro road will not be significant.

It should be noted that it is not planned to use any other infrastructure of Bakhmaro resort for project purposes, accordingly, the impact risk does not actually exist. The project area of the domestic-sanitary wastewater biological treatment plant of Bakhmaro resort will be in about 1200 m from the HPP headworks and no impact is expected on construction and operation of mentioned facility.

For minimization of impact on traffic flows and movement safety, following mitigation measures are planned:

- Access road from downstream will be used for implementation of main transport operations, and Chokhatauri-Bakhmaro access road will be used only during inactive holiday season.
- Movement of project-related transportation means will be restricted on Bakhmaro resort area;
- The movement of the machinery (especially caterpillar equipment) will be restricted on public roads and a corresponding transportation means will be used for this purpose;
- If road is damaged during work implementation, corresponding damaged sections of the road should be recovered in the shortest possible time, in order to make them available for population
- Specially designated personnel (flagman) will control the movement of vehicles, if necessary;
- Movement speed of transportation means will be limited on the sections within the borders of settlements;
- Relevant warning, indicating and restricting signs will be installed nearby the construction sites and construction camps;
- If any question is raised by population regarding the road issues, the Company will record them and discuss through Grievance mechanism.

6.12.2.6 Limited Access to Local Resources

On construction phase, usage of local resources (forest and water resources) will be restricted to some extent. This will be related to the restriction of movement due to arrangement of temporary structures, which can entail discontent of population. Local population and Forestry Agency should be informed on such events in advance, so that population is provided with firewood without any hindrance. To achieve this goal, corresponding measures should be taken beforehand.

It should be noted that at present, the existing access road from downstream is in poor technical condition and it is possible to pass through on it only by off-road vehicles. After the road rehabilitation, accessibility to the upper elevations of the valley will be increased, which will be positively reflected on local population; however, it should be stated that this can become the reason of additional load on environment. Presence of the road on operation phase will ease movement of population within the valley. Existing forest resources will be accessible for them, which can be deemed as positive impact from social viewpoint. Grievance Book will be kept for recording complaints on construction and operation phases, in order to ensure accessibility to natural resources. Resolution of dissatisfaction of population/entrepreneurs will be provided through consultations. In the result of consultations, the best solutions for conflict resolution are obtained. In addition:

- Population will be informed in advance about the decision, which causes temporary restriction of access to local resources;
- Works, restricting local resource accessibility and movement within Bakhvistskali river valley, will be carried out in the shortest possible time.

6.12.3 Impact on Human Health and Safety Risks

In addition to the indirect impact (deterioration of air quality, noise distribution and others described in the relevant subsections), expected during implementation of construction works, there are direct risks of impact on health and safety (mainly staff working within the project) during the construction phase.

Direct impacts may be: vehicle collision, electrical shock during construction, falling from height, injuries while working with construction equipment and others. In order to prevent direct impact, safety measures in the conditions of strict supervision will be followed:

- Personnel should to be trained on safety and labor protection issues;
- Personnel must be equipped with means of personal protection;
- Prohibiting, warning and indicating signs will be placed on areas dangerous for health;
- Fencing of areas dangerous for health;
- Presence of standard first-aid kit on areas dangerous for health and on construction camp;
- Ensure technical functionality of the vehicles and equipment;
- Maximum observance of safety rules during transportation operations, speed limitations;
- Limited use of roads passing through populated areas;
- Control and prohibition of unauthorized and unprotected access to the construction site;
- In-situ assessment of risks to determine specific risk factors for population and for proper management of such risks;
- Insurance of staff working on heights with ropes and special fasteners;
- Incidents and accidents should be recorded in special Register.
- Implementation of all measures in order to prevent ambient air, water and soil pollution. Implementation of mitigation measures against noise distribution (see relevant paragraphs.).

Additional preventive measures for health and safety impacts are considered in "Emergency Response Plan".

6.12.4 Impact Assessment

Table 6.12.4.1 Summary of Impact on Socio-Economic Environment

Description of impacts and impact sources	Impact receptors	Residual Impact Assessment					
		Nature	Probability of occurrence	Influence area	Duration	Reversibility	Residual impact
Construction Phase:							
Impact on land ownership; restriction of resource accessibility: • Impact on neighboring land owners - implementation of any type of activities on their lands, or damage to their property; • Limited use of water and forest resources.	Local population	Direct Negative	Medium risk	Site for arrangement of construction infrastructure for headworks	Duration is limited with the construction phase	Reversible	Considering mitigation measures – **Very Low**
Positive impact related to employment	Local population	Direct Positive	High probability	Guria region	Duration is limited with the construction phase	Reversible	**Medium**
Negative impact related to employment: • Employment expectations and dissatisfaction of local population; • Violation of workers' rights; • Reduction of employment and dissatisfaction after the completion of the project; • The risk of conflict between the local and non-local employees.	Construction personnel and local population	Direct Negative	Medium risk	Guria region	Duration is limited with the construction phase	Reversible	**Medium**
Input to economy • Stimulation/development of construction business and its satellite business activities; • Creation of job-places; • Increased budget revenues.	Regional economy, construction and other business activities, local population	Direct Positive	High probability	Impact area may be of regional scale	Duration is limited with the construction phase. Number of impacts will be long-term (e.g.: improvement of infrastructure)	Irreversible	**Medium, positive**

Damage to the road pavement • Movement of heavy equipment; ***Overloaded traffic flow*** • Movement of all types of vehicles and equipment; ***Limitation of movement*** • Closing the local roads for security purposes.	Local infrastructure, population	Direct Negative	Medium risk	Roads used for the project activities, as well as by the population	Duration is limited with the construction phase	Reversible	**Medium** Considering mitigation measures - **Low**
Risks of health and safety • Direct (e.g.: road accidents, electrical shock, falling from heights, injuries from construction equipment, etc.); and • Indirect (emissions, increased acoustic background, climate change, contamination of water and soil).	Construction staff and the local population	Direct or indirect, negative	Medium risk	Construction sites and roads used for project purposes	Duration is limited with the construction phase	Reversible	considering mitigation measures **Low**

6.13 Impact on Historical-Cultural and Archeological Monuments

6.13.1 Impact Assessment Methodology

Table 6.13.1.1. Cultural heritage impact assessment criteria

Range	Category	Damage/destruction of the cultural heritage
1	Very Low	The risk of impact is insignificant because of the large distance from the object or because of the used method of construction/operation
2	Low	1-10% of the insignificant object may be damaged/destroyed
3	Medium	10-25% of locally significant object may be damaged/destroyed
4	High	25-50% of locally significant object may be damaged/destroyed, or the object of regional significance may be damaged
5	Very High	50-100% of locally significant object may be damaged/destroyed, object of regional significance may be damaged, national or international significance protected object may be damaged

6.13.2 Impact Description

According to the results of historical-cultural monument surveys within the project area of Bakhvi 1 HPP, there are no historical-cultural monuments observed within and near the project area, which is included in UESCO World Heritage Site List or are nominated as candidate to include in this list. Visual observation of the project area did not identify any approved cultural heritage sites or their remains – neither sites having national status nor any existing sites without status were observed.

Every construction project bears certain risks to cultural heritage sites and it applies equally to the aboveground architectural monuments, as well as archaeological sites, whether it is unit, isolated burial, former settlement or any historical-cultural site of other designation.

Within the borders of the project area, visual observation of the cultural heritage did not reveal any sites, which requires pre-construction archaeological excavations or any other type of preliminary study.

Considering the fact that no visible cultural heritage sites or their remains were observed on the project area, risks actually equal to zero and the likelihood of the negative impact of the construction project on existing cultural heritage is virtually absent.

The likelihood of archaeological chance finding is very low, however, prior to the start of construction activities, the construction company should have management plan and procedure for chance finding prepared and approved, which should be included in the environmental management system and must represent one of the operation documents. The mentioned plan must define procedures to be implemented by the project developer team, in case of finding any archaeological artifact, site or any sign, indicating at the presence of archaeological site, during earth works. Besides, the procedure of actions and notifications should be described, according to which the measures envisaged by the legislation of Georgia (Law of Georgia on Cultural Heritage, 2007) will be carried out. In particular, during such a discovery, the construction company is obliged to stop the construction works at the given place, protect the site and invite the specialists from the agency, authorized by the legislation of Georgia to determine the significance of the archeological monument and make a decision on continuing the work. Works can be renewed on the basis of a permit issued by a competent state body.

6.13.3 Mitigation Measures

In case of discovering any artifact, construction process will be suspended. Expert-archaeologists will be invited to examine the chance finding and based on their recommendation, the company will support site conservation or removal to the depository. Works will be renewed after obtainment of the corresponding permit.

Personnel involved in the project should undergo training and instruction for raising awareness on cultural heritage issues.

6.14 Residual Impact

After completion of the construction and commissioning following should be singled out from residual impacts:

- Reduction of the green cover and restriction of habitat for wildlife due to cutting of trees and plants within the project corridor;
- Reduction of natural runoff, impact on aquatic biodiversity;
- Natural landscape environment alteration in the result of construction works and presence of HPP infrastructures;

All above-listed negative impact scales can be reduced by effective implementation of mitigation measures, given in EIA report and by providing environmental monitoring. In total, scales of negative impact will not be more than medium level and irreversible changing of certain environmental receptors is less expected.

6.15 Cumulative Impact Assessment

Due to the increased public interest from the one hand and on the other hand, in compliance with the provisions of the Scoping Opinion, Bakhvi 1 HPP project executor company invited an international expert – Mr. Pier Biderman for implementation of the cumulative impact assessment.

A cumulative impact assessment report has been prepared by an international expert, which is provided in Annex 14.

According to the given report, cumulative implies such impact, which is resulted from sequential, increasing, and/or entailed by combined actions, projects, programs, or activities (collectively "actions") that add to other existing, planned, and/or reasonably anticipated future actions. For practical purposes, the identification and management of cumulative impacts is limited to impacts that are generally recognized as substantially important according to scientific considerations and/or considering the problems of the affected population.

Multiple and consistent impacts of current activities on the natural and social environment, combined with potentially increasing impacts arising from proposed and / or expected future activities, may result in significant cumulative impact that would not have been expected in the case of a separate action.

Cumulative Impact Assessment is a process that involves (a) analyzing the potential impacts and risks of a proposed development in the context of the potential impacts of other human activities and natural and social environmental factors over time on relevant natural and social components; and (b) as far as possible Propose specific measures to prevent, reduce or mitigate cumulative impacts and risks.

The main analytical task is to determine how the cumulative impact of the proposed action will be combined with other human activities, along with other potential natural stress factors such as droughts or extreme climatic events. Important components of the natural and social environment are naturally in a constantly changing environment, which affects their condition and vitality. Important components of the natural and social environment combine the stressors that affect them. For example, periodic extremes of precipitation (drought or flood), temperature (extreme cold or heat), etc. Currently and in the future, it is expected that global warming (climate change) will have a significant impact on the condition of an important component of the natural and social environment.

There are following objectives of cumulative impact assessment:

- Identification of all significant natural and social environmental components that can be impacted by assessing activities;
- Selection of significant assessing components of natural and social environment;
- Identification all existing and reasonably expected and/or planned and potentially induced actions, as well as natural environment and external social determinants that may affect important components of the selected natural and social environment.
- Assessment and/or calculation of the future condition of selected significant components of natural and social environment, which is caused by potential cumulative impact of the activity, along with other reasonably expected activities in combination with inducing natural and external social factors.
- Assessment of the future condition of significant components of natural and social environment, considering established or assessed limit or comparable levels.
- Avoidance and reduction of the impact on significant natural and social environmental components according to the hierarchy of mitigation measures, throughout the duration of action or impact.
- Monitoring and management of risks of viability and stability of the significant national and social environmental components, during activity or its following impact, which will be longer.
- Submit project-related monitoring data to the corresponding governmental agency and/or stakeholders during implementation of the activity, and provide material support for establishment of the initiative of collaborative regional monitoring and resource management.
- Continuous involvement and participation of the project impacted population in decision-making process, selection of significant natural and social environmental components, impact identification and mitigation, monitoring and supervision.

As far as cumulative impact is the result of several sequential, gradual and/or combined activities, various parties are responsible for their prevention and management. Since one party is not capable to take all measures for cumulative impact elimination, it is highly probable that joint effort will be needed. Governments can play significant role ensuring environmental and social sustainability by developing regulatory frameworks that will facilitate the appropriate identification and management of cumulative impacts and risks.

Cumulative impact report assesses the cumulative impact of the hydropower plant scheme, planned on Bakhvistskali river, in combination with past, present and future hydropower plant schemes in the catchment area of the river and covers the geographic zone, including Bakhvistskali river watershed and lower basin of Supsa river (confluence of Bakhvi-Supsa rivers in lower reaches, as Bakhvistskali river is the tributary to Supsa river) till the Black Sea.

The approach used is based on the Good Practice Handbook on Cumulative Impact Assessment for Private Sector in Emerging Market Countries (IFC 2013).

Components of hydropower schemes including in the assessment, comprises of hydropower facilities, roads and transmission lines. Other anthropogenic activities, participating in the cumulative impact, such as forestry, are also included in the assessment, however, not as independent project, but as stress factors of anthropogenic origin. In the given assessment, all past, present and reasonably predicted activities are considered, which can contribute to the cumulative impact.

Based on cumulative impact assessment, the international expert developed management and monitoring plan, which comprises of 8 main components. Please, see the Table 6.15.1

Table 6.15.1

Mitigation Measures	Implementation Period	Monitoring	Progress indicator	Failure indicator (mitigation measure is needed)
(1) Meeting of Bakhvi 1 project executor with GSE, where potential ways for mitigation of impact on landscape are discussed.	From permit issuance for Bakhvi 1 HPP project till the start of the construction	Minutes of the Meeting with GSE	Meeting with GSE and discussion was held	Meeting with GSE was not held or it was held but did not give any proper result
(2) Designing and construction of Bakhvi 1 HPP headworks so that to ensure minimization of visual effect: 1. Avoiding usage of high buildings or bright colors; 2. After completion of construction, landscaping of temporary sites around the water intake site in order to restore their natural condition as far as possible; 3. Where possible, using naturalized fish way instead of concrete block structures; 4. Planting trees (local species) around the intake to serve as a visual barrier. Planting trees so that they look naturally (and not in rows)	Actions from 1-to 3: Preparation of designing and construction- throughout the whole implementation process. Action 4: Planting trees and fencing during a year after completion of the construction.	Monitoring by Environmental and Social (E&S) manager at main stages of the development.	Actions from 1-to 3: Instructions are included in the contracts with engineer-designer and construction companies and measures are implemented in a satisfactory manner. Action 4: Large size local species are planted in corresponding places to form visual barrier, suggesting that up to 30% plants cannot grow.	Actions from 1-to 3: Actions are not satisfactorily included in the outcomes of design or construction Action 4: more than 30% of trees could not thrive
(3) Preparation and implementation of traffic management plan, required for supply and construction of Bakhvi 1 HPP for the following purposes: 1. Minimization of road accidents, namely – using of traffic regulator at crossings of main road to Bakhmaro by access road to construction sites.	Plan preparation prior to construction Plan implementation during construction (requirements for plan preparation and implementation should be submitted to main contractor)	Plan approval prior to construction by E&S Manager of C-C-E-H Monitoring of plan implementation throughout the construction by E&S supervision personnel of	The plan is approved and implemented	The plan is not submitted, it is not approved. The plan is not implemented according to its recommendations

2. Avoiding supply operation on weekends; organization of supply operations during morning hours, from Monday including Friday, during summer touristic season. 3. Control over risks and incidents (interview with drivers), to ensure adaptation of traffic management plan by seasons.		C-E-H (weekly inspection)		
(4) Designing and construction of Bakhvi 1 HPP headworks so that to enable easily collect solid waste, occurred in Bakhvistskali river from Bakhmaro. Signing a contract with a company licensed on waste management, for collection and legally defined disposal of solid waste, existed at Bakhvi 1 HPP intake.	Preparation of designing and construction/throughout the whole process of implementation and operation	Monitoring by E&S manager at main stages of the development. Record volume or weight of solid waste collected on operation phase.	Design instructions are included in the contracts with engineer-designer and construction companies and measures are implemented in a satisfactory manner. Solid waste are collected at intake and then disposed to permitted landfill.	Project design complicates collection of waste management. Collection of solid waste and disposal to the permitted landfill is not carried out
(5) Based on consultations with competent agencies and GSE, preparation and implementation of traffic management plan for following purposes: • Minimization of risks of road accidents/incidents on earth roads, used by various stakeholders at the same time (including woodmen and GSE). • Limited only to roads, arranged for Bakhvi 1 project purposes, usage by other people, who are not related to HPP construction and operation.	Plan preparation prior to construction. Plan introduction throughout the whole period of construction and operation.	Plan approval prior to construction by E&S Manager of C-C-E-H Monitoring of plan implementation throughout the construction and operation by E&S supervision personnel of C-E-H (weekly inspection)	The plan is approved and implemented.	The plan is not submitted, it is not approved. The plan is not implemented according to its recommendations

(6) Meeting between Bakhvi 1 project executor and GSE and discussion of erosion control and monitoring measures, which were carried out in relation with Ozurgeti-Zoti ETL construction and connection to Bakhvi 1. Bakhvi 1 can propose GSE erosion monitoring around newly constructed towers.	From permit issuance for Bakhvi 1 project to the start of the construction.	Minutes of Meeting with GSE	Meeting was held and consensus reached with GSE	Meeting was not held with GSE, or meeting was held, but consensus was not reached
(7) Preparation and implementation a plan for restoration Bakhvistskali river ecological continuity for trout: • Pre-determination of existing blockage by shots a drone or helicopter; • Based on aero-photo shooting, organizing and conducting field survey with an ichthyologist and expandable cement specialist (starting from Bakhvi 3) to define improvement sites and corrective methods/logistics. Determination of fish monitoring points by ichthyologist. • Organize expeditions, aiming at gradual removal of blockage manually or using expandable cement (explosive substance usage in aquatic habitats is restricted), which should be carried out in compliance with decisions, made during field surveys	During construction	In low-water season (prior to the snowmelt and in autumn – in migration period) permanent monitoring over riverbed continuity and fish occurrence (using electrical fishing), in order to document fish re-colonization in Bakhvistskali river. Removal of a new blockage that can appear.	Ecological continuity restoration plan is implemented Trout population growth is observed.	Ecological continuity restoration plan is not implemented Trout population growth is not observed and no external factors have an impact on this fact.
(8) Preparation and implementation forest restoration plan within the framework of Bakhvi 1 and Bakhvi 2 for following purposes:	Plan preparation during construction. Implementation during the first year after construction.	Monthly monitoring, which considers inspection of fence	The plan is timely prepared and approved by the competent agency, indicating the land, which	The plan is not timely prepared or it is not implemented.

• Implementation forestation program to avoid loss of the forest cover; carry out compensation planting. • Preservation tree diversity during compensation planting. • Ensure sustainability through fencing tree planting sites or enclosing the area with barriers, which helps to avoid eating seedlings by herbivores. • Considering the global climate change, project aims to have a positive impact through following approaches: through planting coniferous trees within the specific area (above the line of existing trees), which will stipulate mitigation of the gradual replacement process of coniferous trees with deciduous ones. For this purpose, involvement of corresponding agencies will be ensured.		integrity for the first ten years.	is available for the project for forest restoration.	

Additional information on cumulative impact assessment is given in Annex 14

7 Mitigatin Measures Plan

Information presented in the plan of environmental mitigation measures is based on some certain data given in the paragraphs of the EIA report. Implementing mitigation measures are scheduled according to the planned works and impacts expected during these works.

Hierarchy of environmental measures is as follows:

- Impact avoidance /prevention
- Impact reduction
- Impact mitigation
- Damage compensation

Impact can be avoided and risks can be reduced by using best construction and operation practices. Some mitigation measures are considered within the process of the project development. Due to the fact that it is impossible to avoid all impacts, in order to ensure maximum security of the project for the environment on all stages of project lifecycle and all receptors, corresponding plan of the mitigation measures will be determined.

Executor Company takes responsibility on implementation of the environmental mitigation measures, as well as on those obligations, which are given in the attached documents (waste management plan, emergency response plan).

7.1 Institutional Mechanisms to Control the Implementation of Environmental Measures

The executor company, with the assistance of the technical and environmental supervisors and contractors (if necessary) will control the quality of construction works implemented by the construction contractor and the performance of the environmental standards on HPP construction phase. The designated supervisor will be obliged to set the strict control over the works implementation and to control the ongoing construction works. The supervisor will have the right to inspect the quality of environmental measures, to identify the gaps and to determine the type of environmental or social issues appeared within the construction process.

In its turn, the executor company will be controlled by the Department of Environmental Supervision of the Ministry of Environment Protection and Agriculture of Georgia. The Department will carry out the inspection within the impact zone; it will check the performance of environmental measures and permit conditions defined in frames of the Environmental Impact Assessment. In addition, International or local Financial Institutions may fulfill the functions of control body.

Within the construction process, monitoring implies visual inspection and instrumental measurements if necessary. All monitoring results, environmental documents and records should be kept in the office of the project executor company.

Construction contractor will be in charge of preparing and submitting the following environmental documents and records to the client:

- Program and schedule of the implementing works;
- Environmental permits and licenses (if necessary);
- Records related to the environmental problems;
- Schemes of water supply and wastewater treatment of the construction sites;
- Records on amount and quality conditions of wastewater;
- Records related to the waste management issues;
- Providing written markings of the waste disposal sites and instructions for waste transportation rules issued by the local government;

- Records about the stock of materials and consumption;
- Register book for complaints;
- Register book for incidents;
- Reports on the adjustment measures;
- Providing registers for equipment control and technical services;
- Records about the workshops;

After signing the agreement with the construction contractor, it will develop and submit the client the following thematic management plans:

- Detail Waste Management Plan;
- Detail plan of Health and Safety Management;
- Detail Emergency Response Plan;
- Project of the reinstatement works.
- Other plans required by the Client.

The Department of Environmental Supervision will be the main control body over the performance of the environmental mitigation measures on the operation phase.

Table 7.1.1 Mitigation Plan for the Construction Phase

Impact/impact description	Objective	Mitigation measures: Description	Mitigation measures: Responsibility, terms and costs	Monitoring
Inorganic dust distribution in ambient air: • Dust due to earth works; • Dust due to vehicle movement; • Dust due to inert material and waste rock loading/unloading; • Dust due to construction works; **Distribution of combustion products in the ambient air:** • Exhaust from vehicles, construction equipment; • Exhaust from generators and other machinery; • Welding aerosols.	Minimization of dust emission in order to reduce environmental impact, such as: • Disturbance of people (population, working personnel) and negative impact on their health; • Disturbance of animals and their migration; • Polluting vegetation cover with dust and impeding the growth and development of plants.	• Ensuring the technical functionality of equipment and vehicles, as well as stationary facilities. Vehicles and equipment emitting harmful substances (due to technical failure) will not be allowed to work sites; • Turning off engines or working with a minimum rpm when they are not used (especially, concerning equipment, operating on the construction camp); • Providing the optimal speed of the movement (esp. on unpaved roads); • Machinery and equipment should be away from sensitive receptors (settlements, forest zone) as much as possible; • Restriction of usage of roads, passing through settlements (population will be informed about intensive transport operations in advance); • Dust reduction measures will be implemented in dry weather (e.g., watering of the construction sites, protection of rules of bulk construction material storage, etc.) • Implementation of precautionary measures in order to avoid excessive dust emission during earth works and materials loading-unloading (e.g., restriction material dropping from a big height during loading-unloading); • Instruction of the personnel prior to the works; • Recording of complaints and relevant response to them, considering above-mentioned measures;	**Responsible for implementation of mitigation measures:** "Bakhvi 1" HPP site managers **Time-frames for implementation of mitigation measures:** • prior to the works and then periodically; • during transport operations; • Periodically, esp., in dry and windy weather; • During earth works and material loading/unloading **Cost for implementation of mitigation measures::** The implementation of mitigation measures will be related to **"Low"** costs.	Environmental and safety manager will carry out daily visual observation, inspection of transport operations. He/she will make special entries related to vehicle maintenance works. Monitoring is not related to the additional costs
Noise Propagation • Noise and vibration due to transport operations; • Noise and vibrations caused by construction operations and equipment;	To minimize the noise propagation. Reduce impacts on the environment: • Impact on human health; • Disturbance of animals and migration	• Ensure the technical functionality of construction equipment and vehicles. Technical state of the machinery will be checked prior to the start of working day. Vehicles and equipment generating high noise level (due to technical failure) will not be allowed to the work sites; • Nosy activities will be carried out only at daytime; in case of making decision on working during night hours, the population will be informed about it in advance;	**Responsible for implementation of mitigation measures:** "Bakhvi 1" HPP site managers **Time-frames for implementation of mitigation measures:** • Permanent; • Prior and during the noisy works; • prior to the works and then in every 6 months	Control over proper working of machinery; If necessary, carry out instrumental measurements (during intensive noisy work process). Expenses will be related to

		• Prior to the start of noisy works near residential zone (here transport operations are meant), residents will be warned and provided with relevant explanations; • Noisy equipment should to be allocated away from sensitive receptors as much as possible; • If necessary, equip personnel with proper protective equipment (earmuffs); • In case of complaints, they should be recorded and appropriate action should be taken considering the above listed measures.	**Cost for implementation of mitigation measures::** The implementation of mitigation measures will be related to **"Low"** costs	instrumental measurements
Activation of geological hazards (erosion, landslide, etc.): • Destabilization of rocks and activation of landslide processes during construction activities; • Destabilization of rocks and landslide occurrence, activation of erosive processes during the preparation of foundations of the structures and other excavation works; • Disposal of waste rocks	• Maintenance of rock stability. Reduce the risks of erosion and landslide process activation. Protection of structures under construction from damage.	• Engineering-geological conclusions and recommendations, outlined in par.4.2.2.8. will be considered during the project implementation; • Prior to the start of the construction works of certain hydraulic unit facility, boreholes will be arranged on the site and based on the data, obtained from these boreholes, physical-mechanical properties, distribution depth, etc. of forming rocks will be specified. According to this information, specific parameters for foundations of the project structures will be defined; • Construction works will be implemented under the strict supervision of engineer- geologist. If required, additional preventive measures will be carried out on the basis of his recommendations; • Borders of the work corridor will be protected and felling of trees and vegetation cover will be controlled within these borders; • Materials and waste will be disposed so that to avoid erosion and their removal from the construction site by surface water runoff. The height of the ground pile will not be more that 2 m; pile sides will have proper inclination angle (45^0); drainage channels will be arranged on the perimeter; • After completion of the construction works, recultivation and landscaping of the construction sites will be carried out. • Construction works in or near the riverbed will be restricted during the period, when the mudflow development is expected. During intensive implementation of above-mentioned works, environmental manager/engineer-geologist will control official forecast of National Environmental Agency on weather/disasters expected in the region. Works	**Responsible for implementation of mitigation measures:** "Bakhvi 1" HPP site managers **Time-frames for implementation of mitigation measures:** • On the preparatory and construction phases; • After completion of the construction works. **Cost for implementation of mitigation measures:** In total, implementation of mitigation measures will be related to **"Medium"** costs	Regular visual observation of the rock stability by engineer-geologist. Employment of additional staff will be related to low costs.

		will be planned considering recommendations, issued on the basis of these forecasts: Preliminary implementation of some preventive measures may be required (e.g.: improvement of temporary barriers and diversion channels, cleaning of the riverbed as far as possible from large boulders, etc.); • Temporary barriers and diversion channels will be designed for flood flows (10-year flood flow); • Timely maintenance of the temporary barriers and diversion channels will be provided. Their technical functionality will be checked after each heavy rain or sediment runoff in large amount; • Low-threshold headwork arrangement is planned. Its structure ensures safe downstream passage of mudflow streams; • Bank protective structures will be arranged at the power house and at all sensitive sites; • Preventive measures against gravitational processes will be carried out at all sensitive sites of the penstock. Stabilization will be provided using following approaches: o Drainage and regulation of uncontrolled water stream – upstream of unstable site, drainage channel will be arranged along the whole length, which divert the water, flowed from upper elevations, from unstable site. A trench with steel lining will be arranged: the trench with light steel lining, which can be arranged and moved even in complex conditions; o Reinforcement of the surface layer of the ground, which is posed to the landslide impact, with double wire steel mesh; the steel ropes of the mesh are fixed with anchors into lower layer of the stable rocks, which ensures the double stability of the ground and protection of rocks under the road surface from potential disintegration. Certain amount of rocks (more than 2-3 m^3) requires special attention and it is necessary to fix them with steel rope and anchors. The mesh will be made of high-quality wire, in order to ensure long-term protection against corrosion; • Analogous measures will be carried out on sites, where signs of similar geodynamic process development are observed after implementation of earth works;		

		• Wherever there are rockfall development risks, prior to the start of works, the slope will be checked and cleaned from loose boulders and stones, if any; • Sites with high risks of rockfall will be reinforced with double wire steel mesh. • Riprap bank protection structure will be arranged on all sensitive sections. Including, bank line protection will be provided within the shorelines adjacent to headwork and power house; • Highly inclined slopes and the perimeter of soil grounds will be provided with corresponding drainage systems		
<u>**Surface water pollution:**</u> • Pollution during implementation of works in or near the riverbed; • Pollution caused by inappropriate management of solid and liquid waste; • Pollution in case of spilling fuel/oil.	<u>Prevention of surface water pollution and reduction of impact on the environment, such as:</u> • Impact on aquatic biodiversity; • Pollution of ground water; • Impact on receptors, depending on water resources (animals, population)	• During arrangement of the construction camp and storage areas, conditions, defined by Technical Regulation on Water Protection Zone, approved by the Decree #440 of the Government of Georgia (December 31. 2013) will be considered; • Ensure technical functionality of machinery/equipment; • Arrangement of machinery and potentially polluting material in not less than 50 m from water bodies (where possible). If it is impossible, strict control will be established and safety measures will be carried out to avoid water contamination; • Prohibit washing of vehicles in the riverbed; • Cesspools will be arranged for collection of generated sanitary-fecal water; • Prior to the making decision on wastewater discharge into the river, project on MPD standards will be developed and agreed with the ministry; • Potentially pollution sites of storm water will be roofed with shed-like structure as far as possible; • All potentially polluting material should be removed after the completion of works. In case of spillage of oil/lubricants, spilled product should be localized/cleaned; • Staff will be provided with corresponding instructions.	**Responsible for implementation of mitigation measures:** "Bakhvi 1 HPP site managers **Time-frames for implementation of mitigation measures:** • Prior and during the construction works; • After completion of the works. **Cost for implementation of mitigation measures:** The implementation of mitigation measures may be related to "<u>**Low"**</u> costs	Check/control over proper working of machinery; Control over waste management plan implementation; Visual control of soil, water and wastewater condition.
<u>**Impact on the groundwater:**</u> • Quality deterioration due to polluted surface waters or soil;	<u>Reduce impact on receptors (population, biodiversity) depending on groundwater resources.</u>	• Ensure technical functionality of machinery/equipment; • In case of identification of fuel leakage, malfunctioning will be promptly solved; • Arrangement of cesspools for collection of sanitary-fecal water;	**Responsible for implementation of mitigation measures:** "Bakhvi 1" HPP site managers **Time-frames for implementation of mitigation measures:** • During construction works	Proper maintenance control; Control of waste management plan implementation; Visual control of soil, water condition.

• Due to fuel/oil spilling during construction works (esp. earth works);		• Localization of spilled material and immediate cleaning of the damaged area. Personnel will be equipped with corresponding means (absorbents, shovels, etc); • After completion of works all potentially pollutant material will be removed. In case of fuel/lubricant spillage contaminated site will be localized/cleaned;	**Cost for implementation of mitigation measures:** The implementation of mitigation measures is not related to additional expenses.	Laboratory monitoring if required.
<u>**Disturbance of soil/ground stability and destruction, pollution of topsoil:**</u> • Disturbance of the stability during the road construction and other construction works; • Destruction of topsoil during the preparation of construction site; • Soil pollution with waste; • Soil pollution due to fuel/oil or other substance spilling	<u>Prevention of soil pollution and accordingly, reduction of indirect environmental impact, such as:</u> • Deterioration of animal habitat; • Indirect impact on vegetation; • Pollution of ground and surface waters;	• Topsoil removal-storage will be carried out in compliance with requirements of the Technical Regulation - "Topsoil Removal, Storage, Use and Cultivation", approved by the decree №424 of the Government of Georgia; • Removed topsoil will be arranged on the area, protected from water impact as far as possible, separately from non-humus layer. After completion of works, topsoil will be used for recultivation of the spoil ground; • Strict adherence to the boundaries of work sites in order to prevent possible contamination of neighboring areas, damage and compaction of topsoil; • Determination of routes for vehicles and machinery and restriction of off-road movement; • In case of identification of fuel/oil leak damage must be fixed immediately. Damaged vehicles will not be allowed to the work sites; • Materials /waste should be disposed so that to prevent erosion and wash off with surface runoff; • Proper management of generated sanitary and fecal wastewater (it will be collected in sealed cesspools); • In case of spillage of pollutants, spilled material should be localized and contaminated site should be immediately cleaned. Staff should be provided with appropriate means (adsorbents, shovels, etc.); • In case of large spill contaminated soil and ground for further remediation should be removed from the territory by the contractor holding an appropriate permit for such activities; • Prior to work staff will undergo training; • Area will be cleaned and recultivated after the completion of construction works.	**Responsible for implementation of mitigation measures:** "Bakhvi 1" HPP site managers **Time-frames for implementation of mitigation measures:** • Permanently during the construction works; • In case of pollution; • Prior and after works periodically; • after completion of works **Cost for implementation of mitigation measures:** The implementation of mitigation measures may be related to **"Low"** costs.	Regular visual observation of construction sites, slopes, road surfaces, storage of removed soil layer. The monitoring will not be related to additional costs.
<u>**Visual-landscape alteration:**</u> • Visual-landscape alteration due to presence of	• Reduce dissatisfaction of people;	• Reasonable selection of colors and designs, so that colors are combined with nature;	**Responsible for implementation of mitigation measures:** "Bakhvi 1" HPP site managers	Visual monitoring to control sanitary-

construction site and construction camp. • Visual-landscape alteration due to increased traffic flow; • Visual-landscape alteration due to cutting of trees	• Prevention of alteration of animal habitat and migration.	• Temporary structures, materials, and waste should be disposed at less noticeable areas; • Protection of sanitary and environmental conditions during construction and operation phases; • Recultivation works should be implemented after the completion of construction works (especially within waste rock disposal areas); • Local species should be planted-grown on some sections adjacent to the powerhouse after completion of construction works.	**Time-frames for implementation of mitigation measures:** • at preparatory and construction stages; • during transport operations; • After completion of construction works. **Cost for implementation of mitigation measures:** Implementation of mitigation measures is not related to additional costs.	environmental condition of the area.
<u>Impact on flora.</u> **<u>Habitat loss, damage, fragmentation:</u>** • Removal of the vegetation cover/deforestation on the project area; • Noise caused by construction works, change of illumination background; • Impact related to arrangement of construction camps and temporary infrastructure.	• Minimizing the risks of the habitat loss and damage; • appropriate management of the habitats.	• Any activity, planned on the areas under the management of State Forest Fund, will be agreed with the Agency, authorized for management of the State Forest Fund; • Personnel will be instructed on the issues of protection of vegetation cover prior to the works are launched; • Vegetation resource removal works will be carried out so that to reduce number of cutting trees and shrubs at minimum; • Boundaries of the working zone should be adhered, in order to avoid additional (excessive) damage of vegetation cover. Working boundaries should be marked in advance; • Transport road network for HPP construction and further service will be planned so that to avoid crossing of large forest sites and forest fragmentation; the fact that the forestry road passes within the construction corridor will also help the construction organization to achieve this goal; • Cutting of trees and plants will be carried out under supervision of authorized service specialists; • Compensation measures for cut trees and plants will be implemented , namely, local species of plants will be planted/grown on 20 ha area; • To compensate damage of vegetation cover, trees and vegetation will be planted at the adjoining territories of the power facilities. Local species will be used for the landscaping works; • Period of earth works (arrangement of foundations) will be limited at maximum and excavated pits will be filled in short terms as far as possible;	**Responsible for implementation of mitigation measures:** "Bakhvi 1" HPP site managers. **Time-frames for implementation of mitigation measures:** • prior to the works of vegetation cleanup on work sites; • during the removal of vegetation cover; • at recultivation phase; • during construction phase, especially at night. **The costs related to mitigation measures:** Implementation of mitigation measures may be related to **medium** costs.	The daily monitoring in working areas, at the stage of the vegetation cover removal, with the aim of work site protection.

		• In order to reduce the risk of habitat fragmentation, especially, in frames of the linear construction corridors, artificial overpasses will be arranged as far as possible (wooden boards will be put on the penstock trenches especially, at night); • After completion of the construction works recultivation of the temporarily used areas will be carried out that will significantly reduce the impact related to the habitat fragmentation; • Safety measures will be adhered to prevent fires; Besides, • Implementation of mitigation measures considered for visual-landscape alteration (see relevant paragraph); • Implementation of mitigation measures considered for water, soil and ambient air pollution (see relevant paragraphs);		

<u>Impact on the behavior of the species:</u>
• Declining the reproduction ability and the normal vitality. Animal migration;
• The direct impact - The animal mortality, injury
	• Minimizing of the direct and indirect impacts on the animal species.	• Prior to the construction works access roads, river crossings (esp. headwork location) will be examined in order to identify bird nests, holes and trails of predatory mammals;
		• Vegetation cleanup will be carried out on some areas within the project site, including trees that may be used as shelters during breeding by bats and boreal owl, as well as squirrel. Prior to the construction, all cut trees, the diameter of which will exceed 40 cm, will be thoroughly observed. In case of identification of animal shelter, written notification will be sent to the Ministry of Environment Protection and Agriculture of Georgia and further actions will be taken in compliance with the Law of Georgia on Red List and Red Book, as well as Law on Wildlife. In particular, every activity that may lead to reduction of numbers of endangered animals and deterioration of their living and existing conditions will be suspended (except for special circumstances). Therefore:
		  ○ Identified sensitive areas will be marked (mapped);
		  ○ Situation will be explained to the personnel and any activity threatening living environment of species will be prohibited (approaching holes/hollows, hunting, etc.);
		  ○ Any activity to be carried out within construction works will be conducted as far from the marked territories as possible;
			Responsible for implementation of mitigation measures:
			"Bakhvi 1" HPP site managers
			Time-frames for implementation of mitigation measures:
			• Prior to the works;
			• During the construction works and transport operations;
			• After completion the construction works.
			The costs related to mitigation measures:
			Implementation of mitigation measures may be related to **low or medium** costs.
				Control of waste management. Periodical inspection of drivers and staff; monitoring is not related to additional costs.

		○ Transport movement will be limited near the sensitive areas, speeds will be reduced, bypass roads will be used, where possible ○ In special cases, project implementer shall address the Ministry of Environment Protection and Agriculture in written form and shall carry out further activities basing on instructions provided by the Ministry; • Personnel employed for the construction will be trained and warned in a proper way on corresponding sanctions, determined for damage to animals; • Border of the construction corridor will be adhered in order to ensure that earth works do not exceed the marked territories and to avoid additional damage to holes, bird nests and bat shelters. Earth works should be controlled by appropriately qualified personnel; • Traffic route will be adhered; • Limited speed of traffic in order to reduce direct impact on animal species (collision); • Pits, trenches and other must be protected to prevent fall of animals. • Works, causing excessive animal disturbance will be carried out in the shortest possible time; • Recultivation of territories adjacent to HPP communications and access roads after the completion of construction works, which will significantly reduce the habitat fragmentation impact. • In order to prevent poaching, personnel, employed for the construction, will be instructed and corresponding warning will be provided in compliance with the Ministerial Order №95 (27.12.2013) on hunting rules and Technical Regulation – "Fishing and protection of fish stock", approved by the ministerial order №423 (31.12.2013) of the Government of Georgia. Additionally, following will be highlighted: • Proper waste management; • Mitigation measures for water, soil and air pollution, noise distribution and etc. will be implemented.		
<u>Impact on fish fauna, their habitat and feeding conditions:</u>	To minimize direct and indirect impact on fish fauna.	• Relevant measures will be taken during construction works of the headwork, in order to prevent wide spreading of river stream (accordingly water depth reduction) and/or creation of	**Responsible for implementation of mitigation measures:** "Bakhvi 1" HPP site managers	Monitoring will be set over the performance

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- Gradual change of water level on certain river sections;
- River mudding, changing of turbidity;
- Noise impact;

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small ponds separately from common stream. Temporary gabions/river sediment will be effectively used for this purpose so that to create single channel deep riverbed;

- Water flow diversion from natural riverbed to artificial riverbed will be provided as long as possible to avoid sudden effect (process will be distributed in time), in order to enable fish adaptation to the new environment;
- Junctions of artificial and natural riverbeds will be arranged so that to avoid creation of artificial barriers for fish migration;
- On headwork construction sites riverbed will be regularly cleaned from wood waste;
- Banks and slopes will be strengthened against negative events (soil getting into water, landslide, mudflow, etc.). All works will be implemented in riverbed with special cautiousness in order to avoid river turbulence;
- While working near the river all measures against noise propagation will be carried out;
- All measures will be taken in order to maintain water quality.

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Time-frames for implementation of mitigation measures:

- Prior the works;
- During construction works and transport operations;
- After completion of the construction works

The costs related to mitigation measures: Implementation of mitigation measures may be related to **low or medium** costs

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<u>The risks of the environmental pollution with waste:</u>

- The construction waste (waste rock, etc.);
- Hazardous waste (lubricant waste, etc);
- Household waste.

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<u>Prevention of a disorganized waste spread and therefore reduction of the following environmental impacts:</u>

- The adverse impacts on human health and safety;
- Pollution of the water environment;
- The direct adverse impact on animals;
- The negative visual/landscape change;
- Other.

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- Construction and other necessary materials will be delivered to the site in the required amount for the project purposes;
- Excavated rocks will be used for the project purposes (for arrangement of the riverbed, etc);
- Recultivation of the surface of waste rock disposal areas;
- Reusing waste as far as possible;
- Special storage facility will be arranged on construction camp site for temporary disposal of hazardous waste and labeled hermetic containers will be arranged on construction sites;
- Protection of safety rules during waste transportation;
- Hazardous waste will be removed from the site only by the contractor, holding appropriate permit for this activity;
- Corresponding recording mechanism will be established and corresponding Register will be kept for waste generation, temporary storage and further management processes;
- Appropriately trained personnel will be hired for waste management;
- Instruction of personnel.

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Responsible for implementation of mitigation measures:
Bakhvi 1 HPP Personnel designated for the waste management.

Time-frames for implementation of mitigation measures:

- At the preparatory stage;
- During the waste management process;
- After disposal of the waste rocks;
- Prior and after the works, periodically.

The costs related to mitigation measures: the considered mitigation measures can be related to "**medium**" costs

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<td>Control over performance of the waste management plan, documenting waste quantity and types, keep register by the special personnel hired for the waste management. The monitoring costs might be related to hiring of the additional personnel.</td>
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<u>Temporary or permanent usage of private property, including the land parcels</u>

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- Excluding discontent of local population

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- Negotiations with owners;
- Providing satisfaction of owners based on agreement reached during negotiations

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Responsible for implementation of mitigation measures:
Bakhvi 1 HPP management

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<td>Develop appropriate grievance mechanism</td>
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			Time-frames for implementation of mitigation measures: • At the preparatory stage; **The costs related to mitigation measures:** Implementation of mitigation measures may be related to **medium** costs	
Employment and the adverse impact risks related to it: • The expectation of employment and the dissatisfaction of the local population; • Violation of the rights of the employees; • Job cuts and dissatisfaction related to the project finalization; • Discord between the local population and the employees (non-locals).	• Prevention of the dissatisfaction of project personnel or the residents.	• Staff recruitment policy will be developed and agreed with local authorities; • Employment on the basis of relevant testing; • Signing individual work contract with each employee; • The contract signed with the personnel will include articles about all plans, procedures and mitigation measures, as well as articles related to monitoring of the safety plans and reports on accidents; • Every employee will be informed about their work - code of conduct will be developed; • All non-local employees should be informed about local habits and culture; • While purchasing various materials, preference should be given to local products (including inert material, timber) in order to support local enterprises; • Grievance mechanism of personnel will be developed and practiced. • Grievance Book of personnel will be practiced.	**Responsible for implementation of mitigation measures:** Bakhvi 1 manager **Time-frames for implementation of mitigation measures:** • Prior to the works (prior and during the recruitment), as well as during the construction works if a new staff is hired; • during the construction works **The costs related to mitigation measures:** Performance of considered mitigation measures can be related to “Low” costs (difference in prices).	Develop appropriate grievance mechanism. Disciplinary recording of complaints. Usage of recruitment base developed for the project
The impact on the transport infrastructure: • Damage of the road surface; • The traffic overload; • The movement limitation.	• Maintain road surface and support free movement of transportation; • Minimizing the traffic danger and jams; • Preventing population dissatisfaction;	• Restrict the movement of the machinery (especially caterpillar equipment) on public roads as much as possible; • Population should be provided with the information about the time and duration of works; • All damaged sections of the road should be recovered in the shortest possible time, in order to make them available for population; • Specially designated personnel (flagman) will control the movement of vehicles, if necessary; • Relevant warning, indicating and restricting signs will be installed nearby the construction sites and construction camps; • Complaints of population will be recorded and relevant actions must be carried out.	**Responsible for implementation of mitigation measures:** Bakhvi 1 HPP, site managers **Time-frames for implementation of mitigation measures:** • During construction works – transport operations; • After completion of the work; • During planning of intense transport operations; • After receiving complaints **Costs of mitigation measures:** Performance of considered mitigation measures can be related to “Low” costs	Constant monitoring of the road quality. Ensure adherence to road safety standards.

<u>Health and safety related risks:</u> • <u>The expected impact on health and safety of the population;</u> • <u>The expected impact on health and safety of the employees.</u>	• Ensuring the human health and safety	• Personnel should to be trained on safety and labor protection issues; • Personnel must be equipped with means of personal protection; • Prohibiting, warning and indicating signs will be placed on areas dangerous for health; • Fencing of areas dangerous for health; • Presence of standard first-aid kit on areas dangerous for health and on construction camp/base; • Ensure technical functionality of the vehicles and equipment; • Maximum observance of safety rules during transportation operations, speed limitations; • Limited use of roads passing through populated areas; • Control and prohibition of unauthorized and unprotected access to the construction site; • In-situ assessment of risks to determine specific risk factors for population and for proper management of such risks; • Insurance of staff working on heights with ropes and special fasteners; • Incidents and accidents should be recorded in special Register. Besides, • Implementation of all measures in order to prevent ambient air, water and soil pollution. Implementation of mitigation measures against noise distribution (see relevant paragraphs.).	**Responsible for implementation of mitigation measures:** Bakhvi 1 HPP site managers **Time-frames for implementation of mitigation measures:** • during the recruitment and then several times a year; • Before starting work; • Before starting work and constant updating; • Constantly, in the working process **The costs related to mitigation measures:** Performance of considered measures can be related to "**medium**" costs.	Controlling the technical order of the machinery and equipment. Making the notes about the incidents and accidents. The unscheduled inspection of the personnel
<u>The impact on cultural-historical and archaeological monuments:</u> • <u>Damage tothe cultural heritage sites during the construction works;</u> • <u>Damage to unregistered archeological heritage sites , during the earth works</u>	• Minimizing the risks of the damage/destruction of the cultural and archeological monuments	• In case of discovering any artifact, construction process will be suspended. Expert-archaeologists will be invited to examine the chance finding and based on their recommendation, the company will support site conservation or removal to the depository. Works will be renewed after obtainment of the corresponding permit.	**Responsible for implementation of mitigation measures:** Bakhvi 1 HPP site managers **Time-frames for implementation of mitigation measures:** During the construction works. If discovering any artifact. **The costs related to mitigation measures:** No expenses are required	Personnel instruction and control. Visual control of earth works

Table 7.1.2. Mitigation Measures on Operation Phase

Impact/The impact description	Goal	Mitigation Measures		Monitoring
		Description	Responsibilities, Time-frames and Expenses	
<u>Noise propagation within the work zone. Impact on other receptors:</u> • Propagation of noise during the operation of hydraulic units and power transformers.	<u>Minimize noise propagation. Reduce environmental impact, such as:</u> • Impact on human health; • Animal disturbance and migration.	• Hydraulic units will be located inside the power house, in the casing and accordingly, noise levels will not exceed the established limits; • Control room in the machine hall will be arranged using special noise insulation material. • Personnel will be provided with special earmuffs; • Quick shift of personnel working with noisy devices.	**Responsible for implementation of mitigation measures:** Bakhvi 1 project manager **Time-frames for implementation of mitigation measures:** • Prior to commissioning; • During operation **The costs related to mitigation measures:** Measures can be related to "**Low**" costs	Control of technical condition of equipment. If necessary, instrumental measurements
<u>Activation of the hazardous geodynamic processes (erosion, landslide and others):</u> • Activation of landslide and erosion processes within the areas of access roads and other infrastructure facilities; • Shore line scouring risks and slope scouring risks.	• <u>Preservation of rock stability and minimization of risks of landslide and erosive process activation. Protection of HPP facilities from damage</u>	• Foundation of main HPP facilities will be provided on the basis of engineering-geological surveys; • Retaining walls will be arranged on sensitive sites of the project corridor; during designing of the protective structures, their parameters will be defined on the basis of engineering-geological surveys and hydrogeological-hydraulic calculations of bottom and bank scouring intensity; • Monitoring over hazardous geological processes/protective structure conditions will be carried out on all sensitive sites, especially during initial 2 years of operation. Personnel with relevant competence (engineer-geologist) will be involved in monitoring; if required in the shortest possible time, corresponding preventive measures (geological study, project development, restoration of protective structures, etc.) will be carried out.	**Responsible for implementation of mitigation measures:** Bakhvi 1 project manager **Time-frames for implementation of mitigation measures:** • during designing and construction phase; • After completion of works and during operation phase, especially during the first years (in case of activation of geodynamic processes on the bases of monitoring). **The costs related to mitigation measures:** Mitigation measures may be related to **"Moderate"** costs.	The systematic supervision over the geological stability of the sensitive areas.
<u>Violation of hydrological regime – reduced river water flow</u>	• Maintain sufficient water flow for socio-economic purposes;	• Natural river runoff of the project river will be recorded during the construction and operation phases. Besides, control over the environmental flow release at headworks will be established (environmental flow will	**Responsible for implementation of mitigation measures:** Bakhvi 1 project manager	Monitoring of natural runoff. Systematic monitoring on the release of environmental flow (especially during low waters)

	• Maintain sufficient water flow for environmental purposes – less impact on water related biological environment.	be monitored daily). Results of monitoring over environmental flow will be submitted to the Ministry of Environmental Protection and Agriculture of Georgia on a quarterly basis; • In case of flow equal to or less than the environmental flow in the river, power plant will stop operation and full volume of water flow will be released downstream the headwork; • During the first 2 years of operation, fish fauna of the rivers will be monitored in the project river and the report will be submitted twice a year to the Ministry of Environment Protection and Agriculture. Additional mitigation measures will be taken, if necessary; • Within the framework of fish fauna monitoring, checking of the project impacted riverbed section will be emphasized. The control mainly considers observation on preservation of continuous stream in environmental flow conditions. If required, at critical points, riverbed management measures, including wood debris removal at these points and cleaning (relocation) only from those boulders, which hinder the continuity of the stream;	**Time-frames for implementation of mitigation measures:** • Regularly, on the operation phase; **The costs related to mitigation measures:** Mitigation measures are not related to additional costs.	
Impact on movement of sediments: Due to existence of the headwork and reduction of water flow in the river.	• Maintenance of riverbed dynamics and bank stability	• During floods flush gates will be fully opened in order to ensure downstream passage of sediments; • Twice a year, after the floods of spring and autumn, passage of sediments in the headwork sections will be monitored; • According to the results of this monitoring, if it is revealed that the sediment downstream release is limited, appropriate measures will be taken (e.g. cleaning the upstream by excavator, etc.).	**Responsible for implementation of mitigation measures:** Bakhvi 1 project manager **Time-frames for implementation of mitigation measures:** • On the operation phase during flooding; • On the operation phase twice a year, after spring and autumn floods; • If necessary. **The costs related to mitigation measures:** Mitigation measures can be related to “low” costs	Monitoring over sediment transportation at the headwork sections

Pollution of surface waters: • Surface water pollution with waste and untreated wastewater	Prevention of surface water pollution and accordingly, reduction of the environmental impact, such as: • Impact on water biodiversity; • Ground water pollution • Impact on receptors depended on water resources (animals, population).	• Systematic control over implementation of measures considered by the waste management plan; • Systematic supervision on fuel/oil storage and usage rules; • In case of accidental fuel/oil spill, localization of the pollution and implementation of measures to prevent deterioration of the surface water; • Instruction of personnel on environmental and safety issues.	**Responsible for implementation of mitigation measures:** Bakhvi 1 project manager **Time-frames for implementation of mitigation measures:** • Promptly after oil spillage; • Regularly on operation phase. **The costs related to mitigation measures:** Considered measures can be related to "medium" costs	Control of waste management plan implementation. Control of observation of rules related to the fuel/oil storage and usage; Visual control of soil and water condition.
Reduction of groundwater debit, which is related to natural runoff reduction on the section between the headwork and powerhouse.	Reduction of the impact on receptors depending on groundwater resources (population, biodiversity).	• Downstream release of environmental flow and systematic control over it.	**Responsible for implementation of mitigation measures:** Bakhvi 1 project manager **Time-frames for implementation of mitigation measures:** Permanent release of required environmental flow downstream **The costs related to mitigation measures:** It will be related to water loss for energetic purposes.	Constant monitoring on the release of environmental flow
Visual-landscape changes: • Visual change due to presence of HPP infrastructural facilities; • Pollution with waste;	• Preventing the people dissatisfaction; • Minimize change of animal habitat and migration.	• Usage of natural material during arrangement of facilities as far as possible, proper selection of colors;; • Implementation of recultivation and landscaping works; • Systematic supervision over downstream release of environmental flow; • Proper waste management.	**Responsible for implementation of mitigation measures:** Bakhvi 1 project manager **Time-frames for implementation of mitigation measures:** • during construction phase before commissioning; • Regularly on operation phase **The costs related to mitigation measures:** Mitigation measures can be related to "low" costs	Monitoring over performance of waste management plan, visual monitoring in order to control sanitary-ecological state of the area. Control over environmental flow release.
Impact on the behavior of the species:		• Mandatory environmental flow will be released in tailrace of the headworks;;	**Responsible for implementation of mitigation measures:** Bakhvi 1 project manager	Monitoring over regeneration of the vegetation cover. Control of environmental flow release

• Decline of the normal vitality due to the reduced water level in River and sparse forest. Animal migration;	• Minimizing the direct and indirect impacts on the animal species.	• Awareness of staff on illegal hunting/fishing will be raised and monitoring will be established; • Optimization of night illumination; Besides, • Proper waste management; • Implementation of mitigation measures considered for water, soil contamination (see relevant paragraph).	**Time-frames for implementation of mitigation measures:** • at recultivation stage; • Regularly on operation phase **The costs related to mitigation measures:** Measures considered by mentioned paragraphs may be related to "medium" costs	
Impact on aquatic biodiversity: • Negative impact on aquatic habitat. • Risk of getting fish in the intake and death	Maximum preservation of aquatic biodiversity	• Liquid flow management will be effectively provided. Established environmental flow will be permanently released downstream of headwork; • According to the project fish pass structure will be arranged at headwork in compliance with international standards. Technical functionality of fish pass will be regularly monitored and wood waste will be removed, which is especially important during spawning and migration periods of fish; • Technical functionality and operation of fish passage will be effectively monitored; • In order to minimize the risk of fish damage (death), fish excluders will be arranged on water intake; • During the first 2years of operation, species of ichthyofauna will be monitored in order to implement additional mitigation measures if required; • Within ichthyologic monitoring, checking project impacted riverbed section will be focused. Monitoring mainly considers checking stream integrity in the environmental flow conditions. If required, at critical points, riverbed management measures will be provided, which considers cleaning of mentioned section from debris and removal (relocation) of boulders, only which hinder the stream integrity. Additionally, following will be considered: • All mitigation measures in order to avoid quality deterioration of surface waters (see relevant paragraph);	**Responsible for implementation of mitigation measures:** Bakhvi 1 project manager **Time-frames for implementation of mitigation measures:** • On the construction phase; • Regularly, on the operation phase, especially, during spawning and migration periods. **The costs related to mitigation measures:** Mitigation measure can be related to "medium" costs	Periodic monitoring of technical functionality and efficiency of the fish passage. Control over environmental flow release. Control over the performance of waste management plan. Monitoring of River biological environment.
	Prevention of the disorganized waste spread to reduce of the	• Corresponding storage infrastructure will be arranged on powerhouse site for temporary disposal of waste;	**Responsible for implementation of mitigation measures:** Bakhvi 1 project manager	Monitoring over performance of waste management plan by

The risks of the environmental pollution with waste: • Hazardous waste (oil used in turbine and transformer, etc.) • Household waste;	following indirect environmental impacts: • adverse impact on human health; • water environment pollution; • adverse impact on wildlife; • adverse visual-landscape change, etc.	• Corresponding containers will be arranged on powerhouse site for disposal of household waste; • Appropriately trained personnel will be hired for waste management, who will undergo training and testing; • Instruction of personnel; • Reusing of waste as far as possible; • Hazardous waste will be removed from the site only by the contractor, holding appropriate permit for this activity;	**Time-frames for implementation of mitigation measures:** • during construction phase before commissioning; • Regularly on operation phase **The costs related to mitigation measures:** Mitigation measures considered by paragraphs can be related to "low" costs	specially designated personnel. Record waste types, amounts, keep relevant record book.
Employment and the adverse impact risks related to it, in particular: • The expectation of employment and the dissatisfaction of the locals; • The violation of the rights of the employees; • The discord between the local population and the employees (non-locals).	• Preventing the dissatisfaction of the personnel and the local population;	• Staff recruitment policy will be developed and published at local (office), municipal (administrative building, etc.) and regional levels; • Employment on the basis of relevant testing; • Signing individual work contract with each employee; • The contract signed with the personnel will include articles about all plans, procedures and mitigation measures, as well as articles related to monitoring of the safety plans and reports on accidents; • Every employee will be informed about their work - code of conduct will be developed; • All non-local employees should be informed about local habits and culture; • Grievance mechanism of personnel will be developed and practiced. • Grievance Book of personnel will be practiced.	**Responsible for implementation of mitigation measures:** Bakhvi 1 project manager **Time-frames for implementation of mitigation measures:** • Prior to the works (before and after recruitment), as well as during the construction works if a new staff is hired. • During the implementation of works **The costs related to mitigation measures:** Mitigation measures will not be related to significant additional costs	Establish grievance redress mechanism. Keep disciplinary recording.
Health and safety related risks: • The expected impacts on health and safety of the population; • The expected impacts on health and safety of the personnel;	• Ensuring the human health and safety	• Personnel should to be trained on safety and labor protection issues; • Provision of personnel with medical insurance; • Personnel must be equipped with means of personal protection; • Prohibiting, warning and indicating signs will be placed on areas dangerous for health; • Fencing of areas dangerous for health; • Presence of standard first-aid kit on areas dangerous for health and on construction camp; • Ensure technical functionality of the vehicles and equipment;	**Responsible for implementation of mitigation measures:** Bakhvi 1 project manager **Time-frames for implementation of mitigation measures:** • during personnel recruitment and several times a year afterwards; • before the works; • before starting works and constant update; • Constantly during working process.	Control over the technical functionality of the machinery and equipment. Making notes about the incidents and accidents. The unscheduled inspection of the personnel.

		• Control and prohibition of unauthorized and unprotected access to the construction site; • In-situ assessment of risks to determine specific risk factors for population and for proper management of such risks; • Incidents and accidents should be recorded in special Register. Besides, • Implementation of all measures in order to prevent water and soil quality deterioration. Implementation of mitigation measures against noise distribution (see relevant paragraphs.).	**The costs related to mitigation measures:** Considered mitigation measures can be related to low costs	

Except the measures listed in the previous paragraph, the operator company will recurrently carry out maintenance/repair and corresponding monitoring works for the certain infrastructural facilities of the HPP. Works listed below are significant for the proper and regular operation of the HPP and for prevention of sudden damage to the infrastructure. However, the listed measures reduce different negative impact risks, expected on the environmental receptors in the result of some unexpected accidents:

- Recurrent inspection of the mechanical installations of the headworks and improvement whenever required (cleaning, painting);
- Cleaning of the settling tanks from the sediments;
- Maintenance of walls and bottom of the settling tanks;
- Periodic inspection of the diversion/penstock system;
- Detection of water leakage on the inlet and outlet of the penstock with the comparison method of the measured flow;
- Seasonal maintenance works of the HPP:
    - Inspection of the main technological (turbines, generators) and auxiliary installations (valves, cranes, pumps, etc.);
    - Check fencing of structures, improvement of gates, warning signs, lightning and organizing the territory if necessary;
    - Checking and repairing of electrical installations;
    - Visual monitoring over technical functionality of transformers and circuit breakers and repairing if required;
    - Change/adding oil in the transformers;
    - Mowing of the grass, regular mechanical control of the weeds along the fence;
- Ensure proper condition of the access roads.

8 Environmental Monitoring Plan

In the framework of the HPP construction and operation, the process of environmental monitoring aims at resolution of the following objectives:

- Confirming that the construction and exploitation procedures are carried out in compliance with the environmental legislation;
- Providing control of the risks and environmental impacts;
- Providing stakeholders with relevant environmental information;
- Confirmation of the process of minimizing/mitigating the negative impacts, determination of their effectiveness and making necessary adjustments if necessary.
- The permanent environmental control during the project implementation (construction and operation).

Environmental Monitoring Plan for HPP construction and operation phases is given in paragraphs 8.1.1. and 8.1.2. It should be noted that the given plan is general and it can be detailed and corrected in some directions. The project executor takes responsibility for performance of Environmental Monitoring Plan.

Table 8.1 Monitoring Plan on the Construction Phase

Subject of Control/ Controlling activity	Control/Sampling point	Method	Frequency/Time	Goal	Responsibility
1	2	3	4	5	6
Ambient Air Quality:					
Air (Dust and emission)	• Construction camp; • Construction sites; • Access roads to the construction sites	• Visual; • The technical checkup of the machinery and equipment	• Regularly, during the earth works in a dry weather; • During the construction works; • Through the intensive transport operations, in a dry weather; • Technical checkup before the work start;	• Minimal disturbance of population; • Ensuring safety of the personnel; • Minimal disturbance of the vegetation/flora and fauna; • Development and implementation of the additional mitigation measures (e.g. watering the roads).	C-C-E-H Hydro VI LLC
Noise and vibration	• Construction camp; • Construction sites; • Access roads to the construction sites	• Technical checkup of the machinery.	• Technical checkup before the work start	• Ensuring the compliance with the health and safety regulations; • Ensuring the comfortable working conditions for personnel; • Minimal disturbance of fauna; • Determination of the need of additional measures.	„--------------“
		• Instrumental measurement of noise level	• During intensive noise-generating works once a month.		
Geological environment, ground stability, hazardous geodynamic and hydrological processes:					
Landslide processes.	• Landslide site on the left bank; • Headwork location section;	• Observation over the landslide process development likelihood;	• Permanently during the construction works; • Permanently during excavation of the pipeline corridor;	• Ensuring the stability of the slopes; • Preventing the damage of the facilities under	„--------------“

	• Penstock corridor; • Other more or less sensitive sites of the project area.	• Observation over the hazardous geodynamic process development; • Inspection of the slope stability.	• After extremely intense precipitations; • During intensive traffic movement; • Inspection by the engineer-geologist after the completion of works	construction and human injuries; • Development and implementation of the additional mitigation measures (terracing, reinforcement);	
Mudflow events and sensitive sites toward these events – constructing sites	• Temporary diversion structure of Headwork; • Up and downstream of the Headwork construction site; • Existing road, especially at riverbed turning points and near the riverbed.	• Observation on the stability of construction facility; • Observation over proper functionality of the temporary diversion structure; • Observation over distribution of mudflow runoff (in order to identify the risk of riverbed blockage).	• Recurrently, especially prior to spring and autumn floods; • After intense precipitations;	• Safe passage of mudflow stream and protection of constructing structures against damage; • Prevention of riverbed blockage and accompanying adverse processes; • Provision of safety of personnel.	„--------------“
Rockfall risk	• More or less sensitive sites of the project corridor.	• Observation over activation of rockfall processes.	• Permanently during the construction works; • Permanently during excavation of the pipeline corridor; • After extremely intense precipitations; • During intensive traffic movement; • Inspection by the engineer-geologist after the completion of works	• Ensuring the stability of the slopes; • Preventing the damage of the facilities under construction and human injuries; • Development and implementation of the additional mitigation measures	
Fluvial erosive processes and bank stability	• Up- and downstream shoreline of headwork;	• Observation over the scale of erosive processes; • Observation over the safety of the constructing structures.	• Recurrently, especially, prior to spring and autumn floods; during floods and after flood season.	• Maintenance of the shoreline stability;	„--------------“

	• Sections of the pipeline and those sections of the road, which approach the riverbed; • Power house site along the whole length of the riverbed.			• Protection of the constructing structures and access roads against damage; • Development and implementation of the additional mitigation measures (bank protective structures);	
Soil/ground:					
Stability of spoil grounds	• Disposal area for the waste rocks	• Observation on development of the erosive processes (scouring)	• Inspection after heavy precipitations on the construction phase; • Inspection after completion of the construction and recultivation works.	• Prevention of development of the erosive processes and maintain stability of the pile	„--------------“
Soil/ground quality	• Construction camp; • Construction sites; • Warehousing sites for the material and waste.	• Control, supervision; • Control of technical functionality of machinery/vehicles; • Lab control	• Periodical inspection; • Inspection after the construction works; • Lab survey – in case of spillage of polluting substances.	• Maintain of soil/ground quality.	„--------------“
Aquatic Environment:					
Natural runoff of Bakhvistskali river.	• Headwork location site.	• Use of flow meters and level meters.	• Permanently on the construction phase. Submitting to the Ministry – once in a quarter.	• Specification of natural flows of the project river.	„--------------“
Surface water quality	• Construction camp; • Construction sites – near the water bodies	• Visual; • The technical checkup of the machinery and equipment; • Monitoring over the solid and liquid waste management;	• Through the arrangement of the construction sites (near the water bodies), especially after the rain/snow;	• Providing water quality protection	„--------------“

		• Monitoring over the sanitary-fecal wastewater management; • Lab control.	• Through the working process (near the water bodies); • During the transporting/disposal of the solid waste; • Technical checkup before the work is started; • Lab survey – after identification of pollutant spill.		
Vegetation cover:					
Vegetation cover within the project corridor	• Within the headwork corridor; • Penstock corridor; • Locations for powerhouse; • Construction camp and other work sites	• Visual control • Control over protection of boundaries of the construction sites;	• Monitoring through the process of the vegetation removal; • At the other construction sites – Unscheduled control; • Inspection of vegetation cover after completion of works, control over their recovery measures.	• Maintaining the vegetation cover. Minimum disturbance of the fauna/ population; • Minimizing the negative impacts on the animals	„-------------“
Wildlife:					
Sensitive habitats; animals, living near the project corridor or visiting the area, (especially those species that are protected under international conventions or Red List of Georgia)	• The surroundings of the construction camp and construction sites; • Riverbank line; • Access road corridors.	• Identification/recording of holes, bird nests and shelters of bats; • Observation over the animal species and comparing to the baseline state; • Visual observation over the pits trenches made for the foundations	• Identification/recording of holes and nests prior the construction works and inspection after completion the construction process; • Observation over the animal species (occasionally during the construction and after the works are finished; • Inspecting the pits and trenches - before backfilling;	• Minimizing the negative impacts on animals; • Assessing the effectiveness of the mitigation measures; • Determination of compensation measures and additional mitigation measures if necessary.	„-------------“

Performance of mitigation measures by the construction contractor	• Surroundings of construction camp and construction sites; • Transport corridors;	• Supervision over the personnel; • Unscheduled inspection	• Inspection prior and after the construction works; • Supervision - permanently (especially, at the preparatory stage); • Inspecting - unscheduled.	• Confirm performance of the mitigation measures by the personnel; • Providing additional trainings and explanations for the personnel; • Prevention of poaching facts.	„-------------“
Aquatic biodiversity (esp. red-listed species)	• Section under the river impact zone	• Conduct a survey by corresponding specialist (ichthyologist) and submit the report to the Ministry of Environment Protection and Agriculture	• Once a year during construction.	• Assessment of impact on fish fauna caused by ongoing construction works. If required, determining the additional mitigation measures; • Assessment of efficiency of the defined mitigation measures.	„-------------“
Waste:					
The state of waste management	• Construction camp and its surroundings; • Construction sites; • Waste disposal areas, spoil grounds.	• Visual observation of the area; • Waste management control.	• Regularly, especially in windy weather; • Within the spoil ground borders – after the flood or precipitations.	• Maintaining the soil, water quality; • Minimum effect on the biodiversity; • Less visual-landscape change.	„-------------“
Occupational safety:					
The status of the compliance with the safety standards by the personnel	• Work area	• Inspection; • Presence of the personal protective equipment, regular control over their functionality; • Monitoring of the technical functionality.	• Occasional control in the working process; • Unscheduled inspection	• Ensuring the compliance with the health and safety standards; • Avoiding/minimizing the injuries	„------------“
The monuments of the archeological and cultural heritage:					

The possible late discovery of the archeological artifacts during the construction	• The work area	• Visual observation	• permanent observation during the earth works; • Inspecting the arranged pits before taking further actions	• Prevention of the accidental damage of the archeological monuments	„--------------“

Above-mentioned information is supplemented with mitigation measures, developed by the international consultation company SLR, which have been combined with Biodiversity Management Plan.

General Mitigation Measures:

- Restriction of lighting and light emission in the forest or in forest areas. Usage of the yellow light instead of the white one. The light should not be in all the time, but motion detectors and circuit breakers on timer should be used.
- On construction and operation phases, waste management plan should be considered at waste storage areas, in order to reduce potential conflict between humans and wildlife;
- On construction and operation phases Pollution Prevention and Control Plan should be considered, in order to reduce occurrence of pollution incidents;
- Usage of silt retention devices in drainage channels, to avoid solid waste occurrence in water springs; a fiber material, hay bales may be used for sediment retention.
- After day hours, no earth works will be implemented or heavy equipment used to avoid disturbing or injuring nocturnal animals.
- Vegetation cover removal and earth works will be carried out with consideration of hibernation period (October-April/May) of reptiles and Brown Bear.
- On construction phase, the best international practice in the field will be implemented, including usage of bridges on springs and arrangement of corresponding drainage systems.
- Trees, having a nesting places for bats, will be checked prior to felling. If nests are found, they will be left overnight so that bats can leave this place naturally.
- Before tree felling, they will be inspected in order to check presence of Caucasian squirrel in breeding period; in case of identification of its nest, trees should not be cut until squirrels do not leave their nests.
- Cleaning of the area from shrubs and trees is prohibited in nesting period (from April to August – depending on the location above the sea level). In exceptional cases where vegetation removal is necessary during this period, the nests will be inspected by a qualified person. Vegetation will only be cleared if nests/bat roosts are not occupied/used.
- Fencing water ponds to avoid animals to get into them and be trapped.
- Prevention getting in deep trenches (by fencing or covering). Arrange a way to come out of deep trenches to avoid animal trapping in them.
- Implementation of Invasive Species Control Plan, as required.
- Clear marking of all areas, subject to vegetation cover removal, will be provided (fencing or usage of biodegradable paint), no other vegetation cover outside the fencing will not be impacted.
- Raising awareness in schools on wildlife; preparation booklets about wildlife benefits (reptiles, mammals, invertebrates, fish and birds, etc.) This may also include site visits.
- If Guria National Park is established, the project will provide support for the implementation of the park management plan.

Vegetation Cover

Key Objectives:

- Proper removal and storage of the topsoil;
- Local species should be used for planting, which are characteristic to the habitat subject to restoration. It is possible by using local resources instead of arrangement a special nursery.
- For local planting of seedlings and trees, community involvement should be considered. This approach has worked in other projects.

- Holding meetings and reaching agreements with local land users to address both biodiversity and agricultural needs.

Monitoring

With regard to landscaping strategy, in some cases plants may not grow for a variety of reasons. In order to make the forest development (forestation) program to be as successful as possible, a post-landscaping program will be implemented. This program will be valid for 5 years after construction is completed. The landscaping follow-up care program includes an annual survey of reforested areas of the forest to determine the progress rate of landscaping and to take additional measures if necessary.

Annual monitoring for each of the restored sites for the first five years also considers erosion monitoring in the restored areas. Erosion usually decreases after vegetation and root system formation, although a number of mitigation measures may be required to reverse erosion within the first five years if it is significant.

After monitoring of each restored area for the first five years, the need and frequency of monitoring will be reviewed and this plan will be updated as necessary.

Compensation Planting

Key Objectives

- Management and replanting of trees to degraded and deforested areas near the intake and the powerhouse sites. Planting should be carried out at least on 20 ha area to achieve net growth comparing to 9.09 ha permanent habitat loss, expected due to the project implementation.
- Replanting/reforestation above existing tree line using coniferous species; this activity can bring benefits for adaptation to global climate changes.
- Management of fields around the intake site to prevent overgrazing and further increase the availability of suitable habitat for the Caucasian salamander.

Monitoring

With regard to landscaping strategy, in some cases plants may not grow for a variety of reasons. In order to make the forest development (forestation) program to be as successful as possible, a post-landscaping program will be implemented. This program will be valid for 5 years after construction is completed. The landscaping follow-up care program includes an annual survey of reforested areas of the forest to determine the progress rate of landscaping and to take additional measures if necessary.

It is expected that in five years trees and other plants will be steadily represented and grown, as this area is relatively humid, green area, where plant species grow more quickly; thus, follow-up care is not needed. However, this area will be properly assessed and monitoring program will be proceeded as required.

Field management progress program for Caucasian salamander will be included in the monitoring of these species.

Reptiles

Key Objectives

- Instruction for all project personnel in order to provide them with information on work practice in relation with reptiles, such as fencing certain areas, as well as how to behave if they see a reptile, whom communicate about it.
- Fencing should be arranged around the work sites for sufficient time, prior to the start of works.
- Vegetation cover removal and start of earth works after hibernation period (October-April/May) of reptiles.

- Ground/timber/stone piles, accumulated in the result of excavations during summer months, which should be placed in “safe fenced areas”, will be dismantled only in the active period (April/May-October) for reptiles.
- Collection and relocation of eggs (spawning) and tadpole larvae in ponds on access roads or work areas (e.g., in the ponded vehicle’s traces). This will benefit to a number of amphibian species.
- During the active season for reptiles (April/May - October), security group will inspect roads and trenches every morning, in order to release trapped animal (if any), including reptiles, before works start.

There are mitigation or in some cases compensation measures given below. They can be carried out during or after construction.

- Creation of 10 wintering places, which will be used by Caucasian salamander. Location for wintering places are determined based on elevation above the sea level and slope.
- Raising awareness in schools about the wildlife. Preparation of information package on the usefulness of the wildlife (reptiles, mammals, invertebrates, fish and birds, etc.). This may consider site visits.
- Creation at least 8 ponds for Caucasian salamander above the water intake.
- Management of fields around the intake site to prevent overgrazing and further increase the availability of suitable habitat for the Caucasian salamander.

Monitoring

Monitoring will be carried out over Caucasian salamander. This includes target surveys in May and June for monitoring their presence. Monitoring results will give the information about the effectiveness of reservoir arrangement and if additional measures are potentially required; for example: change of depth and location of arranged small reservoir. Applied methodology will be similar to that used during preconstruction surveys and will be carried out so that it can be expandable and obtained data can be compared by years. The monitoring also considers examination of the turbidity in small streams, as the transparency of these streams is a good indicator for rescuing of eggs or larvae of salamander.

Mammals, birds and invertebrates

Key Objectives

- Bat boxes or bat blocks will be built in the powerhouse building. In addition, 40 boxes will be placed on trees between the powerhouse and intake sites.
- Five nesting boxes will be placed for boreal owl on trees between the powerhouse building and intake sites;
- 20 nesting boxes and roosts on Bakhvi 1 powerhouse building for birds, such as common swift, swallow and common house martin.
- When a beech or other host tree for alpine longhorn beetle is cut, logs are placed in 6 piles. Cut logs will be placed directly on the opposite side of the south/south-west slopes, below the powerhouse.

Monitoring

When artificial nests and bat nests are arranged, all points will be marked with GPS and depicted on a map. Once a year an environmental officer will inspect each box (generally in autumn), visually observe the damaged areas to repair/replace them as needed throughout the useful life of the facility.

No special monitoring measures are proposed, however, recorded notes on all incidents should be collected and combined. This includes facts identified by the environmental and social team during construction, as well as data recorded by project staff during construction and operation. All notes and records will be collected in the annual report.

Otter will be monitored via a video camera (CCTV), which will be placed at Bakhvi 1 intake and will be used to monitor otter activity at the intake site. All signs of otter existence will be recorded in the Register, and all video recordings will be kept. It will then be possible to submit an annual report. Data on otters will also be recorded when conducting fish survey, see next section.

Fish

Key Objectives

- Fish excluder will be used at Bakhvi 1 intake to avoid fish occurrence in the pipe and turbine.
- Fishing will be restricted within 200 m radius up and downstream Bakhvi 1 intake.
- Issue of arrangement of fish way at Bakhvi 1 intake will be considered instead of the fish ladder, if it is technically possible.
- Installation of video-camera (CCTV) at Bakhvi 1 intake to carry out monitoring. This can be used to eliminate or identify illegal fishing.
- Within the project framework, riverbed management should be considered, which covers the section between Bakhvi 1 intake and the powerhouse. Implementation of the given program will facilitate to restoration of the ecological integrity, which will be positively reflected on fish population.

Monitoring

Fish monitoring program will be carried out on 6 locations, including near Bakhvi 1 powerhouse building; next two locations are in the upstream direction from intake, to Bakhmaro. The monitoring will be carried out using electrical devices and other legally permitted equipment, as required, every year in autumn. Monitoring also considers involvement of local fishermen, in order to determine which points are used by them for fishing, how much fish/in what size and in what season is caught. This information can then be used to define the efficiency of the fish pass for consideration of the brook trout population status in the river or the given river section surveys. The monitoring will be carried out yearly during construction and for the first three years after construction. After that the frequency of the survey will be reviewed.

Additional information on biodiversity management plan is provided in Annex N8 (SLR).

Table 8.1 Monitoring Plan for Operation Phase

Subject of Control/ Controlling activity	Control/Sampling point	Method	Frequency/Time	Goal	Responsibility
Ambient air:					
Noise	• Powerhouse;	• Ensuring the technical functionality of the equipment; • Instrumental measurement.	• Regular control; • Instrumental measurement – in case of entry of complains or after repair works.	• Ensuring the compliance with the health and safety regulations; • Minimal impact on fauna	C-C-E-H hydro VI LLC
Geological environment, soil stability, hazardous geodynamic processes:					
Landslide-gravitational and other hazardous geological processes.	• Project corridor. Especially pre-determined sensitive sites and those, identified during construction process.	• Monitoring over the development of geodynamic hazards; • Monitoring of slope stability;	• Visual observation after the intensive precipitations; • Inspection by the engineer-geologist twice a year during initial years of operation.	• Ensuring the stability of the slopes; • Preventing the damage of the facilities and the human injuries; • Development and implementation of the additional mitigation measures.	„------------“
Protective structures.	• Protecting walls arranged at the slopes and river side through the project corridor and the surrounding sites.	• Inspection of technical functionality of protective structures; • Inspection of development of erosive or other processes on the surrounding sites.	• Inspection by the engineer-geologist twice a year	• Providing the slope stability; • Preventing the damage of the facilities and the human injuries; • Development and implementation of the additional mitigation measures (terracing, reinforcement);	„------------“
Soil/ground:					
Soil/ground quality	• Territory of powerhouse; • Waste disposal sites.	• Visual control • Lab testing	• After adding/ changing the transformer oil; • Lab research – In case of oil spill.	• Maintaining the soil quality; • Preventing the surface water pollution by surface runoff; • Preventing the ground water pollution.	„------------“
Aquatic environment:					

Natural river runoff	• At the section of headwork location	• Measurement by using flow meter, installed at headwork	• Operation phase – regularly. • Submission of the results to the Ministry – once in a quarter.	• Specification of the natural runoff	„-------------“
Environmental flow release	• Downstream of headworks	• Measurement of environmental flow using flow meter and/or level gauge.	• Operation phase – daily. • Submission of the results to the Ministry – once in a quarter.	• Ensure constant environmental flow release downstream and minimizing the impacts related to the water receptors	„-------------“
Solid flow release	• Upstream and downstream of headworks	• Inspection of sediment accumulation upstream and defining possibility of transit release of sediments downstream.	• Periodically, during shallow water; • Inspection twice a year after spring and autumn floods	• Providing sediment release from upstream to downstream; • Maintain stability of banks; • Cleaning of upstream with excavator if necessary.	„-------------“
Biological environment:					
Sensitive habitats; inhabiting or visitor animals within the neighboring sites (esp. endangered species).	• Neighboring sites to HPP location; • Corridor of access roads;	• Observation on animal species and comparison to baseline data.	• Twice a year during 2 years after commissioning;	• Check efficiency of mitigation measures; • If required, determination of compensation and additional mitigation measures.	„-------------“
Aquatic biodiversity	• The river section within the impact zone (esp. sensitive sections described in EIA report).	• Conduct a survey by corresponding specialist (ichthyologist) and submit the report to the Ministry of Environment Protection and Agriculture	• Within 2 years after commissioning, twice a year.	• Prediction of the damage made to the fish fauna and determining (if needed) the additional mitigation measures; • Assessing the effectiveness of the mitigation measures.	„-------------“
Technical functionality of fish pass and effectiveness of its work.	• Fish pass	• Inspection by the engineer-specialist	• Prior to the fish migration period	• Possibility of upstream movement of fish	„-------------“
Waste	• Headwork area; • Powerhouse site; • Waste disposal areas	• Visual observation of the territory;	• Periodically.	• Protection of the soil, water quality.	„-------------“

		• Monitoring over the waste management			
Occupational safety	• Work implementation area	• Inspection; • Presence of the personal protective means, regular control over their functionality;	• Regular control in the working process.	• Ensuring the compliance with the health and safety regulations; • Avoiding/minimizing the injuries.	„-------------“

9 Possible Emergency Situation Response Plan

The goal of the given Emergency Response Plan is to create and define guidelines for constructing and operator company personnel, in order to ensure the provision of rational, coordinated and efficient activities by the personnel, working within the project and other staff, during the response and liquidation process on manmade accidents and incidents of any scale, as well as protection of staff, population and environment.

Objectives of the Emergency Response Plan are as follows:

- Identify possible emergency types during implementation of planned activities according to its specification;
- Define each emergency response group members, equipment, action plan and responsibilities during emergency situations;
- Identify internal and external communication system, their order, communication ways and methods and ensure delivery of notification (information) about emergency situation;
- Immediate activation of internal resources and if necessary, mobilization of additional resources according to stated rules and definition of relevant procedures;
- Ensure activation of emergency response organizational system;
- Ensure compliance with the legislative, regulatory and industrial safety requirements of the internal code of conduct during emergency response process.

Following emergency situations may occur during process of the planned activity:

- Emergency situations related to damage of hydraulic structures;
- Risks of accidental spill of pollutants;
- Fire (including landscape fire);
- Road accidents;
- Personnel injury (traumatism);

Emergency Response Plan for emergencies expected during HPP construction and operation is given in Annex N11.

10 Determination of Ways and Means to Restore Former Environmental Conditions in Case of Termination of HPP Operation

10.1 Short-Term Cessation of Operation or Repair of the HPP

In case of temporary cessation of operation of the HPP or in case of repair works (minor and major) of the existing facilities, operation service will develop operational plan related to a temporary suspension of activities or repair works, which firstly includes security requirements and should be coordinated with the local authorities and all interested legal persons.

10.2 Long-Term Cessation of Operation or Conservation of the HPP

In case of long-term cessation of the HPP or conservation, administration will establish a liquidation body, which will develop the plan for long-term cessation or conservation. The plan for long-term cessation or conservation of HPP, major content of which must be safety requirements, should be coordinated with the authorized agencies (including the Ministry of Environment Protection and Agriculture of Georgia).

Following measures are to be carried out before the termination of the activities:

- Internal audit of the area – to record the technical condition of infrastructure, to identify the risks of emergency situations, as well as environmentally problematic areas and to solve the problem;
- Temporary demobilization of supporting infrastructure – to remove the stockpiled material and waste from the warehouse, and to allocate a special area for equipment and vehicles;
- To provide warning and prohibition signs throughout the outer perimeter of the area;

10.3 Decommissioning

In case of liquidation of the HPP, a special project identifying the ways and means of restoring previous conditions of the environment must be developed.

Such project must be developed by the operator company. Under the current rules, a special project of termination should be agreed with the competent authorities and the information should be provided to all stakeholders (physical and legal entities). The project shall cover rules and the sequence of termination of technological processes, dismantle of facilities and equipment, terms and conditions of demolition works, safety and environmental measures, terms and conditions of neutralization and disposal of hazardous waste, recultivation works and other issues.

11 Public Disclosure at Scoping Stage and Assessment of Public Opinion and Comments

Pursuant to the requirements of the Law of Georgia – Environmental Assessment Code, public discussions of the scoping report and EIA report of the project are provided by the Ministry of Environmental Protection and Agriculture of Georgia.

Public discussions of the given EIA report will be held compliant with Article 11 and 12 of the Environmental Assessment Code, namely:

- Within the three days after registration of EIA report application, the Ministry shall have the application and the attached documents placed on its official website and on the notice board of the executive body and/or representative body of a respective municipality, and upon request, shall make printed copies available under a procedure established by the legislation of Georgia.
- Within three days after an application for obtaining an environmental decision has been registered, the Ministry shall establish an expert commission provided for by Article 42 of this Code to review the EIA report. The expert commission shall prepare and submit to the Ministry an expert opinion on the EIA report within 40 days after the establishment of the commission.
- The public may, within 40 days after the placement of the application under the procedure established by Article 11(3) of this Code, submit to the Ministry opinions and comments under the procedure established by Article 34(1) of this Code with respect to the EIA report, the planned activity and the conditions to be included in the environmental decision. When making an environmental decision or a legal act refusing the carrying out of the activity, the Ministry shall ensure the review of the opinions and comments submitted and, if there are appropriate grounds, take them into account.
- Not earlier than the 25th day and not later than the 30th day after the placement of the application under the procedure established by Article 11(3) of this Code, the Ministry shall hold a public review of the EIA report. The Ministry shall be responsible for organizing and holding reviews. Public reviews shall be led, and the minutes of public reviews shall be drafted, by a representative of the Ministry. The Ministry shall be responsible for the accuracy of the minutes. Information on the public review shall be published not later than 20 days before the public review is held, in accordance with Article 32 of this Code. Public reviews shall be held in the building of the appropriate administrative body located closest to the location of the planned activity or in the

territory adjacent to the building. If it is planned to carry out the activity within the administrative boundaries of a self-governing community, public reviews shall be held in the building of the appropriate administrative body located closest to the location of the planned activity or in the territory adjacent to the building; or if it is planned to carry out the activity within the administrative boundaries of a self-governing city, public reviews shall be held in the building of the appropriate administrative body determined by the Ministry or in the territory adjacent to the building. Public reviews shall be open and any member of the public may participate in them.

The public hearing of the Scoping Report for Bakhvi 1 HPP construction and operation project was held on January 29, 2021. For prevention of noval coronavirus within the country, pursuant to amendments made to the Law of Georgia – Environmental Assessment Code, public hearing of the scoping report was held remotely, using electronic means of communication.

The information about response by the Ministry of Environmental protection and Agriculture of Georgia on issues, required by the Scoping Opinion is provided in the Table 11.1.

After public hearing of the Scoping Report, by initiation of the project executor company – C-C-E-H Hydro VI, 43 meetengs were held with the stakeholders. The information on meetings with stakeholders is provided in the paragraph 5.5.9.

The information about response on comments and opinions of stakeholders, made during the public hearing, is given in the Table 11.2.

Table 11.1. Information on response to issues required by N29 Scoping Opinion of the Ministry of Environmental Protection and Agriculture of Georgia on June 10, 2021 for Bakhvi 1 HPP project.

N	Issues Required by the Scoping Opinion	Performance status
1	**EIA report should include** information defined by the Section 3 Article 10 of Environmental Assessment Code;	The report is prepared in compliance with requirementas of the Section 3 Article 10 of Environmental Assessment Code;
2	The documentation defined by the Section 4 Article 10 of Environmental Assessment Code **should be attached to EIA report.**	The documentation defined by the Section 4 Article 10 of Environmental Assessment Code is attached to the report.
3	**EIA report should provide** survey results, indicated (defined, planned) in the scoping report, the obtained and examined information, impacts, studied in details within the EIA process and reduction/mitigation measures;	**Considered**
3.1	**Pursuant to the Section 2, Article 10 of Environmental Assessment Code, EIA report should be signed by a peson, people, who participate in its preparation, including consultants.**	See par. 1.2. of EIA report
4	**Following information should be provided in EIA report:**	
	Project Description;	See par. 4.
	Justification of the need for the project	See par. 3.7 and par. 3.8
	Technical parameters of HPP	See par. 4.1
	Shape files of HPP constituent facilities, substation, access roads, spoil grounds and construction camp.	The electronic version of Shape files of HPP constituent facilities, substation, access roads, spoil grounds and construction camp is attached to EIA report.
	Description of HPP infrastructural facilities;	See par. 4.
	Space between main HPP infrastructure and the nearest residential house and Bakhmaro resort indicating specific distances.	See par. 4.1
	The detailed information on the penstock (parameters (length, diameter, section, etc.), where it is also discussed the penstock corridor, ravine crossings, crossings of surface bodies and Bakhvistskali and Baisurastskali river tributaries)	See par. 4.1.2.
	The detailed information on HPP turbines, indicating at design flows and capacities	See par. 4.1.3.
	Project alternatives: with corresponding justification, including no-action alternative, alternatives for locations of HPP infrastructural facilities, access roads and substation, the environmentally justified alternative;	See par. 3.3.

	A detailed description of the fish pass and fish excluder, design drawings and information on their operation, including upper and lower elevations of the fish pass, parameters, results of the hydraulic calculation (in order to forecast the impact on fish fauna).	See par. 4.1.1.1 and par. 4.1.1.2.
4.1.	**Information about implementation of the construction works, namely:**	
	Issues related to the need for access roads and construction of these roads, including longitudinal profiles and cross sections of access roads.	See par. 4.2.5.1.
	A detailed information about vegetation and soil cover removal works, earth works and recultivation works (in compliance with requirements of the Technical Regulation on Topsoil Removal, Storage, Usage and Recultivation);	See paragraphs 4.2.8 – 4.2.10
	Order of HPP and its infrastructure construction (indicating terms);	See par. 4.2.1.
	List and number of equipment and machinery, used during construction of HPP, related infrastructure and access roads;	See par. 4.2.3.
	Number of people, employed on HPP construction and operation phases, including the share of locals among them.	See par. 4.2.1.
	The issue of excavated rock handling; where is temporary or final disposal of waste rock planned, which are not suitable for usage in construction. In particular, coordinates of waste rock disposal (spoil ground), volume and spoil ground project with its anti-scouring protective structures (if any)	See par. 4.2.6.
	Issues related to inert material extraction, transportation and disposal, which are required for construction activities.	See par. 4.2.4.
	The information about construction material manufacturing facilities;	See par. 4.2.2.
	The master plan of construction camp with explication and high resolution	See par. 4.2.2.
	Coordinates and area of the construction camp sites	See par. 4.2.2.
	List and characterization of existing and planned infrastructure in the construction camps, which are designated to serve HPP construction	See par. 4.2.2.
	Description of water supply project (individually or from water supply systems)	See par. 4.2.7. Water supply of camps will be provided individually, from nearby local streams.
	Detailed information on vegetation and soil cover removal and recultivation works	See paragraphs 4.2.8 - 4.2.10.
	Total number of people, employed on construction and operation phases, including the share of locals among them.	See par. 4.2.1.

4.2.	**Geological Survey Report conducted within the corridor, which should include following information:**	
	Geological structure of the project site	See par. 5.2.2.2
	General geological map of the region;	See par. 5.2.2.2. and Annex N3
	Relief (geomorphology);	See par. 5.2.2.1.
	Engineering-geological map, engineering-geological profiles;	See par. 5.2.2.7. and Annex N3
	Description of geomorphological, geological, hydrogeological, seismic and tectonic conditions of the area.	See par. 5.2.2.2
	Results of the engineering-geological survey, conducted within the project corridor (Number of boreholes, location, lab surveys, results of the ground laboratory survey, etc.). Locations and description of the sites, which are complicated from hazardous geodynamic process (landslide, erosion, rockfall) activation viewpoint, should be emphasized. Detailed description of planned preventive/mitigation measures (protective structures, terracing of slopes, etc.) should be provided.	See par. 5.2.2.2 and par. 6.5.
	Surface/underground water impact assessment during HPP construction-operation and corresponding mitigation measures	See par. 6.8.
4.3	**Hydrological survey report, which should include following information:**	
	Bakhvistskali and Baisurastskali river hydrology	See par. 5.3. Since no weir is planned on Baisurastskali river, only hydrological mode of the project section of Bakhvistskali river is discussed in the hydrological report
	Detailed information on average annual river flow and inter-annual distribution of the runoff for Bakhvistskali and Baisurastskali rivers	See par. 5.3.
	Detailed information on maximum runoff, minimum runoff, solid sediment for Bakhvistskali and Baisurastskali rivers	See par. 5.3.
	Length and width of Bakhvistskali and Baisurastskali rivers (as total, so within the project section)	See par. 5.3.
	Detailed information on tributaries of Bakhvistskali and Baisurastskali rivers. Determination of the share of trobitaries in river flows.	See par. 5.3.
	Methodology for environmental (sanitary) flow determination	See par. 6.7.3.1.
	Detailed information on water amount to be used by HPP for 10%, 50% and 90% provisions.	See par. 6.7.3.1.
	Information about mudflows and if required, measures against mudflows, information about riverbed processes and bank protection works.	See par. 6.5.2.

4.4	**Biological environment**	
	The project area coincides with the preliminary outline of Guria Planned Protected Area, which is being delegated by the Ministry to the WWF Caucasus Office. Accordingly, the installation of a hydropower plant in the mentioned area requires detailed substantiation. However, this fact (coincidence of the project area with the planned protected area) should be taken into account when conducting biodiversity studies and impact assessments, evaluating alternatives, identifying cumulative impacts and developing relevant conclusions, recommendations, or measures to be taken;	See par. 6.9.5.
	The information accompanied with photo-material, prepared on the basis of detailed biodiversity survey, should be reflected in EIA report, including: Plant and animal species, habitats on the project impact area; their conditions and potential impact by planned activities; mitigation, avoidance and if required, compensation measures for the mentioned impact. Degree/scale and distribution in time of the impact on biodiversity. (including the fact, whether this impact is irreversible or on the contrary, insignificant; short-term, long-term or permanent, etc); besides, compensation, including habitat restoration activities should be defined based on mentioned detailed surveys and provided with proper justification. For example: the information provided in the document about tree planting with 1/3 ratio, requires justification, extension and specification;	See par. 5.4. and par. 6.9.
	EIA report should provide precise data on trees and plants to be cut for arrangement of HPP and other auxiliary structures (spoil ground, construction site/camp, access roads, etc.) required for HPP construction, indicating species and number of trees and plants.	See par. 5.4.1.3.
	Detailed and more justified from biodiversity viewpoint alternatives should be provided in EIA report, including for spoil ground and other auxiliary infrastructure.	See par. 3.
	More detailed project-related cumulative impact assessment should be given in EIA report, from biodiversity point of view, the project impact on the whole area, including: cumulative impact toward planned, operating or project hydropower plants, their infrastructure, electrical transmission lines, other existing or planned infrastructure or activity. During assessment, the main highlighted issue will be water amount to be withdrawn by HPPs(operating, planned) on Bakhvistskali river and on the basis of this, determination of the impact scale and degree on biodiversity (especially on water and water-related species, habitats, ecosystem); taking into consideration of all above-mentioned, corresponding recommendations and conclusions will be prepared, including, on impact avoidance, mitigation and if required, compensation measures. Due to significant increase of negative technogenic impact on Bakhvistskali river, implementation of measures for brook trout stocking should be emphasized.	See par. 5.4. and par. 6.15.

	EIA report should provide information prepared in the result of detailed surveys about biodiversity components (such as: mammals, otter, amhibians, reptiles, fish and their food base, plants, habitats, etc) impacted by the project implementation; impact expected on them due to water stream reduction and impact mitigation, avoidance and if required compensation measures. A water amount to be left (so-called environmental flow) should be considered based on mentioned surveys and justified by expert(s) with relevant qualification. Besides, the sufficiency of the mentioned so-called environmental flow should be properly justified for vitality of water and water-depended biodiversity. Description of fish pass and fish excluder should be given in EIA report and their efficiency should be justified.	See par. 6.9.
	It should be considered in EIA report the need for HPP cleaning, dredging and similar works and detailed description of planned activities, including, impact on biodiversity due to implementation of these activities in coordination with other existing/planned HPPs on the river and impact avoidance/mitigation.	According to the project, low-threshold weir is planned on the headworks of Bakhvi 1 HPP and accordingly, no dredging works are needed. The information on flushing of sediments accumulated upstream the weir is provided in par. 6.7.3.2.
	Monitoring plan provided in EIA report should include observation over activities to be implemented on all project stages, in order to identify and avoid the impact on biodiversity, as well as to plan-implement compensation measures as required and carry out other preventive measures.	See par. 8
5	**Project-entailed potential environmental impact assessment for each environmental component:**	
}}	Impact on ambient air on construction and operation phases; emissions sources, emitted pollutants; emission report, etc.	See par. 6.3.
	Impact on soil, its possible contamination and corresponding mitigation measurs.	See par. 6.6.
	Noise propagation and expected impact on construction and operation phases and corresponding mitigation measures;	See par. 6.4.
	Impact on underground water/groundwater, surface water contamination risks and corresponding mitigation measures;	See par. 6.7. and par. 6.8.
	Types, number, data on hazardous properties of waste, expected on construction and operation phases and follow-up management measures; waste management plan, potential environmental impact due to waste generation and propagation.	See par. 6.10.
	Impact and impact assessment on socio-economic conditions, health and safety risks and corresponding mitigation measures;	See par. 6.12.
	Environmental monitoring plan for construction and operation phase	See par. 8.
	Specific mitigation measure plan to be implemented on construction and operation phases and specific measures for impact avoidance, reduction and mitigation.	See par. 7.
	Main conclusions developed within the EIA framework and main measures to be carried out within the project implementation;	See par. 12.

	Design drawings of HPP constituent facilities (with dimensions), particularly: master plan of HPP (with explication); headwork plan and section; power house plan and section; fish pass and fish excluder plan and section; plan of the substation; **Following issues should also be discussed in EIA report::**	HPP design drawings are given in the corresponding subparagraphs of the par. 4.1.
	Identification, description of direct and indirect (supposed) impact on cultural heritage monuments and cultural values and examination of results should be carried out in EIA report. Besides, it is feasible to involve a specialist with relevant competency (historian/archaeologist) in EIA preparation process.	See par. 5.5.10 and par. 6.13.
	Main technical parameters of HPP infrastructural facilities in unified table and explanatory note of the project with description of all constituent hydraulic structures.	See par. 4.1.
	The information on literature and regulatory document used during environmental impact assessment.	See par. 13.
	Aerophoto (high resolution) with schematic map of the project area hard and soft copies (A3 format; Shape file WGS_1984_37N(38N) with projection) depicting: HPP infrastructural facilities (headwork/power house, substation, construction camps/sites, access roads, spoil grounds).	See par. 4. Figure 4.1. HPP communication location scheme depicting the distances to the nearest settlements and electronic versions of “Shape Files” are attached to the report.
	Evaluation of irreversible impact on the environment and justification of its necessity, which implies the balance of losses caused by irreversible impact on the environment and benefits received in terms of environmental, cultural, economic and social viewpoint.	See par. 3.8.
	In the result of checking “Shape files”, from 175553 m^2 of the project area (shape file), 101344 m^2 is located within the borders of the State Forest Fund, managed by LEPL National Forestry Agency, according to the State Forest Fund borders, approved by the Decree №299 dated as August 4, 2011. Particularly, in the Quarter N11 (alphabetical designation N8); in Quarter N13 (alphabetical designations NN1,4 and in the Quarter N10 (alphabetical designation N11 of Chokhatauri Forestry site; in addition, whithin Ozurgeti Forestry Site Mtispiri Forestry – in the Quarter 17 (alphabetical designations N1,2,3,7,13,18,20,21,24,25,26, in the Quarter N22 (alphabetical designations NN1,3,7,9,16,18,19) and Quarter N23 (alphabetical designations NN12,17,20,29,30,31,37). **Spoil ground arrangement on the Forestry area is not considered by legislation. The activity on the forest area should be agreed with LEPL National Forestry Agency. The documentation proving the agreement should be presented together with EIA report.**	Taxation of timber resources is carriedout within the project corridor and results are provided in par. 5.4.1.3. Areas considered for spoil grounds are not located on the State Forest Fuind area. Activities related to Bakhvi 1 HPP construction and operation will be agreed with LEPL National Forestry Agency; they will be carried out after obtainment of the environmental decision, prior to construction works, that is not contradictory to active environmental legislation.
	The direct and indirect impact on Bakhmaro resort micro-climate (by seasons) and on all micro-climate forming components by construction and operation of the project HPP. While describing baseline climate features, used information sources and data observation period should be mentioned in the references. Besides, basic data/information analysis relating to climate change aspects should be presented. In addition, methodology and instruments for assessment of potential climate change, such as existing and prospect scenarios.	See par. 6.12.2.2.

	Assessment of public opinions/comments/positions made during public hearing and detailed description of planned measures. At EIA stage following should be presented – local population awareness about the project, the information reflecting their positions; as well as documentation, proving corresponding agreement with local population (if any);	See par. 11.
6	Since, based on preliminary data, brook trout *Salmo trutta fario Linnaes* is distributed in Bakhvistskali river, during assessment of fish fauna, special attention will be drawn to the determination of the potential impact scales and degree on brook trout due to water reduction in the river; as well as to impact avoidance, mitigation and if required compensation measure implementation.	See par. 6.9.4.
7	**The scoping report deals with analysis of alternatives for headworks, penstock corridor, access roads to the powerhouse and project sites, considering environmental (relatively lower risks of impact on biological environment), energetic and socio-economic factors. Alternatives for locations of HPP infrastructural facilities requires detailed examination/assessment in EIA report, and the selected alternative requires corresponding justification, on the basis of detailed surveys, considered by the scoping documentation/opinion.**	See par. 3.

Table 21.2. The information about the response on comments and proposals submitted during the public hearing of the Scoping Report

#	Question	Answer
1	During the presentation there was some uncertainty caused by the table of hydrological data. The audience wanted to hear explanations of the terminology used (for example, what the term "environmental flow" meant), how and according to what methodology the data were collected and calculated. Non-governmental sector: Tamaz Trapaidze and Vakhushti Menabde (Georgian Young Lawyers Association - GYLA) Chokhatauri, meeting with the Town Council May 5, 2021	According to the explanation given by the representative of the company, the environmental flow to be passed downstream the Bakhvi 1 HPP headwork will be determined at the detailed design stage and will be reflected in EIA report. In Georgia, for years, during designing of similar HPPs, the approach was applied that considered leaving 10% of the flow as an environmental flow. The water flow at the scoping stage was determined as 0.29 m3/s, and water from small tributaries in the project impact areas will be added to this amount. Within the project section, 32 tributaries of various size join Bakhvistskali river, the total average annual flow of which is 0.332 m3/s. The tributary water will join the river at various points of the river diversion, which surely increase water amount in the river. In its turn, this will have a positive impact on the aquatic biodiversity in terms of the negative impact reduction. Within the project section of the headwork, Bakhvistskali river average multi-annual flow is 2.44 m3/s. Considering aforementioned, the minimum environmental flow calculated at the scoping stage (0.29 m3/s) is ≈12% of the average flow. Within the project section of Bakhvistskali river, the river flows in V-shaped valley, so the riverbed is not divided in branches and flows as a single stream, accordingly, the environmental flow is not going to be dissipated in the riverbed. Mitigation measure plan for the impact of water on the biological environment considers the riverbed examination after each flood and if required, riverbed regulation for maintenance of fish fauna habitat and migration conditions. For regular control over the environmental flow, automated flow meter will be installed downstream the headworks, using which the online flow data recording will be provided. Then the results will be submitted to the Ministry of Environmental Protection and Agriculture of Georgia. Calculation of the

		environmental flow for Bakhvi 1 HPP will be carried out using the same method as in case of Bakhvi 3 HPP. The environmental flow amount of Bakhvi 3 HPP, arranged on Bakhvistskali river, is sufficient to maintain biodiversity. This is proved by monitoring of the existing biodiversity, which is carried out twice a year by the independent third party.
2	The question was about the flood surface area and the impact it may have on Bakhmaro resort climate. Irakli Kuchava (Mayor Chokhatauri municipality) Chokhatauri, meeting with the Town Council May 5, 2021	According to the company representatives, it should be considered that there is no proper methodology for small HPPs, as the surface area of their impoundments is so small that it cannot cause climate change on adjacent areas, however, if we use calculation methodology considered for larger HPPs, and this will not be correct for Bakhvi 1 (taking into account the fact that such calculations are applied only for large HPPs), calculated impact area of accumulated water will be insignificant and is limited with 200 m radius on maximum. If we consider that the distance from the headworks to Bakhmaro resort zone and to the nearest settlement is much more than 200 m (630 m and 1 760 m to Chadrekili settlement and to Bakhmaro resort zone respectively), climate change is not expected. Besides, the planned impoundment surface area is 3.3 ha. (Note: in the short period after the mentioned meeting the engineering team of the project updated the project scheme and the reservoir surface area reduced to 0.24 ha, thus public comments were considered). From above-mentioned area 2.3 ha was added to already existing natural riverbed, which occupies 1 ha area; this is less than 0.1% of Bakhmaro recreational zone. It should also be considered that the difference between Bakhmaro resort and reservoir elevation is 150 m; this excludes any possibility of the negative impact on Bakhmaro climate.
3	As it was mentioned, in general Vakhushti and his friends are not against HPPs. However, it is important for them that HPP construction is provided according to the Law, with minimum environmental impact and full compliance with environmental rights. According to his words, it is essential that project developer company provides detailed comparative analysis of environmental impact and received benefit from the project implementation, i.e. the company has to present cost-benefit analysis. Vakhushti Menabde (GYLA) Chokhatauri, meeting with the Town Council May 5, 2021	According to the company representatives, environmental impact and biodiversity surveys will be carried out independently. Surveys will be implemented by the consulting company SLR (https://www.slrconsulting.com/), the global leader in environmental and consultation solutions and the foreign expert having 25 year international experience – Pierre Biedermann, who is the consultant of Alpage, the main author of the publication –Recommendations on Environmental and Social Issues for Hydropower Projects, and the member of consultation team of experts for publication of International Hydropower Association (IHA) – Handbook for Hydropower Sector Sustainability against Climate Change. The mentioned survey will be attached to EIA report. In addition, it was mentioned that the company adheres to high standards of environmental, social and governance (ESG) set by IFC and EIB, while protecting social, environmental and governance issues. The company representative also clarified that in the future stakeholders will be provided with a list of benefits received as a result of the project.

4	How is the humidification issue studied by the project developer, which is expected by the project implementation in Bakhmaro resort? According to him, Bakhmaro is characterized with dry climate, and arrangement of the reservoir within the HPP project framework will cause increase of humidity and will have an impact on bakhmaro climate. Accordingly, it is important to publish monthly humidity data in Bakhmaro, existing for today, in order to compare them with the situation after HPP construction. Tamaz Trapaidze (GYLA) Chokhatauri, meeting with the Town Council May 5, 2021	The company representative responded that the Company is going to assess climate change risk at EIA development stage. The mentioned survey will be carried out through two independent processes; from the one hand, climate change risk assessment will be carried out by the international expert – Mr. Pierre Biedermann, who is well-acquainted with widely recognized approaches for planning and implementation of similar surveys. On the other hand, the Company plans to hire an international company, which will use methodology developed by International Hydropower Association (IHA). IHA has developed the protocol for climate sustainability, which includes methodology for hydropower projects of all types, scales and geography. Six phase methodology presented in the protocol considers screening of climate risk, data analysis, checking sustainability against climate change, climate risk management and monitoring, assessment and reporting.
5	Was Bakhvi 3 HPP constructed by CCEH or has CCEH purchased its share after its construction? He also mentioned that landslide slumped twice on HPP area. Tamaz Trapaidze (GYLA) Chokhatauri, meeting with the Town Council May 5, 2021	The Company explained that it purchased the share of Bakhvi 3 HPP after its construction.
6	Mr. Trapaidze stated that according to the practice recognized in USA, 30% of water is left in the river for provision of the environmental flow. Accordingly, he states that if Bakhvi 1 HPP developer is an American company, they should use this practice. Tamaz Trapaidze (GYLA) Chokhatauri, meeting with the Town Council May 5, 2021	A company representative questioned this allegation and asked to name the official source of the information. However, the author of the question could not name such a source.

7	Will Bakhvi 1 HPP construction pose a threat to region's touristic potential and development of touristic routes? Tamaz Trapaidze (GYLA) Chokhatauri, meeting with the Town Council May 5, 2021	The Company explained that at the given stage, there is no final decision made in relation with the project of the protected areas, planned in Guria. The meeting was held between the Company and representatives of WWF; at the meeting parties shared information on current works both orally and in the written form. Based on information delivered by WWF, Bakhvi 1 HPP project gets within the conditional borders of Guria Protected Area, which is the subject of further survey at the given stage. WWF plans to finish hist works by June 30, 2023. For comparison, according to shape file, presented by WWF, following riverbed type HPPs similar to Bakhvi 1 HPP, can be found within conditional borders of Guria Protected Area: operating Bzhuzha HPP, Bakhvi 3 HPP, Sashuala 1 HPP, Sashuala 2 HPP and at designing stage, waiting for obtainment of the construction permit: Natanebi 1 HPP, Natanebi 2 HPP, Natanebi 3 HPP, Bakhvi 2 HPP, Bzhuzha 2 HPP, Sashuala HPP. Active communication with Caucasus Office of WWF is planned at EIA stage; recommendations of mentioned office will be considered in the process.
8	Due to HPP construction, WWF may change borders of Guria protected areas or may not consider feasible to create such area. So, he proposes that they should wait until 2023 when WWF finishes demarcation process of the protected area or if it is impossible to wait for such a long time, should not WWF declare that Bakhvi 1 HPP does not pose a threat to the WWF project? Tamaz Trapaidze (GYLA) Chokhatauri, meeting with the Town Council May 5, 2021	According to the Company representative, active communication with WWF Caucasus Office is planned at EIA stage. Corresponding recommendations of this organization will be considered during EIA preparation, besides, surveys conducted by this company will facilitate and help WWF in the process of determination and announcement of the protected area.
9	What will be the tariff for electricity generated by Bakhvi 1 HPP? How many years has the company been obliged to sell the generated electricity to Georgia? Tamaz Trapaidze (GYLA) Chokhatauri, meeting with the Town Council May 5, 2021	According to the Company's representative, there is no contractual obligation between the State and CCEH in relation with purchasing of the generated power. However, it is clear that the Company wishes to sell generated power to the State during deficit season (winter), which presently lasts from 12 to 10 months. Expected cost is about 6 USA cents per kW.h.

10	Surveys submitted by the Developer at the scoping stage are carried out according to old (Soviet) methods and she thinks that if the project developer is an American Company, hydrological and climate change surveys must be carried out by a reliable western companies. Irma Gordeladze (Environmental Organization Eco) Chokhatauri, meeting with the Town Council May 5, 2021	According to the Company, environmental and biodiversity impact surveys will be carried out by a reliable European organization - SLR and its foreign expert in biodiversity issues, Nicola Faulks; survey will be attached to EIA report. In addition, the company plans to assess climate change risk at EIA development stage. This survey will be carried out through two independent processes. From the one hand, climate change risk assessment will be carried out by Pierre Biedermann who is well-acquainted with widely recognized approaches for planning and implementation of similar surveys. On the other hand, the Company plans to hire international consulting company ((Afry - https://afry.com/en or Blue Rivers- https://www.bluerivers.kiev.ua/), which during climate change risk assessment will be guided by the methodology, developed by International Hydropower Association (IHA)
11	How much water will be left in the river for environmental flow? According to which calculation has the environmental flow amount been determined, namely 12%? She states that following issues should be studied: habitat change, fish fauna modeling, climate change impact, water flow and river hydraulics. She indicates at Association Agreement with EU and necessity of consideration of its standards during determination of the environmental flow. Irma Gordeladze (Environmental Organization Eco) Chokhatauri, meeting with the Town Council May 5, 2021	According to the explanation given by the representative of the company, the environmental flow to be passed downstream the Bakhvi 1 HPP headwork will be determined at the detailed design stage and will be reflected in EIA report. In Georgia, for years, during designing of similar HPPs, the approach was applied that considered leaving 10% of the flow as an environmental flow. The water flow at the scoping stage was determined as 0.29 m3/s, and water from small tributaries in the project impact areas will be added to this amount. Within the project section, 32 tributaries of various size join Bakhvistskali river, the total average annual flow of which is 0.332 m3/s. The tributary water will join the river at various points of the river diversion, which surely increase water amount in the river. In its turn, this will have a positive impact on the aquatic biodiversity in terms of the negative impact reduction. Within the project section of the headwork, Bakhvistskali river average multi-annual flow is 2.44 m3/s. Considering aforementioned, the minimum environmental flow calculated at the scoping stage (0.29 m3/s) is ≈12% of the average flow. Within the project section of Bakhvistskali river, the river flows in V-shaped valley, so the riverbed is not divided in branches and flows as a single stream, accordingly, the environmental flow is not going to be dissipated in the riverbed. Mitigation measure plan for the impact of water on the biological environment considers the riverbed examination after each flood and if required, riverbed regulation for maintenance of fish fauna habitat and migration conditions. For regular control over the environmental flow, automated flow meter will be installed downstream the headworks, using which the online flow data recording will be provided. Then the results will be submitted to the Ministry of Environmental Protection and Agriculture of Georgia. Calculation of the environmental flow for Bakhvi 1 HPP will be carried out using the same method as in case of Bakhvi 3 HPP. The environmental flow amount of Bakhvi 3 HPP, arranged on Bakhvistskali river, is sufficient to maintain biodiversity. This is proved by monitoring of the existing biodiversity, which is carried out twice a year by the independent third party.

12	Four areas should be studied within the borders of HPP project area, observation must be carried out for a year. She states that the Developer also has to submit information about the river water level during draught and whether the riverbed is regulated during floods. Irma Gordeladze (Environmental Organization Eco) Chokhatauri, meeting with the Town Council May 5, 2021	According to the Company representative, mitigation measure plan for the impact of water on the biological environment considers the riverbed examination after each flood and if required, riverbed regulation for maintenance of fish fauna habitat and migration conditions. For regular control over the environmental flow, automated flow meter will be installed downstream the headworks, using which the online flow data recording will be provided. Then the results will be submitted to the Ministry of Environmental Protection and Agriculture of Georgia. It is planned to arrange the fish pass. According to the preliminary feasibility study, at the given stage, arrangement of so-called fish ladder is discussed. However, at the detailed design stage, arrangement of fishway, similar to natural conditions, can be decided. In order to reduce the risk of fish occurrence in the intake, installation of fish excluder is discussed. Details of fish excluder will be defined at the detailed design stage.
13	According to Mrs. Gordeladze, presenting of Jvari reservoir as an analogue to assess the environmental impact of Bakhvi 1 HPP flood surface area is neither valid nor appropriate in this case. This reality must be individually studied using modern methods. Irma Gordeladze (Environmental Organization Eco) Chokhatauri, meeting with the Town Council May 5, 2021	According to the company representatives, it should be considered that there is no proper methodology for small HPPs, as the surface area of their impoundments is so small that it cannot cause climate change on adjacent areas, however, if we use calculation methodology considered for larger HPPs, and this will not be correct for Bakhvi 1 (taking into account the fact that such calculations are applied only for large HPPs), calculated impact area of accumulated water will be insignificant and is limited with 200 m radius on maximum. If we consider that the distance from the headworks to Bakhmaro resort zone and to the nearest settlement is much more than 200 m (630 m and 1 760 m to Chadrekili settlement and to Bakhmaro resort zone respectively), climate change is not expected. Besides, the planned impoundment surface area is 3.3 ha. (Note: in the short period after the mentioned meeting the engineering team of the project updated the project scheme and the reservoir surface area reduced to 0.24 ha, thus public comments were considered). From above-mentioned area 2.3 ha was added to already existing natural riverbed, which occupies 1 ha area; this is less than 0.1% of Bakhmaro recreational zone. It should also be considered that the difference between Bakhmaro resort and reservoir elevation is 150 m; this excludes any possibility of the negative impact on Bakhmaro climate.
14	She expressed her concern about the fact that the HPP Cascade (Bakhvi 1, 2 and 3) on the Bakhvitskali river, will completely pass the river into pipes. So she wonders if cumulative risks have been studied? Irma Gordeladze (Environmental Organization Eco) Chokhatauri, meeting with the Town Council May 5, 2021	According to the Company representative, the company adheres to high environmental and social standards of IFC and EIB, while protecting social, environmental and economic rights. The company representative also added that environmental and biodiversity impact survey will be conducted by a reliable European consulting company – SLR and recognized foreign expert. .

15	What will be the tariff for electricity generated by Bakhvi 1 HPP? Will the cost for electricity be cheaper? Irma Gordeladze (Environmental Organization Eco) Chokhatauri, meeting with the Town Council May 5, 2021	According to the Company's representative, there is no contractual obligation between the State and CCEH in relation with purchasing of the generated power. However, it is clear that the Company wishes to sell generated power to the State during deficit season (winter), which presently lasts from 12 to 10 months. Expected cost is about 6 USA cents per kW.h.
16	The main concern is related to the fact that the scoping report was prepared by GAMMA Consulting, as she has quite critical questions to this company and does not trust to the work implemented by them. Irma Gordeladze (Environmental Organization Eco) Chokhatauri, meeting with the Town Council May 5, 2021	As it was explained by the representative of the Company, EIA report will be prepared by GAMMA Consulting. However, additional biodiversity survey will be carried out in compliance with high environmental and social standards of IFC and EIB, which ensures protection of social, environmental and economic rights. In addition, environmental impact and biodiversity surveys will be carried out independently. Surveys will be implemented by the consulting company SLR (https://www.slrconsulting.com/), the global leader in environmental and consultation solutions and the foreign expert having 25 year international experience – Pierre Biedermann, who is the consultant of Alpage, the main author of the publication –Recommendations on Environmental and Social Issues for Hydropower Projects, and the member of consultation team of experts for publication of International Hydropower Association (IHA) – Handbook for Hydropower Sector Sustainability against Climate Change. The mentioned survey will be attached to EIA report.
17	He is interested whether CCEH has contacted Sashuala HPP developer (another HPP in Guria region) to find out how reliable is their forecast and calculations in reality. He thinks that in order to identify the need for the project implementation, it is important to carry out detailed analysis of the possible impact and potential benefit. Koba Kalandadze, a member of the Town Council Chokhatauri, meeting with the Town Council May 5, 2021	A company representative noted this proposal. According to him, in the near future the company will present to the stakeholders a list of the benefits that are expected in the result of the project. As for Sashuala HPP, it was noted that the company has no relation with Sashuala HPP.
18	According to him, in 2014 Bakhmaro was granted the recreational zone status. He was in the work team and construction of HPP on this area had not been mentioned. He thinks that it is not correct to make paralells with Bzhuzha HPP too as air masses in	A company representative noted this issue and the issue of using Bzhuzha HPP as an analogue will be further studied

	Bakhmaro move in different directions; there is difference in elevations as well (Bzhuzha HPP and Gomismta, from the one hand and Bakhvi 1 HPP reservoir from the other hand) Vladimer Sikharulidze, a member of the Town Council Chokhatauri, meeting with the Town Council May 5, 2021	
19	Small HPPs differ from Namakhvani HPP only by capacity, in other way they are equally damaging. Giorgi Beridze (local resident) Chokhatauri, meeting with the Town Council May 5, 2021	A company representative explained that the comparison of large and small HPPs in terms of environmental impact is incorrect.
20	Does the developer takes responsibility that generated electricity is left in Georgia? Giorgi Beridze (local resident) Chokhatauri, meeting with the Town Council May 5, 2021	A company representative stated that for the given stage there is no contractual obligation between the State and CCEH in relation with purchasing the electricity. However, it is clear the Company wishes to sell generated power to the State.
21	What is the aim of Bakhvi 1 HPP construction – energy independence or economic profit? Giorgi Beridze (local resident) Chokhatauri, meeting with the Town Council May 5, 2021	A company representative explained that construction of Bakhvi 1 HPP will facilitate energy independence, as well as economic growth of the country, especially when attraction of western investments is complicated in Covid-19 conditions.

22	What is the guarantee that the issue of HPP construction and leaving of environmental flow in rivers is not decided in Tbilisi? He thinks that local government should actively be involved in the process and express its position. Giorgi Beridze (local resident) Chokhatauri, meeting with the Town Council May 5, 2021	(answer from the Mayor) The Mayor stated that the municipality is actively involved in the discussion. They put questions and received sufficient information from the Company, which is strengthened by the official letter from the Ministry of economy.
23	She said that she was one of the members of the initiative group "No HPP in Bakhmaro". The group started to collect signatures on petition against Bakhvi 1 HPP construction and 1000 signatures have been already collected in Chokhatauri. Ketevan Sikharulidze (a member of Town Council) Chokhatauri, meeting with the Town Council May 5, 2021	No comment was made from the side of the Company.
24	She opposes the construction of ugly and unjustified hydropower plants. Ketevan Sikharulidze (a member of Town Council) Chokhatauri, meeting with the Town Council May 5, 2021	The Company representative stated that the Company follows high environmental and social standards of IFC and EIB and ensures protection of social, environmental and economic rights. Accordingly, Bakhvi 1 HPP project will not be unjustified or damaging project.
25	She states that Bakhmaro is a special resort which is stipulated by its dry climate, and reservoir surface area will surely cause negative impact on climate. Ketevan Sikharulidze (a member of Town Council) Chokhatauri, meeting with the Town Council May 5, 2021	The company representative responded that the Company is going to assess climate change risk at EIA development stage. The mentioned survey will be carried out through two independent processes; from the one hand, climate change risk assessment will be carried out by the international expert – Mr. Pierre Biedermann, who is well-acquainted with widely recognized approaches for planning and implementation of similar surveys. On the other hand, the Company plans to hire an international company, which will use methodology developed by International Hydropower Association (IHA). IHA has developed the protocol for climate sustainability, which includes methodology for hydropower projects of all types, scales and geography. Six phase methodology presented in the protocol considers

		screening of climate risk, data analysis, checking sustainability against climate change, climate risk management and monitoring, assessment and reporting.
26	She also brought an example of Shuakhevi HPP which left locals without water. What guarantee is there that the same will not happen with Bakhvi 1 HPP? In the case of Shuakhevi, there was also an approved environmental impact assessment (EIA) and was anyone responsible for the water shortage? Ketevan Sikharulidze (a member of Town Council) Chokhatauri, meeting with the Town Council May 5, 2021	According to the company representative, it is incorrect to generalize the defects of other projects and extend them to Bakhvi 1 HPP project. According to him, CCEH is a responsible developer and its portfolio includes both the existing HPP and the HPPs under construction. Western investors are also interested in the CCEH adhering to the high environmental and social standards set by IFC and the EIB and ensuring the protection of social, environmental and governance issues.
27	She thinks that there is the problem of improper communication. The another problem is that surveys have not been finished yet and it is unclear what benefits will bring Bakhvi 1 HPP to the environment. Maia Paichadze (a member of Town Council) Chokhatauri, meeting with the Town Council May 5, 2021	A company representative said CCEH will remain open and transparent to all stakeholders and will provide updated information to all stakeholders. It was emphasized once again that the Environmental and Biodiversity Impact Assessment will be conducted by a reputable European research organization - SLR and a recognized foreign expert and mentioned survey will be attached to the EIA report.
28	He inquired about the contractual relationship between the CCEH and the State. Also, whether the CCEH is bound by its obligations under the Memoranda of Understanding (MoU) signed in previous years. Koka Kighuradze (Management Systems Development Center) Chokhatauri, meeting with the Town Council May 5, 2021	According to the company representative, the Memorandum of Understanding (MoU) between CCEH and the State was signed on August 21, 2020. According to him, CCEH is not bound by any previous contractual obligations.

29	Land tax - what is the area of the project area and in what form the company intends to purchase the land - by lease or easement. Koka Kighuradze (Management Systems Development Center) Chokhatauri, meeting with the Town Council May 5, 2021	(Answer from the mayor) The mayor cited the example of Zoti HPP, when the State (Ministry of Economy and Sustainable Development) handed over the land plots to the municipality and the amount of rent received from these plots was fully transferred to the municipal budget.
30	The mayor noted that their questions have been competently answered by the Company and the Deputy Minister of Economy, and therefore he believes the project is compatible, the survey should be continued and information on the economic benefits and social package should be provided later. Irakli Kuchava (the Mayor of Chokhatauri Municipality) Chokhatauri, meeting with the Town Council May 5, 2021	No comment was made by the company
31	What is CCEH project portfolio? Konstantine Sharashenidze (Ozurgeti Municipality Mayor) Ozurgeti, the meeting with the mayor June 4, 2021	According to the director of the Company, the Company CCEH owns 2 operating HPPs - Bakhvi 3 (shareholder) and Lakhami. The Company is currently in the process of construction of Akhalkalaki 1 and Akhalkalaki 2 HPPs, which are located on the river Paravani and its right tributary - Kirkhi. He added that after CCEH acquired a stake in Bakhvi 3 HPP and introduced modern environmental and social standards, otters and trout reappeared in the project area. Therefore, it is a good example of responsible action of the Company. It was also noted that an environmental expert invited from France regularly visits all the hydropower plants included in the CCEH portfolio and conducts detailed environmental and social monitoring.

32	Why is not the headwork moved to lower location (by about 2km) by the Company? In terms of cumulative impacts, Bakhvi 1, 2 and 3 HPPs will enclose the river in the pipe on about 14 km length and about 90% of the water stream will flow into the pipe, which will undoubtedly have a negative impact on the river and its surrounding biodiversity. Irma Gordeladze (Environmental Organization Eco) Ozurgeti, the meeting with the mayor June 4, 2021	According to the Company Director and Project Manager, Austrian and Swedish specialists have been invited to study the possibility of modifying Bakhvi 1 HPP project in order to relocate its headworks away from the Bakhmaro resort and also to reduce the impoundment area (to less than 1 hectare). The Company will have more information on this issue in a month.
33	She states that species included in the Red List such as otter, fox, brown bear and other species are not mentioned in the scoping report of Bakhvi 1 HPP. Irma Gordeladze (Environmental Organization Eco) Ozurgeti, the meeting with the mayor June 4, 2021	The Deputy Project Manager immediately provided an excerpt from the scoping report (subsection 4.4.2.4.1) to verify that the report did indeed include a list of various mammal species found in the project impact area, including brown bear, otter, and others.
34	He argued against the project manager on an updated table of hydrological data. In particular, how the annual average environmental flow changed from 12% to 28.6%. According to him, he has saved the photo of the previous table, which was presented at the Chokhatauri meeting. Tamaz Trapaidze (GYLA) Ozurgeti, the meeting with the mayor June 4, 2021	According to the project manager, the environmental flow is 29%, and if the flow of tributaries is added to it, this figure will increase to 42%. He explained that these calculations are based on water flow meter data installed at Bakhvi 3 HPP. He also added that after the construction of Bakhvi 1 HPP, the data obtained by the control and measurement of the water level in the river in a continuous mode will ensure the minimum environmental flow.

35	She asked project manager why the type of the fish pass structure is not specified in the scoping report. Irma Gordeladze (Environmental Organization Eco) Ozurgeti, the meeting with the mayor June 4, 2021	According to the project manager, given that topographic data is required when designing a fish pass, no specification of the type of building is required at the scoping stage. He added that the project considers the arrangement of both natural type and stepped (fish ladder) fish passes. The final decision will be made after the feasibility study. The project manager also added that on the example of Bakhvi 3 HPP fish pass (which is designed with 20 cm steps) it ensures absolutely smooth movement of fish between the upstream and downstream.
36	He is interested who company met in Bakhmaro on June 5. He stated it would be better to hold a meeting in the beginning of the season as there are more people at that time. Tamaz Trapaidze (GYLA) Ozurgeti, the meeting with the mayor June 4, 2021	The director of the Company replied that the meetings will be held periodically, including during the tourist season. He also invited representatives of NGOs and the media to a meeting scheduled for June 5 in Bakhmaro. Moreover, it was explained that the participants of the meeting will have the opportunity to see the project area of Bakhvi 1 HPP together with the project team in order to get better acquainted with the project area and to see how far it is from Bakhmaro resort.
37	What will happen if after all surveys and calculations HPP still has negative impact on environment? He gave negative examples of other HPPs, especially Shuakhevi HPP, which according to him, caused drying out of several rivers. Lado Menabde (Guria News, Main Channel) Ozurgeti, the meeting with the mayor June 4, 2021	The Company Director explained that Bakhvi 1 HPP is a small capacity HPP, its installed capacity is only 12 MW; accordingly, it is not correct to compare its possible impact to large HPPs.

38	Is there any survey about Bzhuzha HPP impact on Gomi mountain environment (according to him, it had negative impact on mentioned environment and the climate became more humid) and what is the guarantee that Bakhvi 1 HPP project does not cause the same negative impact on Bakhmaro resort. Lado Menabde (Guria News, Main Channel) Ozurgeti, the meeting with the mayor June 4, 2021	The Company Director responded that CCEH invited widely recognized international experts to carry out detailed surveys and examination, in order to assess possible environmental impact and to determine corresponding mitigation measures.
39	Other developers also give promises to local communities although finally, nothing is done for well-being of locals. Moreover, criminals are used to frighten local residents who are against HPP construction. Tamaz Trapaidze (GYLA) Ozurgeti, the meeting with the mayor June 4, 2021	The Company Director stated that CCEH acts according to the highest ethic standards and its activity meets requirements of national legislation and the best international practice set by International Finance Corporation (IFC) and European Investment Bank (EIB). Thus, it is impossible to make parallels between such negative examples and Bakhvi 1 HPP and CCEH
40	She mentioned that it becomes clear, CCEH makes "advertisements" (paid articles are meant) for establishment of public opinion in favor of Bakhvi 1 HPP. She also does not like the fact that CCEH plans an event only for the media representatives at the Paragraph Hotel and rules out the participation of the non-governmental sector. She suggests that the meeting will be used for "ideological brainwashing" of journalists to advocate for the HPP construction. She plans to take countermeasures. Irma Gordeladze (Environmental Organization Eco)	PR Manager explained that the mentioned event is held only for journalists, this event will help them to better understand the issue, get more information on the topic of energy generation in general and international best practices, which will ultimately help them in covering hydropower projects.

	Ozurgeti, the meeting with the mayor June 4, 2021	
41	Summing up, according to the statement of Ozurgeti municipality mayor, the Company should be given possibility to carry out required surveys. Mrs. Gordeladze agreed that Company carries out surveys using modern methodology and by involvement of recognized experts and if it is proved that the environmental flow is maintained at sufficient level, she will not be against Bakhvi 1 HPP. Konstantine Sharashenidze (Ozurgeti Municipality Mayor) Ozurgeti, the meeting with the mayor June 4, 2021	CCEH Team thanked attended public for constructive discussions and promised to maintain active and healthy communication with them.
42	Will Bakhmaro receive electricity generated by Bakhvi 1 HPP? Ilia Ghlonti (local resident) Bakhmaro, public meeting June 5, 2021	The Company Director explained that the electricity generated by Bakhvi 1 HPP will be transmitted to the unified energy system and then it will be distributed.
43	How can Bakhvi 1 HPP be useful for Bakhmaro resoert? How much will social budget be? Wil locals be employed at HPP construction and operation phases? Ilia Ghlonti (local resident) Bakhmaro, public meeting June 5, 2021	The Company Director stresses that Bakhvi 1 HPP considers a social program, aiming at creation certain benefits for local population. First of all, he noted that local residents will be employed at HPP construction and operation phases. As for investment of infrastructural projects, which will be a large and long-term solution for the resort. Locals discuss this issue and will share with the project team, which issue they are going to give preference. After that the project team will study the relevance of the issue and available resources for its fulfilment.

44	Will the water sufficient for power generation? The water level is very low in august. In general, climate changes and in winter precipitation in the form of snow is reduced. Ilia Ghlonti (local resident) Bakhmaro, public meeting June 5, 2021	According to the project manager, the environmental flow is 29%, and if the flow of tributaries is added to it, this figure will increase to 42%. He explained that these calculations are based on water flow meter data installed at Bakhvi 3 HPP. He also added that after the construction of Bakhvi 1 HPP, the data obtained by the control and measurement of the water level in the river in a continuous mode will ensure the minimum environmental flow.
45	Local representatives should also be involved in surveys Ilia Ghlonti (local resident) Bakhmaro, public meeting June 5, 2021	According to ESG manager, all surveys and survey process conducted by CCEH is transparent. Accordingly, local experts can join survey groups and attend the meeting with SLR leading British experts, who will present preliminary results of biodiversity surveys to the audience.
46	Will Bakhvi 1 HPP construction have any impact on riverbed processes of the river? Ilia Ghlonti (local resident) Bakhmaro, public meeting June 5, 2021	Project Manager noted that HPP construction will not cause any negative impact on the riverbed. Only headwork structure will be arranged directly in the riverbed, and the pipe and power plant will be arranged outside the riverbed. Undoubtedly, during HPP operation the water level in the river will be potentially less compared to the present situation, however, the environmental flow will be left in compliance with the adopted practice, which is sufficient for maintenance of ecosystem and biodiversity.
47	What impact is expected on Bakhmaro climate? Mindia Zgheria (Deputy Mayor of Chokhatauri Municipality) Bakhmaro, public meeting June 5, 2021	ESG manager noted that climate survey will be carried out by the foreign expert having 25 year international experience – Pierre Biedermann, who is the consultant of Alpage, the main author of the publication –Recommendations on Environmental and Social Issues for Hydropower Projects, and the member of consultation team of experts for publication of International Hydropower Association (IHA) – Handbook for Hydropower Sector Sustainability against Climate Change. Besides, it was explained that surface area of impoundment is so small, that it cannot have any impact on Bakhmaro climate. In addition, the Company involved Austrian and Swedish experts in the project development in order to relocate headwork to lower elevations, far from Bakhmaro and tor educe the surface area of impoundment.

48	What are the guarantees that in case of the negative environmental impact of Bakhvi 1 HPP, it will be dismantled? Local resident Bakhmaro, public meeting June 5, 2021	The Company Director explained that all required surveys will be carried out in advance; construction of Bakhvi 1 HPP will be carried out with consideration of the highest standards and any risks to the environment or people will be excluded.
49	He noted that hydropower belongs to renewable energy resources and in Europe, especially in Alps many resorts are proud that they are supplied from such type of renewables. Accordingly, he supports construction of Bakhvi 1 HPP and thinks that HPP construction creates opportunity for resort development. Ingo Schlutius (owner of the hotel - Bakhmaro Pioneers, tour operator) Bakhmaro, public meeting June 5, 2021	No comments were made by the Company
50	Mr. Trapaidze questioned the statement of the project manager of Bakhvi 1 HPP that it is as if the project facilities do not fall within the recreational zone of Bakhmaro. According to Mr. Trapaidze, Bakhmaro goes beyond the officially demarcated recreational boundaries for him and many other people and includes the surrounding areas. He added that the resort Bakhmaro has the potential for further development and the areas beyond the currently recognized recreation area could be used for further development of the resort. Tamaz Trapaidze (GYLA)	No comments were made by the Company

	Ozurgeti, the meeting with the biodiversity expert June 18, 2021	
51	Mr. Trapaidze questioned the statement of the project manager that Bzhuzha HPP should be used as analogue for Bakhvi 1 HPP. He states that no surveys have been conducted about the impact of Bzhuzha HPP on Gomi mountain climate. Tamaz Trapaidze (GYLA) Ozurgeti, the meeting with the biodiversity expert June 18, 2021	No comments were made by the Company
52	Survey of Bakvi 1 HPP impact only is not sufficient. The society is interested what cumulative impact Bakhvi 3 HPP will have, which is in operation on Bakhvistskali river. Tamaz Trapaidze (GYLA) Ozurgeti, the meeting with the biodiversity expert June 18, 2021	According to CCEH and ESG Manager, the project group works on cumulative impact assessment and it will be presented at EIA disclosure stage.
53	Mr. Trapaidze stated that the Director of CCEH has recently declared that CCEH owns Bakhvi 2 HPP too. Tamaz Trapaidze (GYLA) Ozurgeti, the meeting with the biodiversity expert June 18, 2021	According to Bakhvi 1 HPP manager, Bakhvi 2 HPP does not belong to CCEH and it is owned by another company. Thus, the Director of CCEH has never declared such statement.

54	Bakhvi 1 HPP gets within the borders of planned protected areas of Guria. How admissible is it from environmental viewpoint? Tamaz Trapaidze (GYLA) Ozurgeti, the meeting with the biodiversity expert June 18, 2021	Nicola Faulks cited the examples of Europe, Britain and the United States, where many small-capacity hydropower plants are being built and operated within protected areas. Moreover, she said, the infrastructure of small-capacity hydropower plants is often used by the administration of protected areas for positive impacts. She cited another example of the positive contribution of small hydropower plants, namely when Scotland's largest aluminum plant was supplied with electricity generated by 27 small power plants.
55	How long does it take for implementation of biodiversity survey? Why bats are surveyed? How long will trap cameras be installed in the forest? Tamaz Trapaidze (GYLA) Ozurgeti, the meeting with the biodiversity expert June 18, 2021	Nicola Faulks highlighted the fact that seasonality is an important factor in biodiversity survey. Therefore, this factor also applies to Bakhvi 1 HPP. She explained that field surveys are conducted in the spring, summer and fall (Phase 2 of the fish survey will be conducted in the fall). Information for the winter season will be obtained on the basis of past surveys conducted by her within the project area (JSC Georgian State Electric System Transmission Line Project) and desk survey of the available literature. According to Ms. Faulks, bats are an important part of biodiversity, and Georgia is a signatory to the Convention. Therefore, the study of bats within the project area is quite logical. Regarding trap cameras, according to her words, by the end of August sufficient information will be gathered through trap cameras.
56	Will SLR develop mitigation measures? Tamaz Trapaidze (GYLA) Ozurgeti, the meeting with the biodiversity expert June 18, 2021	Nicola Faulks stated that SLR, as required, together with the project group and experts, will work on development of the complex list of mitigation measures, corresponding to Bakhvi 1 HPP.
57	What is the need to build a power plant near Bakhmaro? If it is a small power plant, what is the point of building it? Nona Garganjia (Women for Region’s Development) Ozurgeti, the meeting with the biodiversity expert	According to Bakhvi 1 HPP Project Manager, the project area was determined by the Government of Georgia on the basis of a Memorandum of Understanding. Regarding the importance of Bakhvi 1 HPP, he explained that despite the small capacity (installed capacity 12 MW), the HPP will fully meet the demand of Chokhatauri and Ozurgeti municipalities for electricity. Consequently, it can make a positive contribution to the overall electricity system of the country. Mr. Trapaidze questioned this statement. According to him, the electricity generated by Bakhvi 1 HPP will not remain in Guria region, but will be distributed in the country's energy system, to which the

	June 18, 2021	Project Manager of Bakhvi 1 HPP replied that this is how electricity supply and distribution is organized.
58	What does the HPP construction process carried out abroad? Does the developer make a decision first and then meet with the public? Merab Maminashvili (Finix 2009) Ozurgeti, the meeting with the biodiversity expert June 18, 2021	According to Bakhvi 1 HPP Project Manager, the HPP design process is carried out in accordance with the procedure established by national legislation and includes the following stages: signing a memorandum of understanding with the government, preparing a scoping report, public disclosure of EIA report and then obtaining an environmental decision and construction permit. As for the examples of foreign countries, he cited the example of Austria, which has a well-developed network of hydropower plants across the country and has fully utilized hydropower resources.
59	What technical solution is for Bakhvi 1 HPP? Merab Maminashvili (Finix 2009) Ozurgeti, the meeting with the biodiversity expert June 18, 2021	According to Bakhvi 1 HPP Project Manager, Bakhvi 1 HPP is run-of-river HPP which has very small impoundment.
60	Will a conflict of interest take place in case of SLR Consulting? Will the company be able to reflect the reality in the report if it follows the client's instructions? Merab Maminashvili (Finix 2009) Ozurgeti, the meeting with the biodiversity expert June 18, 2021	Nicola Faulks explains that SLR and Nicola herself follow high standards and use so-called “red flags” or alarm signals. In case of identification of such areas during the survey, she will immediately ring the alarm and demand due attention to be given to the problematic issue. Consequently, SLR and Nicola herself are completely independent in the process of conducting biodiversity survey and reporting. The CCEH ESG Manager added that the project management will publish biodiversity survey in both Georgian and English.
61	Bakhvi 1 HPP means that Bakhvi 2 and 3 will also be constructed. This will be huge cumulative impact; look at Europe – they use alternative resources such as solar and wind energy. You use out-of date methods. Maia Beridze (Anti-violence network of Georgia)	The response came from audience, that Bakhvi 3 HPP has already been constructed and operated. Project Manager of Bakhvi 1 HPP repeated that bakhvi 2 HPP is not owned by CCEH. As for Europe, he stated that Europe utilized hydro-resources long time ago and therefore, now they use renewable energy sources. However, he emphasized the situation that according to the preliminary surveys construction of Bakhvi 1 HPP will not cause large-scaled tree felling.

	Ozurgeti, the meeting with the biodiversity expert June 18, 2021	Eka Ninidze, who represented Education and Equality Center, noted that tree felling has already been going on in Bakhmaro and Gomi mountain area. Why should not HPP be constructed, we could at least get some benefits.
62	In western countries the environmental flow is determined as 30%, and in case of Bakhvi 1 HPP, it is planned to be only 12%; what do you think about it? Nugzar Asatiani (the newspaper “Alioni”) Ozurgeti, the meeting with the biodiversity expert June 18, 2021	Nicola Faulks explained that in Georgia according to adopted practice, the environmental flow in HPP projects is determined as 5%. She recommended that this value should be increased and maintained at least up to 10%
63	Environmental activists have not attended today’s meeting, and supposedly, you (CCEH) are not going to attend their briefing on Monday (June 21). Does it mean that there is no constructive dialogue between you? Nugzar Asatiani (the newspaper “Alioni”) Ozurgeti, the meeting with the biodiversity expert June 18, 2021	According to ESG manager of CCEH, all 16 NGOs operating in Ozurgeti and Chokhatauri attended the meeting. As for some organizations, which does not participate today’s meeting, they were at the previous events. We continue to hold meetings and accordingly, they will be invited to the next events.
64	Considering the fact that Bakhmaro is a winter resort with unique climate, will HPP construction have an impact on it? Ia Mamaladze (Guria News) Ozurgeti, the meeting with the biodiversity expert June 18, 2021	Nicola Faulks explained that Switzerland, France and other European countries have positive examples of small capacity HPP operation near resorts.

65	The project group of Bakhvi 1 HPP introduced a different precedent of communication with the local civil society, while other developers do not meet local society at all or meet post factum. She added that regarding the relationship with local self-government, NGOs and population, Bakhvi 1 HPP is a role model. She noted that HPP cannot do more harm to the nature of Bakhmaro than it happens due to uncontrolled tree felling within the resort and the construction of summer houses with tin roofs. Ia Mamaladze (Guria News) Ozurgeti, the meeting with the biodiversity expert June 18, 2021	No comments were made by the Company
66	You want to complete HPP construction before opening of the national park. The Ministry is engaged in double dealing. Irma Gordeladze (Environmental organization Eco) Ozurgeti, the meeting with Climate Change Regional Action Group July 14, 2021	Company's response: The information is false. Surveys regarding the park are carried out by WWF, with financial support of Sweden embassy. According to the information available to us, these surveys should be submitted to the Ministry of Environmental Protection and Agriculture of Georgia. Based on information available to the Company, there are numerous examples of presence of HPPs (small as well as large HPPs) on the territory of the protected areas
67	Will all three HPPs, planned on Bakhvistskali river, have common impounding basin or will they have separate ones? David Tenieshvili (Bio Farmer, tea producer) Ozurgeti, the meeting with Climate Change Regional Action Group July 14, 2021	Company's response: Each project will have individual impounding basin. Bakhvi 3 is completed project.

68	What dangers and risks does CCEH face? Are there funds? Manana Mindadze (member of Chokhatauri town council) Ozurgeti, the meeting with Climate Change Regional Action Group July 14, 2021	Company's response: The project is long-term and return on investment is expected in 10-12 years. Accordingly, this is risk-bearing, however, fund is backed by reputable investors and possible liquidity problems are not discussed.
69	How CCEH is related with Bakhvi 3 HPP? Irina Sajaia Ozurgeti, the meeting with Climate Change Regional Action Group July 14, 2021	Company's response: the Company purchased 40% share after HPP construction and CCEH involvement in its management is small.
70	How 700 thousands GEL will be distributed between Ozurgeti and Chokhatauri municipalities? Naizbrola Kazaishvili Ozurgeti, the meeting with Climate Change Regional Action Group July 14, 2021	Company's response: according to the area used by HPP and in compliance with the rule set by legislation.
71	How can prove that all three HPPs will not destruct Bakhmaro climate? Irma Gordeladze (Environmental organization Eco) Ozurgeti, the meeting with Climate Change Regional Action Group July 14, 2021	Company's response: The Company invites various international experts from France, Austria, Germany, in their surveys the impact of all three HPPs on climate will be considered and CCEH will make a decision only on the basis of their conclusions.

72	Where does power generated by Enguri HPP go? To Russia? So new HPPs are not needed, are they? Irma Gordeladze (Environmental organization Eco) Ozurgeti, the meeting with Climate Change Regional Action Group July 14, 2021	Company's response: 40% of the generated power goes to Abkhazia (not to Russia) and HPPs are needed to reduce dependence on neighboring countries, especially on Russia, as on unreliable partner.
73	If surveys show that HPP has damaging impact on Bakhmaro climate, how the Company will response? Manana Mindadze (a member of Chokhatauri town council) Ozurgeti, the meeting with Climate Change Regional Action Group July 14, 2021	Company's response: in such case CCEH will make amendments to the project or cancel it.
74	Why the electricity generated by solar and wind resources is rejected? David Tenieshvili (Bio Farmer, tea producer) Ozurgeti, the meeting with Climate Change Regional Action Group July 14, 2021	Company's response: Wind and solar energy is not stable, as it depends on weather conditions, besides, arrangement of corresponding infrastructure is related to high expenses, and at the given moment, neither the Company not the State have such resources
75	Is it possible that the river disappears completely after construction of 3 HPPs? Maia Chavleshvili (the representative of Ozurgeti Municipality Mayor in Mtispiri administrative unit) Mtispiri, the meeting with the representatives of self-government of the village July 14, 2021	Company's response: the river level has not been reduced after Bakvi 3 HPP construction, accordingly, it won't do in this case too, besides, the Company has already made a decision to leave 29% of the river instead of 10% outside the pipe.

76	In case of road damage during construction, are you going to restore it? Vladimer Chavleshvili (Majoritarian Deputy of Ozurgety Town Council from Mtispiri administrative unit) Mtispiri, the meeting with the representatives of self-government of the village July 14, 2021	Company's response: The company will definitely include the relevant clause in the contract, signed with the contractor, which will consider restoration of damage occurred during HPP construction. However, before starting the construction, the road must be videotaped and photographed.
77	How many people will be employed during HPP construction? Vladimer Chavleshvili (Majoritarian Deputy of Ozurgety Town Council from Mtispiri administrative unit) Mtispiri, the meeting with the representatives of self-government of the village July 14, 2021	Company's response: about 150 to 200 people.
78	How many people will be employed during HPP operation ? Vladimer Chavleshvili (Majoritarian Deputy of Ozurgety Town Council from Mtispiri administrative unit) Mtispiri, the meeting with the representatives of self-government of the village July 14, 2021	Company's response: about 15-20 people
79	Does the government oblige you to implement social projects?	Company's response: No, this is the goodwill of the Company and one of the priority issues for our company.

	Maia Chavleshvili (the representative of Ozurgeti Municipality Mayor in Mtispiri administrative unit) Mtispiri, the meeting with the representatives of self-government of the village July 14, 2021	
80	What experience does the company have? Vladimer Chavleshvili (Majoritarian Deputy of Ozurgety Town Council from Mtispiri administrative unit) Mtispiri, the meeting with the representatives of self-government of the village July 14, 2021	Company's response: the Company has completed HPP in Svanety (Lakhami HPP), owns share in Bakhvi 3 HPP and currently carried out construction in Akhalkalaki.
81	Will HPP have impact on Bakhmaro climate? Vladimer Chavleshvili (Majoritarian Deputy of Ozurgety Town Council from Mtispiri administrative unit) Mtispiri, the meeting with the representatives of self-government of the village July 14, 2021	Small HPPs cannot have impact on climate, however, the Company carries out surveys, the results of which will be gradually introduced to the public.
82	How trout in the river be impacted by HPP? Maia Chavleshvili (the representative of Ozurgeti Municipality Mayor in Mtispiri administrative unit) Mtispiri, the meeting with the representatives of self-government of the village July 14, 2021	Similar to Bakhvi 3 HPP, when the fish pass had been arranged during its construction, a fish pass is planned at Bakhvi 1 HPP too, using which fish can live and move in the river

83	When does HPP construction start? Nana Cheishvili (the director of public school) Mtispiri, public meeting July 29, 2021	Company's response: Till the end of 2021 the Company have to carry out surveys, then it will obtain environmental impact and construction permits and only after that it will start construction from 2022.
84	Will only unskilled workforce be employed from locals for HPP construction? Local residents Mtispiri, public meeting July 29, 2021	Company's response: if representatives of local population present the certificate of relevant qualification and show corresponding technical knowledge, they will be employed for various positions and provided with opportunities advancement and development.
85	Will the river be dried out after passage through the pipe? Amiran Kvaratskhelia (local resident) Okroskedi, public meeting July 29, 2021	It is an accepted practice in Georgia to leave 10% of the water outside the pipe; CCEH will leave 29%, which will be supplemented by tributaries on the way, therefore drying of the river due to Bakhvi 1-HPP is excluded.
86	How is the water level controlled in the river? Maia Chavleshvili (the representative of Ozurgeti Municipality Mayor in Mtispiri administrative unit) Okroskedi, public meeting July 29, 2021	Company's response: the Company installs flow meter in the river, which makes recordings and records are sent to the Ministry. If water level reduces to 290 l, the company is obliged to stop HPP operation.

87	Why did you decide to use Chadrekili road? Local resident Okroskedi, public meeting July 29, 2021	Company's response: In order to avoid passing through Bakhmaro resort and bothering resort visitors.
88	What benefits will HPP construction bring to the village? Avto Makharadze (local resident, former governor (Gamgebeli) of Mtispiri) Okroskedi, public meeting July 29, 2021	Company's response: firstly, there will be employment opportunities for locals, during construction employment during 2-3 years and on HPP operation phase – permanent employment opportunities. Besides, the Company decided to implement social projects within the requirements of the villagers and the ability of the company.
89	Include the clause in the contract, according to which the village will be supplied with free electricity. Avto Makharadze (local resident, former governor (Gamgebeli) of Mtispiri) Okroskedi, public meeting July 29, 2021	Company's response: according to the legislation of Georgia, power generated by HPP should be connected to the unified electric system of Georgia, from where the electricity is distributed throughout the country according to set tariffs; changing these tariffs is beyond the competence of the developer company.
90	The road problem is common for all villages of Mtispiri community and in winter the movement is complicated. Could you help to solve this problem with cooperation of Ozurgeti town council? Avto Makharadze (local resident, former governor (Gamgebeli) of Mtispiri) Okroskedi, public meeting July 29, 2021	Company's response: The option of repairing the drive way in the context of social projects will definitely be discussed by the company and then the population will be informed about the answer.

91	Will locals benefit with free electricity or at least reduced tariffs after HPP construction? Local resident Ukanava, public meeting July 29, 2021	Company's response: according to the legislation of Georgia, power generated by HPP should be connected to the unified electric system of Georgia, from where the electricity is distributed throughout the country according to set tariffs; changing these tariffs is beyond the competence of the developer company.
92	Have you built Bakhvi 3 HPP? During construction of Bakhvi 3 HPP, we blocked the drive way thrice as a sign of protest, because villagers could not pass through the road and it was very muddy. Local resident Ukanava, public meeting July 29, 2021	Company's response: CCEH is not related with the construction of Bakhvi 3 HPP. It bought the share from Bakhvi 3 HPP after its construction. Accordingly, it cannot be responsible for problems ocured during construction, however, the company will surely consider mistakes made and take preventive measures.
93	How many people will be employed during construction? Local resident Ukanava, public meeting July 29, 2021	Company's response: about 100 people will be employed for 2-3 years and on operation phase, about 15-20 people will be employed permanently.
94	During construction of Bakhvi 3 HPP workforce was mobilized from various regions. We hope you will not act in the same way. Local resident Ukanava, public meeting July 29, 2021	Company's response: Our company will ensure that most of the employees during the construction are representatives of the local community.

95	Will local population have at least reduced tariffs for electricity in the result of HPP construction? Local resident Vaniskedi, public meeting July 29, 2021	Company's response: according to the legislation of Georgia, power generated by HPP should be connected to the unified electric system of Georgia, from where the electricity is distributed throughout the country according to set tariffs; changing these tariffs is beyond the competence of the developer company.
96	Does HPP construction result water level reduction in the river and cause drying of the river? Local resident Vaniskedi, public meeting July 29, 2021	Company's response: Company invited experts of international level, who carry out surveys in different directions and CCEH act only incompliance with their recommendations and conclusions. As for water level, we have good example of Bakhvi 3 HPP, after construction of which water level in Bakhvistskali river has not been reduced. The same will happen in the given case. In addition, the Company will install flow meters in the river, using which water level will be controlled and monitored. .
97	In Chadrekili settlement with its 32 families there is no electricity at all. Could you solve this problem? Local resident Vaniskedi, public meeting July 29, 2021	Company's response: EnergoPro is responsible for power supply of the new facilities, but we will try to play a positive role in resolution of the given issue, as Bakhvi 1 HPP is quite near to Chadrekili settlement.
98	Do you need Vaniskedi road to access HPP and are you going to arrange the asphalt coating? Local resident Vaniskedi, public meeting July 29, 2021	Company's response: We will definitely improve the road condition so that there will be unimpeded movement for the villagers as well as the company staff and equipment, but we cannot promise to make asphalt pavement, as it requires a fairly high budget.

99	The access road to the reservoir, which supplies water to 20 families, is unavailable and could you help to improve the road? Local resident Vaniskedi, public meeting July 29, 2021	Company's response: The company will consider the problem of the access road to the reservoir as well as the problem of unsystematic water supply and will come back to you at the next meetings with specific answers.
100	Who carries out the climate impact survey for Bakhvi 1 HPP? Tamar Oniani (Young Teacher union) Akhaltsikhe, Bakhvi 1 HPP Advisory Board Working Meeting September 8, 2021	Company's response: Climate survey is carried out by one of the reputable companies - Blu Rivers (https://bluerivers.kiev.ua/home/) and an independent expert, founder of French environmental consulting company Alpage, Pierre Biedermann, who has 25-year environmental survey experience in hydropower field: https://www.alpage-consult.com/fr/mentions-legales.html
101	How will water level in Bakhvistskali be controlled? As it is known to you, number of draughts increased worldwide. Tamar Oniani (Young Teacher union) Akhaltsikhe, Bakhvi 1 HPP Advisory Board Working Meeting September 8, 2021	Company's response: the Company installs flows meter in the river, which make recordings and records are sent to the Ministry. If the water level reduces to certain value, the Company is obliged to stop HPP operation.

102	There were suspicions in the community that members of the Advisory Board would lose their objectivity and become CCEH like-minders. David Tenieshvili (Bio farmer, Tea producer) Akhaltsikhe, Bakhvi 1 HPP Advisory Board Working Meeting September 8, 2021	Company's response: Board members have a kind of ambassadorial function and it is their free will to make both positive and negative evaluations of the project.
103	Will Bakhvi 1 HPP headworks be visible from Sunset Slope in Bakhmaro? Tamar Oniani (Young Teacher union) Akhaltsikhe, Bakhvi 1 HPP Advisory Board Working Meeting September 8, 2021	Kristine Gurielidze responded (Manager of the hotel Bakhmaro Pioneers, tour operator): I know both locations very well and it is impossible to see the HPP headworks from the sunset hill.
104	Will local population have any benefits in the form of reduced tariffs on electricity? Lika Asieshvili (Youth Center "Progress") Akhaltsikhe, Bakhvi 1 HPP Advisory Board Working Meeting September 8, 2021	Company's response: according to the legislation of Georgia, power generated by HPP should be connected to the unified electric system of Georgia, from where the electricity is distributed throughout the country according to set tariffs; changing these tariffs is beyond the competence of the developer company.
105	What is flooding area of Bakhvi 1 HPP and that of Akhalkalaki HPP? Nugzar Asatiani (the Newspaper "Alioni")	Company's response: Akhalkalaki HPP flooding area is 3,5 ha and that of Bakhvi 1 HPP is much smaller - 0.3 ha.

	Akhaltsikhe, Bakhvi 1 HPP Advisory Board Working Meeting September 8, 2021	
106	Despite the usage of large resources in Chokhatauri, Nabeghlavi HPP has problems of operation. What are your guarantees that the hydropower plant constructed by you will operate properly? Lika Asieshvili (Youth Center "Progress") Akhaltsikhe, Bakhvi 1 HPP Advisory Board Working Meeting September 8, 2021	Company's response: No one is safe from mistakes, CCEH hires Afry (Austrian office of Scandinavian engineering company Afry https://afry.com/en) to manage similar risks, which uses the highest standards and has the best engineers.
107	NGOs think that there is no sufficient information given about the biodiversity in the scoping report of Bakhvi 1 HPP. Ia Mamaladze (Guria News) Zugdidi, Bakhvi 1 HPP Advisory Board Working Meeting October 18, 2021	Company's response: At the scoping phase, a general overview of all issues is provided and delving into the depths is not advisable (nor required by law). As for biodiversity, for example, survey is conducted by SLR Consulting, a British office expert Nicola Faulks, and after publishing of her report, the Company is ready to answer any questions.
108	Is the impact of Bakhvi 2 HPP, planned on Bakhvistskali river considered during assessment of cumulative impact? Ia Mamaladze (Guria News) Zugdidi, Bakhvi 1 HPP Advisory Board Working Meeting October 18, 2021	Company's response: During cumulative impact assessment, experts consider and evaluate potential impact of Bakhvi 2 HPP.

109	Bakhvi 3 HPP helps the first graders of Mtispiri school every year, what do you think in that direction? Maia Chavleshvili (representative of Ozurgeti municipality Mayor in Mtispiri administrative unit Zugdidi, Bakhvi 1 HPP Advisory Board Working Meeting October 18, 2021	Company's response: As you know CCEH has already helped the school upgrade its computer lab as well as installed video surveillance cameras in it. Despite all this, the company continues to communicate with the school principal and there is an idea to provide support from the company to the alumni of Mtispiri school who will continue their studies in the field of hydropower and environment.
110	It will be good if Bakhvi 1 HPP becomes the tourist location; if resting areas are arranged, huts are constructed in Bakhvistskali river valley, etc. Nugzar Asatiani (the Newspaper "Alioni") Zugdidi, Bakhvi 1 HPP Advisory Board Working Meeting October 18, 2021	Company's response: we will think on this issue
111	When are you going to submit the Environmental Impact Assessment report to the Ministry? Nugzar Asatiani (the Newspaper "Alioni") Zugdidi, Bakhvi 1 HPP Advisory Board Working Meeting October 18, 2021	Company's response: we have to submit EIA report in December, 2021.

112	How valid these studies are and whether duplication of gamma studies has occurred. Giorgi Girkelidze (Guria News) Ozurgeti, the meeting of Bakhvi 1 HPP Advisory Board with foreign experts November 20, 2021	The given question was answered by the researcher Nicola Faulks (SLR Consulting, UK) - I know the area quite well, even before the Bakhvi-1 project, in 2017 I had to conduct survey in the area under the GSE (Georgian State Electric System) project. In addition, in 2021, detailed field surveys were conducted with the company Gergili to eliminate or confirm the information recorded during desk surveys. Accordingly, independent studies have been carried out under the project and have not been carried out on the basis of Gamma surveys.
113	What is planned in relation to floodplain forest within the project framework and according to some information, it is planned to clean (tree felling) 12 ha forest area. Nugzar Asatiani (the Newspaper "Alioni") Ozurgeti, the meeting of Bakhvi 1 HPP Advisory Board with foreign experts November 20, 2021	The given question was answered by the researcher Nicola Faulks (SLR Consulting, UK): According to our calculation, a total of 9 ha of forest is expected to be cut down, which will be specified before construction. The following approaches will be used to reduce damage to the habitat - cutting down of only the trees needed, rehabilitating and planting. In particular - use of existing degraded habitats for rehabilitation. Landscaping beyond the headworks.
114	What type of fish excluder will be used? Temur Janukvadze (deputy mayor of Ozurgeti) Ozurgeti, the meeting of Bakhvi 1 HPP Advisory Board with foreign experts November 20, 2021	This question was answered by the expert Pierre Biedermann (Alpage, France); as an example, he introduced to the public a fish excluder structure with iron screens, arranged in a small HPP in France, inside one of national parks. The mentioned screens protect fish from getting into the pipeline and direct fish to the fish pass, so that they could return to downstream section of the headwork.
115	How will salamander and viper coexist? Lado Menabde ("Guriis Moambe", "Mtavari Arkhi" (Guria News, Main Channel))	This question was answered by Nicola Faulks (SLR Consulting, UK): during field surveys, Caucasian viper was not found, however, since the project area includes potential habitats, an area free from reptiles will be arranged and ponds will be arranged for salamander; in addition, shelters for reptiles will be arranged from stone and ground piles.

	Ozurgeti, the meeting of Bakhvi 1 HPP Advisory Board with foreign experts November 20, 2021	
116	It is proposed to hold a panel discussion where Bakhvi 1 HPP opponents will be invited Grigol Makharadze (Center for Democratic Engagement) Ozurgeti, introductory- public meeting about Bakhvi 1 HPP project impact on biodiversity, climate and cumulative impact November 20, 2021	Company's response: The company representative reminded Mr. Makharadze that he had been invited to previous meetings several times but had not attended. It was also unclear to the company why he thought today's meeting was an awkward format. The meeting was attended by locals from Mtispiri, Bakhmaro, representatives of local self-government, non-governmental sector, small business and media (up to 70 people in total).
117	Who will consume generated power; will it be used inside the Country-Georgia or it will be exported? Saba Siradze (Social enterprise „3D") Ozurgeti, introductory- public meeting about Bakhvi 1 HPP project impact on biodiversity, climate and cumulative impact November 20, 2021	Company's response: According to the current legislation and arrangement, the power generator cannot decide who is supplied electricity, as generated power goes to the common grid and then it is distributed, but given that demand is growing and we have a shortage, the cheap power generated will most likely be consumed by the Georgian electricity system.
118	Taking into consideration seasonality, how much water is left outside the pipe during the lowest water level period? How much water is left on average? How much water is left on maximum? How many hectares are used for the project? Have you purchased or leased these lands from the state?	Company's response: A major change in the project by collaboration with the international company AFRY caused leaving at least 290 l/s water downstream the headworks, with the addition of 32 tributaries. Besides, during floods excess water overflows the headwork and goes to the riverbed, which will be positively reflected on the hydrological mode – in total, 40% of annual runoff will remain in the river. Mr. Mikheil Niblidze - The area will be specified after the completion of the detailed project, the lands will probably be leased.

	Vakhushti Menabde (GYLA) Ozurgeti, introductory- public meeting about Bakhvi 1 HPP project impact on biodiversity, climate and cumulative impact November 20, 2021	
119	Firstly, she thanked Bakhvi 1 HPP project team for giving her the opportunity to attend the event online and asked questions as she was in self-isolation and was unable to attend the event. She also stressed the different approach of C-C-E-H to conduct the process of communication with the public openly and transparently, and that the recommendations of her and her friends were taken into account, (for example, the flooding area of Bakhvi 1 HPP was reduced. The population have to choose, which project should they support, Guria National Park or Bakhvi 1? Irma Gordeladze (Environmental organization Eco) Ozurgeti, introductory- public meeting about Bakhvi 1 HPP project impact on biodiversity, climate and cumulative impact November 20, 2021	No comments was made by the Company
120	After passing through 14 km pipe, what impact will the water have on Bakhmaro forests; why was not this issue mentioned in the presentation ? Irma Gordeladze (Environmental organization Eco) Ozurgeti, introductory- public meeting about Bakhvi 1 HPP project impact on biodiversity, climate and cumulative impact November 20, 2021	Pierre Biedermann (Alpage, France): he explained that considering the topography of the valley and in general, according to nature principles, vegetation cover defines river mode and not on the contrary, as the forest, located in 400-500 m above the river, cannot feed from the river.

121	Did foreign experts examine and study Bakhmaro climate? Mrs. Gordeladze also mentioned that she could submit to the company questions of her interest in a written form. However, as for December 9, 2021, the company has not received any questions in a written form. Irma Gordeladze (Environmental organization Eco) Ozurgeti, introductory- public meeting about Bakhvi 1 HPP project impact on biodiversity, climate and cumulative impact November 20, 2021	Pierre Biedermann (Alpage, France): The study of the possible impact on the climate was carried out by him and he presented the relevant results - the scale of flooding and works is so small that it is practically impossible to assess it and there is no need for similar studies on small hydropower plants in the EU.

12 Conclusions and Recommendations

Following main conclusions are developed within EIA report:

1. The project considers construction and operation of the diversion type, non-regulated HPP on Bakhvistskali river in Ozurgeti and Chokhatauri municipalities. The project can be discussed as the part of energy development of the country;
2. Environment baseline conditions of the project region and corridor have been studied within the scope of the EIA, for which, literary sources, the stock materials and also the results of the field surveys of the project area have been used. After environmental baseline studies it was revealed, that the main sensitive receptors within the study area are Bakhvistskali river, geological environment, biological environment (including aquatic biodiversity);
3. International consulting company SLR was involved in the EIA process and additional biodiversity survey was carried out. SLR has developed Biodiversity Manageemnt Plan, which is attached to the report;
4. An international expert was involved in the EIA process, who prepared micro and macroclimate report and also cumulative impact assessment report. Both documents are attached to the given report;
5. Considering work specificity EIA is implemented for two main stages of the project: construction and operation phases;
6. According to calculations carried out within the EIA report, the impact caused by noise propagation and harmful substance emissions is less expected on local population. Impact caused by noise propagation and harmful substance emissions is relatively more significant on wildlife; however, the impact will be temporary and reversible. After HPP commissioning the environmental impact, caused by noise and harmful substance emissions will be significantly lower;
7. In the regard with the impact on water quality, the most sensitive sites are: on construction phase – construction sites, located near the riverbed. On operation phase – powerhouse site. Considering targeted environmental management and planned mitigation measures, significant deterioration of the water quality is not expected on construction and operation phases;
8. Hydrological change (water reduction) in the project sections of the river on operation phase must be considered as significant environmental impact
9. It is noteworthy that downstream of headwork, Bakhvistskali river is joined by several small tributaries. This will slightly improve minimum conditions, required for vitality of aquatic biodiversity;
10. In order to reduce the impact on fish fauna, caused by existence of the dam on operation phase, it is planned to arrange fish ladder and fish excluder. The environmental flow will be released through fish pass;
11. Implementation of the construction works and reduction of the water level within the project section will cause impact (restriction of habitat) on some species of mammals, birds and amphibians, typical to the valley. However, high impact on species subject to special concern and their habitats is not expected;
12. Due to the considerable distance from the project area to the protected areas, there are no risks on them;
13. There are no visible historical-cultural monuments observed within the project corridor. Direct impact on them is not expected;
14. The project implementation corridor passes through state land plots. However, temporary, and less likely permanent acquisition of private land plots may be required. In this case, the project executor will hold negotiations with land owners and provide compensation measures;

15. On construction phase transport operations will cause growth of local traffic flows. It is possible to minimize the impact by selecting various transport routes, warning population in advance and agree transport activities with local government
16. Local natural resources (sand-gravel reserves, water resources for potable-sanitary and technical purposes, forest resources, etc.) may be used for construction, which is also significant in terms of the impact on local environment;
17. Considering Bakhvi 3 HPP downstream of the project facility, the cumulative impact is mainly expected on operation phase. Following should be singled out from cumulative impact types: change of river hydrological mode and impact on aquatic biodiversity; cumulative impact on vegetation cover and forest resources;
18. As a result of project implementation, low or medium residual impact is expected on certain environmental receptors by considering proper mitigation measures. Impact on biological and hydrological environment of rivers can be deemed as the most significant residual impact.
19. In addition, it should be noted that according to the project documentation and analysis of the baseline condition of the environment, it is determined that with consideration of corresponding mitigation measures, following circumstances will mitigate the impact on separate receptors of the natural and social environment on construction and operation phases:

- Low-threshold weir is planned on headwork structure, which ensures overflow of full amount of excess water and sediment downstream.
- Major part of the project corridor coincides with the route of unpaved, dirt road, which passes though the valley. It is not planned to arrange large reservoir upstream of the weir. This significantly reduces the negative impact scale on trees and vegetation cover and habitats;
- Only small impoundment will be arranged upstream, which excludes negative impact risks on the climate and meteorological conditions of the region;
- It is planned to arrange fish pass infrastructure at headwork that more or less reduces the negative impact risks on fish fauna;
- Penstock is planned to be arranged underground; this reduces impact risks on wildlife;

20. Construction and operation project implementation will be related to the significant positive impact, namely:
    - Temporary and permanent job-places will be created for the construction and operation of the infrastructural facilities, which is very important for local population employment (mainly locals will be recruited for low-qualification job-places);
    - Construction and operation project envisages rehabilitation of local roads, which can be assessed as positive impact on local population;
    - Construction and operation project implementation results in positive effect for socio-economic development of Ozurgeti municipality, as well as of the whole region.

Major Environmental Measures to be implemented through the Work Process:

1. The project executor company and construction contractor will set the strict control over the implementation of mitigation measures considered in the EIA report and over performance of the permit conditions considered by the conclusion of ecological examination;
2. Relevant paragraphs will be reflected on performance of environmental standards/obligations in the agreement signed with the construction contractor;
3. Personnel, employed on construction and then on operation phases, will be periodically trained and tested on environmental and occupational safety issues;
4. Staff will be provided with personal protective equipment for the construction and operation phases;
5. Temporary structures will be arranged near the construction sites, so that to reduce intensity of traffic flows near the population at maximum;

6. On construction and operation phases, the issues related to tree felling on the State Forest Fund areas will be agreed with agency, authorized on State Forest Fund Area management;
7. Cultivation of the construction sites and landscaping of the power house perimeter will be considered in project documentation in order to compensate the damage towards the vegetation cover during construction of infrastructural facilities
8. Sediment discharge from upstream towards downstream within the headworks section will be monitored twice a year, after spring and autumn floods;
9. Hydrological parameters of the river will be recorded systematically within the headworks axis. Downstream release of environmental flow will be controlled and the information will be provided to the corresponding agency;
10. In case of inflow of the river flow equal or less than the environmental flow, the HPP operation will be suspended and full volume of water will be released downstream of the headworks;
11. The environmental flow will also be released through the fish pass, creating the conditions for fish migration, that is close to the natural conditions;
12. The technical functionality and effectiveness of the fish pass will be monitored, which is especially important during the reproduction and migration period of the fish;
13. According to Monitoring Plan, during the project implementation, fish fauna will be monitored, with the aim of development of additional mitigation measures, if required
14. The measures considered in the Waste Management Plan, given in the present report, will be carried out;
15. For the purpose of optimization of oil storage and usage rules on the operation phase, special warehouse sites will be arranged on the territory of the powerhouse. Warehouses will be equipped with devices against spillage and spill distribution on the site;
16. In order to minimize hazardous geodynamic process development risks, corresponding preventive measures will be carried out and protective structures will be arranged (it is noteworthy that prior to construction, additional surveys are planned within the project corridor – drilling boreholes, based on which conditions for foundation of HPP project facilities will be specified, as well as parameters of protective structures);
17. Inert materials will be obtained on the basis of the license for mineral resource extraction.

Project Executor – CCEH Hydro VI LLC is responsible for performance of environmental measures in the construction and operation process of Bakhvi 1 HPP.

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14 Annexes

Annexes are attached as a second volume to the Environmental Impact Assessment report for 10.9 MW installed capacity run-of-river Bakhvi 1 HPP on Bakhvistskali river.

Total number of annexes is 15, and detailed list of them is given in the table below.

Annex N1	Spoil ground
Annex N2	Geophysical Survey and Seismic Risk Analysis
Annex N3	Geological Maps
Annex N4	Biodiversity Impact Assessment report (SLR)
Annex N5	Timber Resource Recording Materials
Annex N6	Memorandum Signed with Local Population
Annex N7	Minutes of Various Meetings
Annex N8	Biodiversity Management Plan (SLR)
Annex N9	Conclusion of the National Agency for Cultural heritage Preservation
Annex N10	Calculation of Harmful Substance Emissions in Ambient Air
Annex N11	Emergency Response Plan
Annex N12	Waste management Plan
Annex N13	Macro and Microclimate Impact Assessment
Annex N14	Cumulative Impact Assessment Report
Annex N15	Booklets and Newsletters