Photo by Giorgi Kekenadze

LUKHUNI HPP CASCADE PROJECT

ENVIRONMENT AND SOCIAL IMPACT ASSESSMENT REPORT

NON TECHNICAL SUMMARY

Prepared by SRF Gamma

Tbilisi, 2012

Contents

1. Foreword

This document is a Non-Technical Summary (NTS) of the Environmental and Social Impact Assessment Report (ESIA) of the Lukhuni HPP cascade in Ambrolauri municipality, Georgia.

The document describes in a non-technical manner the project and presents major findings of the ESIA, provides a summary of environmental and socioeconomic conditions, potential impact of the planned development on them and describes the actions have to be taken to reduce this impact.

This NTS is part of the larger package of documents, including the ESIA, Stakeholder Engagement Plan (SEP) and Environmental and Social Action Plan (ESAP).

The NTS along with other documents listed above are available for review and comment at the following places:

- Rusmetal Ltd, 63 Irakli Abashidze str., Tbilisi, Georgia;
  174 Maris Arkhi, 3700, Rustavi, Georgia,
- Amrolauri Municipality, Gamgeoba Office – 1 Tamar Mepe str, Ambrolauri;
- SRF Gamma – 17a David Guramishvili Avenue, Tbilisi, Georgia

The document will be also made available at Uravi construction camp site.

Electric versions of the documents are available on the website: http://rusmetali.com

2. Rusmetali – the applicant

Rusmetali Ltd, was established in 2005. The company launched a factory in Rustavi, nearby Tbilisi, which began production immediately in 2006. The main activity of Rusmetali is ferro-alloys (ferrosilicon manganese, ferrosilicon, ferromanganese, and ferrochrome) manufacturing. It owns the license for several manganese open quarry ore mines in Terdjola region (Brolis Kedi, Chkhari, Dzevri) and has Manganese Processing Factory in the same region where this ore is processed. 100% of the company's production is exported in different countries all over the world. Moreover, "Rusmetali" opened its representative office in Turkey, in order to ensure more flexible and efficient operation on the local market. As electricity is one of significant 'consumables' for ferroalloys production, in 2010 the company made decision to develop a HPP scheme in Ambrolauri municipality.

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Designer - The project design has been developed by STUCKY Caucasus Ltd., a branch of the STUCKY group, a Swiss based consulting company offering engineering and consulting services in the fields of dams, water and energy. The company has a worldwide reputation for excellence acquired over 85 years of continuous services and expertise. The firm was established in Switzerland in 1926, and has completed assignments on over 100 major infrastructure projects worldwide. STUCKY has been active in Georgia for over ten years.

Environmental consultant - Scientific-research firm Gamma was commissioned by Rusmetali Ltd to prepare Environmental and Social Impact Assessment (ESIA) for the project. SRF Gamma is a private

consultancy and design company set up in 1991. The company is active in the following domains: environment; natural resources, including ground water; design and engineering. The staff of the company is 80 strong; portfolio - accounts for hundreds of various projects.

3. Introduction and background

On June 7, 2007, the Parliament of Georgia adopted the Resolution on Main Directions of Georgia's State Energy Policy. The main objectives in energy sector were set. As at present Georgia cannot meet demand for fuel and energy resources and needs to import energy carriers of around 1 billion USD each year, the government set as an object achieving energy security and reverting of the status transforming Georgia from importer into exporter of energy. Full satisfaction of the industrial and communal demand on electricity by maximum utilization of local hydropower resources in the electricity sector was set as priority (Georgian Renewable Energy policy, 2008). Thus, the national strategy of energetic and economical development provides for construction of new hydropower power plants. Construction of a number of small, middle and large scale HPPs are under discussion; some power generation and transmission projects (including trans-boundary) have been already launched or designed.

One of such projects is Lukhuni HPP cascade under consideration. The scheme will contribute to development of renewable energy sources, supply energy to the state energy distribution system. A number of work places will be established favoring to employment of local population and improvement of their economic conditions. Execution of the project will help the region to preserve existed jobs and businesses (including service sphere), what on its side will promote improvement of life conditions of laborers. Besides, local budget will receive taxes paid for water use, as well as taxes paid by service provides delivering their services to the HPPs. By providing energy to the national grid the project will contribute to reduction of power import and increase power export to neighboring countries.

Construction of the HPP cascade will increase the electricity supply in Racha region, and will do so without generating significant greenhouse gases.

4. Scope of Environmental and Social Impact Assessment (ESIA)

According to the Georgian law on Environmental Permit[1], construction of hydroelectric power station of 2 MW and higher capacity belongs to operations subjected to ecological examination. This means that in order to get authorization for implementation of the project, impact of the planned development (construction and operation of the HPP scheme) on environment must be evaluated. Environmental and social safeguards are considered under Environmental and Social Policy (2008) of European Bank for Reconstruction and Development (EBRD), potential lender.

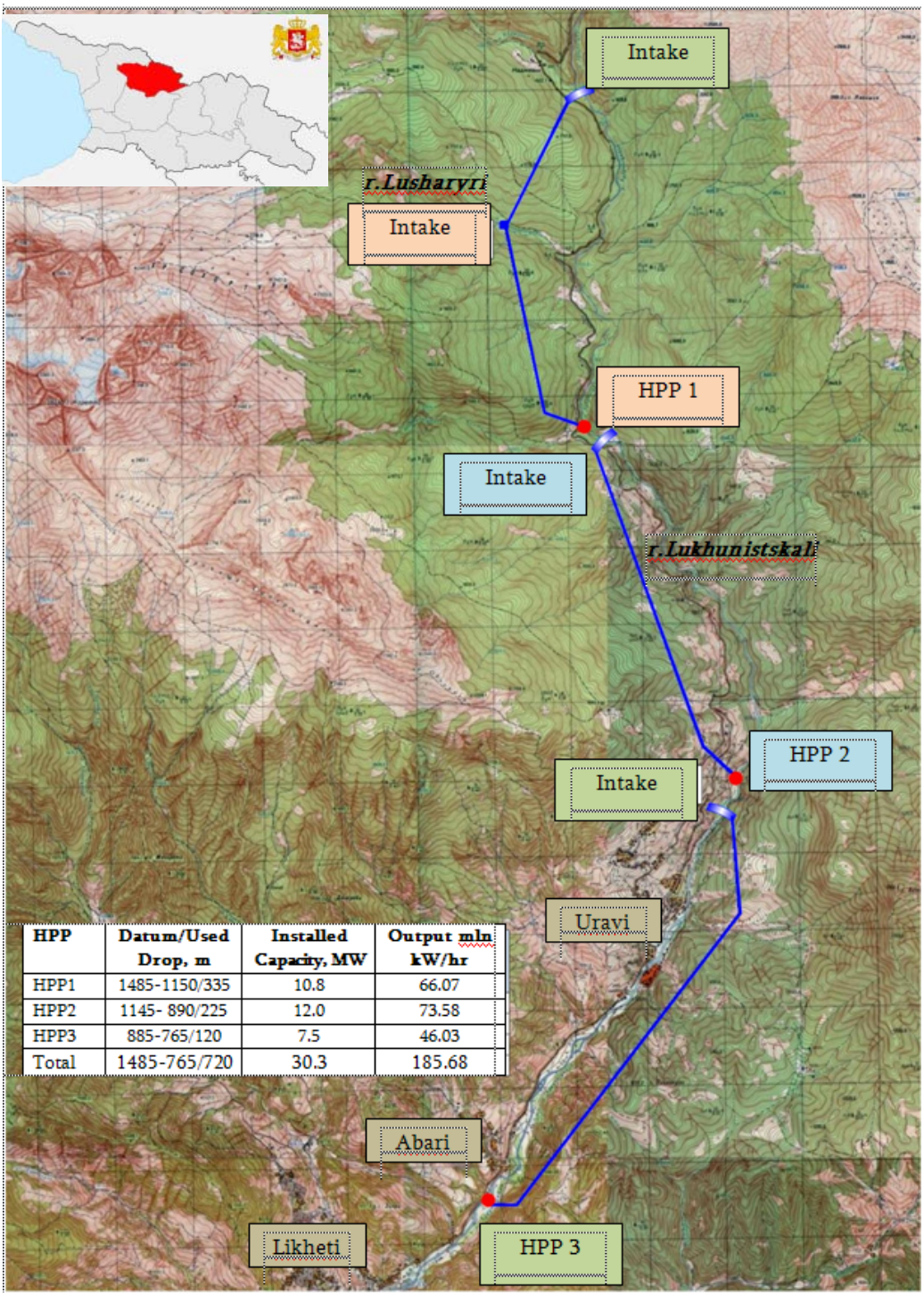
In keeping with Georgian law and EBRD requirements, the overall scope of the ESIA includes the following:

- Scoping and identification of key environmental and socioeconomic issues.
- Description of existing environmental and socioeconomic conditions.
- Evaluation of the potential impacts the project could have, positive and negative.
- Consultation with people who may be affected by the project and with other stakeholders to inform them, identify their concerns, and receive information.
- Development of design and operating practices that will avoid, reduce, or compensate for significant environmental and social impacts.
- Development of monitoring programs to verify the project is constructed and operated as intended, and to identify changes in environmental controls that may be needed.

[1] Georgian law on Environmental Permit - paragraph 4, clause 1, sub-clause "m"

5. Description of Proposed Development

Lukhuni HPP cascade consists of three HPPs: Lukhuni 1 (10.8MW); Lukhuni 2 (12mW) and Lukhuni 3 (7.5MW). Total capacity of the scheme 30.3 MW. The project is being implemented Lukhuni River gorge, Likheti community of Ambrolaury Municipality.



HPP	Datum/Used Drop, m	Installed Capacity, MW	Output mln kW/hr
HPP1	1485-1150/335	10.8	66.07
HPP2	1145- 890/225	12.0	73.58
HPP3	885-765/120	7.5	46.03
Total	1485-765/720	30.3	185.68

Figure 5.1. Location of the main components of the scheme

HPP1 – Two intakes will be built. One on the Lukhunistskali, another on the Lashaturi, both located at 1485 m above datum. Water from the Lashaturi intake will be delivered through tunnel to the main free flow tunnel. The tunnel from the Lukhunistskali headworks to the power penstock forebay will be 10.5 km long with diameter – 2.5-3.0 m. Two penstocks (diameter 600mm, length 1.4km) will deliver water

from the forebay to two Pelton turbines. The power station will be arranged within the above-floodplain terrace at 1150 m above datum. Design water flow of the HPP is 4.01m3/sec, design head - 335 m, installed capacity – 10.8 MW, average annual power generation – 66.07 mln kW. Along with the mentioned facilities 10/35kV substation and 16.8km long 35kV overhead transmission line connecting the HPP1 substation to the HPP2 transmission line will be built.

HPP 2 - Headworks will be located on the Lukhunistskali at 1150 m above datum. The scheme includes: diversion tunnel (length- 5.3 km, diameter – 3.0 m), penstock forebay, two penstocks (length 700m, diameter 600 mm) delivering water to two Pelton turbines and power station built within above-floodplain terrace (890 m above datum). Design water flow of the HPP is 7,0m3/sec, design head - 286m, installed capacity – 12.0 MW, average annual power generation – 73.58 mln kW. Along with the mentioned facilities 10/35kV substation and 2291m long overhead transmission line connecting to the 35 kV substation of Uravi. Will be arranged.

HPP3 - Headworks will be located on the Lukhunistskali at 885 m above datum and provide design flow to the free low derivation tunnel. Length of the circular section tunnel is 6.7 km, diameter – 3.0 m. The tunnel will connect to the penstock forebay. Two penstocks (length 830m, diameter 700m) will deliver water to two Pelton turbines. The power house will be built within the above-floodplain terrace at 765 m above datum. Design water flow of the HPP is 9.6 m3/sec, design head - 120 m, installed capacity - 7,5 MW, average annual power generation – 46.03 mln kW. The scheme also comprises 10/35kV substation and 1.9 m long 35kV overhead transmission line connecting to 35 kV substation of Sori.

As hydraulic works and their main hydraulic parameters are identical for all the three HPPs. The schemes include similar concrete dams of practical profile, with spillway and lateral intake. For the HPP1 and HPP2 water intakes will be installed on the right side of the dam, for the HPP3 – on the dam's left side. The dams will be 30-40 m long and 2.0-2.5 m high. The spillway will let surplus water and solids to freely flow down reach. In dams will be equipped with fishways (length 35-40m, width 2m) and have flush gates. The flush gates are intended for cleaning the upper reach area from sediments and supplying sanitary flow in the downreach during low waters.

Length of the concrete tailrace canal is 80-100 m. It is rectangular, linear and transfers turbine tail water to the Lukunistskali River. Slope of the canal's bottom - I=0.009.

All substations will have metal fence. Gravel-filled pits will be arranged under transformers. The territory will be provided with storm water drainage and emergency oil collector systems. Oil trap units will be installed to treat drainage water.

Electric power generated by the Lukuni HPP cascade will be distributed though Georgian power grid. There is a 35/10 kV substation (property of Energo-pro) in Uravi which connects to the state grid via 35kV transmission line. This infrastructure can be used for transmission of Lukhuni HPP power to the state power grid. The site allocated for HPP1 and HPP2 power houses are respective approximately 6.8 km and 2.29 km away from Uravi substation; HPP3 power house will be in about 1.9 km from transmission line connecting Uravi and Sori substations. In total to connect the scheme to the national grid about 11 km long 35 kV transmission line is to be constructed. The power transmission lines will be conducted along the river valley, mainly on the left bank. The line will run through unpopulated areas. In total 90-100 tower will be required. Basement of each tower will require some 50-60 m2 area, which translates into 6,000 m2

to be acquired for permanent use under the transmission line component of the project. Preparation phase includes arrangement of permanent/temporary access roads, power supply, water, compressed air and temporary facilities for the sites of the hydraulic works. There will be one main camp (0.8ha). The camp will be arranged in Uravi village, on the right bank of the Lukhunistskali, next to the office building of the former arsenic beneficiation plant. These facilities can be used for the construction camp

after rehabilitation and improvement (adequate contract shall be made with Uravi JSC to use the territory and facilities). Besides, construction grounds will be organized at each project site, including: 1) headworks and the tunnel's entrances, 2) access gallery to upper tunnel, 3) forebay, exit portal and penstocks; 3) powerhouse and tailrace canal.

Inert materials for the constructions will be delivered from licensed borrow pits present in Rioni valley. Besides local stocks of building materials - sand and gravel – which accumulate in the floodplain of Lukhunistskali River, on the section between the village of Uravi and Abara can be used. There the river has significant slope and solids (sand, gravel) transported from the upstream.

Construction bases and sites will be powered from the existed grid and diesel-generators. Diesel generators will be used to power both faces of the derivation tunnel and headworks site (on Lukuni River and its tributaries).

Water for drinking and domestic use will be tapped from the natural springs found nearby the construction grounds (the region and in particular the construction camp site is rich in high quality groundwater). Potable water supply will be kept in tanks intended for food products, and technical water – in ferrous metal tanks. A compact biological treatment unit will be provided at Uravi construction camp to treat domestic/sewage wastewater produced there.

Wastewater will be discharged into the Lukhunistakali river. No waste water will be discharged without treatment. The waste water after treatment will meet the following limits: Particulates - 400 mg/l; BOD - 6 mg/l; Ammonia nitrogen – 0.4 mg/l; Chloride – up to 350 mg/l; Polyphosphate – 0.2 mg/l. For treatment of industrial wastewater is considered УСВ-М-20 treatment unit (oil trap). Quarterly monitoring of water quality at the point of discharge will be performed.

Volume of spoil generating during tunneling will be 130-140 thousand m3. Volume of waste rocks generated during construction of the power houses is estimated at some 35-40 thousand m3. Spoil will be temporarily stores at tunnel adits. Temporary dumping areas will be arranged for and at:

- HPP1 derivation tunnel and the entrance of the HPP2 tunnel – spoil will be dumped at so called "Mepischala" territory in the upstream of the Lukhuni. For that 2.6 ha land parcel is identified there.
- HPP2 tunnel and the inlet portal of the HPP3 – spoil will be dumped over 1.9 ha area of the arsenic ore beneficiation plant
- Outlet portal of the HPP3 tunnel - spoil will be dumped over 1.3 ha adjacent area.

Total area used for dumping sites will comprise 5.8 ha. Topsoil will be stripped off the sites before dumping; stripped material shall be stockpiled separately to be used for recultivation of the dump sites post-construction.

Before the start up of construction existing roads will be rehabilitated and access roads to the headworks – built. Rehabilitated shall be 17 km road section between the villages of Tsesi and Uravi, besides major part of 14 km long road between Uravi Village and the headworks also requires thorough rehabilitation, some its sections are to be widened. The existed roads shall be extended to reach the headworks. In particular, more 150-200 m road shall be laid to the headworks of the HPP1, 800-900 m road to the HPP2 headworks and 350-400 m to the HPP3 headworks.

Estimated duration for each HPP will comprise 3 years.

The project is being implemented in Likheti community, Ambrolauri municipality. The settlements nearest to the project are vil.Uravi, vil. Abari and vil Likheti. The nearest settlements are:

Facility	HPP	Settlement	Number of households
Intake facilities	HPP1	n/a	n/a
	HPP2	n/a	n/a
	HPP3	Uravi	158
Power station	HPP1	n/a	n/a
	HPP2	Uravi	158
	HPP3	Abari	48
		Likheti	184

Staff - According to the Feasibility Study total of 150 people will be employed during construction. During operations, 13-15 staff will be employed plus an additional security staff. Policy of the company is to employ local labour force.

6. Environmental and socioeconomic effects and required mitigation

ESIA described the current conditions of water, land use, animals, plants, people and all other environmental and socioeconomic resources that the project could change and describes how the project would affect these resources, including the people.

When the ESIA found that the project could cause moderate or major impacts, then actions or procedures were developed to avoid, reduce, or otherwise mitigation the effects and reduce their significance (so called “mitigation measures”).

Results of impact assessment are presented below.

6.1 Potential impact on air quality

Emission of pollutants and inorganic dust due to operations of building machinery (excavators, bulldozers, etc) has been evaluated. For consideration of different load on machinery the maximum one shot emission was calculated for 30min period. Atmospheric air in the project area is almost unpolluted in the designed HPP cascade area; thus the background pollution indices can be assumed zero. All the infrastructural objects of the HPP cascade are located considerably far from populated areas. As a construction site of the HPP3 power house is relatively close to a residential zone, air dispersion of hazardous matter was modeled for this site.

During HPP exploitation there will be no emission sources at the water intake or power plant areas. Construction of reservoir is not planned; therefore no evaporation and corresponding humidity increase and climate changes are expected.

On the operation phase emissions are expected during maintenance service/ repairs. Emission amount and impact level will be different according to work volume, duration and area; though these impacts will be limited in time and have reversible character.

6.2 Noise propagation

Noise levels at work areas and nearest receptors (settlement) were estimated according to standard approaches. Considered are all noises produced due to the HPPs and their infrastructure construction as well as road rehabilitation/ improvement. Calculations are done at five different points for simultaneous work of all possible machineries and assuming minimum noise screening (the worst scenario). The calculations showed that produced noise doesn’t exceed permissible norms. The only

exception is the area of the HPP power house and substation. Though if we assume that simultaneous work of all machineries will not take place presumable total noise should be less than 53-55 dBA at the nearest receptor. Also mention that construction works will occur only at daytime. Personnel will be equipped with protecting equipment (ear protectors) as needed.

During the HPP operation main noise sources will be three hydro-turbines. According passport data typical hydro-turbine produces 96 dBA noise. Turbines will be enclosed in a casing with 10dBA noise absorbability. The same noise absorbing capacity will be ensured by reinforced concrete structure of the power plant. Considering these facts and the distance to the nearest settled area we can presume that noise will not exceed permissible norms at the settlement border.

Three transformers will be installed at the substation including one external power transformer and two for internal use. Considering distance (450m) between the HPP3 substation and populated area, noise impact should not be significant. On the operation phase some noise may be induced when routine or emergency incidents will require repair works and/or transportation operations. This “extra” impact will be short-term and depend on volume and duration of works.

6.3 Impact on soil

Preliminary works (preparation of construction camp and building sites, rehabilitation /construction of access roads) and construction operations (ground works, machinery operations) are likely to have certain impact on soil integrity and stability (especially when operations occur on slopes), and soil quality (due to fuel/oil spills, improper management of waste and explosive materials, topsoil damage/loss). Explosive materials needed for tunnel construction will be kept in a specially arranged facility, where appropriate safety/security norms will be followed. There will be no fuel/lubricant stocks at construction grounds what prevent soil pollution risks due to their spill/leakage. Soil and ground may be polluted is fuel/oil leaks from building machinery. Hazardous waste produced at the construction sites will be kept in special containers and moved to the construction camp to be temporarily kept there in adequate facilities. From the construction camp hazardous waste will be removed by an adequately licensed contractor. Domestic waste will be stored in lidded containers. At construction grounds domestic waste will be disposed of in pits. From the construction camp domestic waste will be delivered to Ambrolauri municipal landfill.

To avoid damage/loss of fertile soil during preparation of construction camps and building sites, topsoil will be stripped and stockpiled. Fertile soil will be dumped separately from other ground layers. All stockpiles will be protected against exposure to wind and atmospheric precipitation. Whenever possible, stockpiling areas will be selected minimum 50m away from surface waters. Throughout construction operations to avoid soil pollution/damage a building contractor shall follow to strict environmental requirements given in ESIA document.

Nearby the water intake and tunnel entrances will be allocated certain sites (1-2ha) where debris excavated in the tunnel will be dumped. After waste rocks are dumped, surface of dumps should be covered with topsoil and plants. In case of proper management and execution of mitigation measures, soil quality should not significantly deteriorate. After all works are finished all the machinery and construction materials will be removed off the territory. Temporary constructions will be dismantled and also moved out, and the territory will be remediated (these works will be done according to the plan provided by building contractor and approved by Rusmetali Ltd.)

The only impact on soil on the operation phase can occur due to repairing operations. During maintenance works corresponding mitigation measures should be ensured.

6.4 Development of geological hazards

Geological hazards may be activated due to construction of hydraulic works, temporary and permanent access roads, penstocks, towers for power transmission lines, etc. Visual inspection of territories allocated for infrastructure and access roads has not revealed landslides. But as the relief in the gorge is complex, landslides and erosion are likely to be activated throughout construction operations. There special consideration should be paid to areas selected for laying access roads to the HPPs infrastructural units and temporary roads required to erect transmission line towers.

If on the construction phase will be discovered sites sensitive to geological hazards, they shall be immediately examined and adequate stabilization measures should be executed.

To minimize geological hazards development risks throughout construction of the HPPs infrastructural units and roads, strict mitigation/ prevention measures given in ESIA document should be followed. Geological hazards may develop during rehabilitation and exploitation of motor-roads. Sites where old landslides and gulling are found shall undergo detailed geotectonic survey before constructions are launched. Findings of the survey shall be used for identification and construction of protective engineering structures, including drainage ditches.

Throughout the construction phase important is to keep roadside ditches and drainage facilities in good working condition.

Operation of the HPP cascade should not entail activation of geological hazards. Only reason for that can be emergencies.

6.5 Impact on aquatic environment

Impact on surface waters can occur due to nearby works. Potential risks include:

- Pollution due to fuel/oil spilling from machinery;
- Sediment load/turbidity increase due to works next to the river course;
- Pollution by construction and other waste including untreated effluents;

As for ground water pollution it can occur due to works in area with relatively shallow water horizons. Impact on ground water can be:

- Direct – e.g. due to ground works (boring, foundation excavation, etc);
- Indirect – due to hydraulic connections between surface and ground waters;

In terms of impact on water have to be considered two sites – the water intake and the HPP power house construction sites. The water intake area is especially important among them as construction works are to be done in the river course. Therefore a building contractor must comply with the terms given in the ESIA document. During development of the downreach section, part of the river will be cleaned from waste so that its ecology may be improved.

Impact of the project can be reduced by proper management and organization of works and corresponding mitigation measures.

According to the HPP cascade project design, compact biological treatment facilities (Biotal) will be installed at the power houses to treat domestic and sewage wastewater generated there. Treated effluents will be discharged to Lukhuni River. As no personnel will carry duty at the headworks and forebays, waste water should not be produced there.

On the operation phase only impact due to maintenance works carried out in the proximity to water objects may occur. Impact will depend on volume and type of works. Mitigation measures will be similar to those planned for construction phase.

6.6 Impact on flora

Construction works may impose some direct (damage, loss) and indirect (emission) impact on vegetation. Before starting construction working areas should be cleared from vegetation. Though it has to be mentioned that areas allocated for the water intake, tunnel entrances, fore-bays, penstocks and power houses/substations have relatively low vegetation density. Significant impact on flora is expected due to construction of access roads to the water intake at the Latashura River, as well as due to construction HPP1 and HPP3 fore-bays and their access roads. Installation of new power transmission lines will also have considerable impact on vegetation. To construct transmission lines connecting substations of all three HPPs to existing substations up to 100 towers and respective access roads have to be constructed. According to the audit results, significant amount of vegetation will be grubbed through the HPP cascade construction period including:

- Young and adult low value alder trees, some 1250 trees in total;
- Up to 230 beech trees;
- Up to 700 different tree species;
- Significant amount of bushes and grass;

To protect flora, borders of construction sites will be highly controlled to prevent additional damage to grass cover. After construction the territory will be cleaned, stripped topsoil and vegetation cover will be restored. Vegetation will be only lost at areas allocated for permanent buildings (settling wells, forebays, power houses, substations, towers of transmission lines, etc.). Here should be noted that indirect impact (due to emission of dust and flue gasses) will be local, insignificant and time-limited. Impact of the project on flora can be reduced by proper management of works and corresponding mitigation measures.

There will be no impact on vegetation on the operation phase. Grass at the substation area will be mowed down periodically. Also some cultivated and ornamental trees will be planted at the HPP power houses, what can be considered as an important mitigation measure.

6.7 Impact on fauna

Construction will temporary disturb fauna and may cause its migration from the project territory. It has to be mentioned that the water intake, base camps and power plant will be located close to roads/settlements and therefore fauna is relatively poor there. Construction works will increase noise level and thus affect animals that are used to current background noise.

Main sources of impact on fauna are:

- Traffic;
- Machinery and personnel on the territory.

Both, direct (collision/damage) and indirect (migration due to noise/vibration, emission nuisance) impacts may occur. During the construction phase fauna should not migrate too far. After works are finished and disturbance factors are eliminated animals/birds will return to their initial habitats. Ditches excavated during ground works present some risks for small mammals - they can fall in and get injured, their free movement might be restricted and habitats can be temporarily fragmented; though these will be short term impact. When the works are finished territory will be remediated and restored to its initial condition. Temporarily fragmented habitats will also get restored.

Temporary increase of water turbidity due to construction works can affect aquatic fauna. There are no other impacts (pollution) expected for water. During arrangement of derivation works the river flow will not change and corresponding impact on aquatic fauna will not occur. Impact of the project on local fauna can be reduced by proper management of works and corresponding mitigation measures. The HPPs' operation will not deteriorate water quality. The water intakes will have fish-passes and will not obstruct fish migration. Water flow will not be blocked. While taking water for power generation sanitary flow (10% of average multiannual flow) should be ensured downstream; this will be sufficient for the Lukhuni River dependent fauna. During operation phase noise impact on fauna due to power plant and substation operation will be unavoidable. Considering noise attenuation due to distance and fauna adaptability the impact will not be significant. As all the power transmission lines will be 35kV capacity, impact of electric field on animals should not be significant.

6.8 Impact associated with waste management

Construction of the HPP cascade may produce both non-hazardous inert waste and hazardous waste. Among non-hazardous waste the following residues are more likely to be generated:

- Waste rocks removed throughout tunneling operations;
- Waste due to vegetation clearance;
- Polyethylene waste (packaging/sealing materials);;
- Ferrous and non-ferrous scrap metal;
- Domestic waste, etc.

At the construction camp and construction grounds waste should be collected separately by types. For that building contractor should provide proper number of adequately labeled containers, which are to be placed at specially allocated grounds. Non-hazardous waste produced throughout construction works shall be managed as follows: major portion of timber cut during clearance of construction grounds and access road will be used for construction works; rest will be distributed among local population for as fire-woods.

The planned building operations should not generate numerous scrap metals. Upon accumulation they will be delivered to scrap metal collecting companies. Domestic waste will be collected in adequately labeled lidded containers. At construction grounds domestic waste will be disposed of into pits. Domestic waste form the construction camp will be delivered to the landfill of Ambrolauri City. Throughout construction operations may be produced some 150x0.7=105 m^3/y domestic waste.

Tunneling operations will produce abundant waste rocks (some 130-140 ths m^3). About 30% of waste rocks (mainly hard rocks) will be used for constructions, e.g. for bank stabilization (Lukhuni banks nearby the powerhouses and other sites, as required by the local municipality) and road construction. Hard rocks will be crushed to be used in concrete mixture. Rest of waste rocks will be dumped at certain sites, with 5.8 ha total area.

Waste rocks dumping sites are rather far (100 m and farther) from Lukhuni banks. The following terms are to be adhered to minimize impact on Lukhuni River throughout dumping:

- Dumps are to be arranged apart from the river floodplain;
- Temporary dumps should be arranged in an organized way so that large boulders are placed at outer perimeter.

Ground water drained from tunnels and surface runoffs after settling will be discharged to natural gorges or Lukhuni River. On the construction phase is anticipated the following hazardous waste:

- Paint residues and cans under paints - 150-160 kg/y paint residues and 40-45 cans/y per HPP construction operations;
- Residues of blasting materials left after tunneling - 4-6 kg/y per HPP;
- Residues of fuels and lubricants - 250-260 kg/y;
- Out-of-date and damaged accumulators - 25-28 unit/y;
- Oil filters from building machinery and vehicle - 50-55 unit/y;
- Used rubber tires - 120-130 unit/y;
- Welding electrodes -12-124 kg/y;
- Soil/ground polluted with petroleum hydrocarbons due to accidental oil spills – volume depends on spill scale.

For tunneling drilling and blasting operations will be executed by an adequately licensed subcontractor. Blasting material will be kept in special facility arranged at the construction camp. Blasting material will be delivered on operation sites on a daily basis and residues will be returned to the storage facility at the end of each day. Blasting material will be kept separately from other materials. Only subcontractor will be liable to dispose of such residues adhering safety measures. Other hazardous wastes will be temporarily kept at the construction camp, in a special facility (20-25 m^2 area wagon-container). The facility shall be provided with wash stand, as well as with shelves to place waste. Waste must be labeled.

Hazardous waste generated at construction grounds shall be transported to the temporary storage facility by waste management personnel of a building contractor with use of special vehicles (waste should be removed from construction grounds as accumulated, but at least once per three days interval). After removing from temporary storage facilities final waste management measures (neutralization, utilization, disposal) should be carried out by adequately licensed contractor. Soil/ground polluted due to small oil spills (3-5 m^3) can be remediated in situ (e.g. bioremediation. After large spills removed contaminated soil/ground shall be taken out of the territory for remediation. Spill site shall be recultivated using clean ground. It is rational to transfer polluted soil/ground for remediation to an adequately licensed contractor.

On the operation phase waste generation should not be significant.
Each power house requires special facility to keep temporarily the hazardous waste. It should be arranged according to environmental considerations as given in the ESIA document.

Hazardous waste must be removed from the HPPs and managed by adequately licensed contractor. Terms for hazardous waste management are provided in Annex 1 of the ESIA.

Amount of domestic waste accumulated throughout HPP operations depends on personnel number. Each HPP will employ 12-15 people; the whole cascade will employ 45-50 people including administrative staff. If consider that some 0.7 m^3 domestic waste is produced per employee per annum, total annual amount of domestic waste should comprise 35 m^3. From the power houses domestic waste will be delivered to Ambrolauri City landfill; at the headworks shall be arranged special disposal pits.

6.9 Landscape/visual impact

During preliminary works some landscape and visual impact will occur due to increased traffic, construction sites, presence of personnel and machinery, and building structures. Construction works will cause partial alteration of usual views and landscape. Expected visual and landscape changes will be slightly perceptible for local population as infrastructural objects and construction sites of all the three HPPs are apart from residential zones. Potential receptors of these changes could be hunters, herdsmen and lumbermen. Some construction sites may be seen from the road, though considering distances it should not cause significant discomfort for passengers passing on the road. After finishing the

construction all the personnel, machinery, building materials and waste will be moved out of construction sites. Temporary structures will be also dismantled and removed, and the territory will be recultivated. However, the power houses with their infrastructure and substations and access roads to all the HPPs will be left; road profiles will be changed at the water intake areas and access roads to the tunnel entrances will be reconditioned. All these will cause some alteration of the landscape and similar changes are unavoidable for any project. The impact can be mitigated by reasonable design and coloring of buildings.

Through the operation phase main landscape/visual impact will be associated with the permanent buildings; though after a while local population may adapt to it. Some impact is also expected due to repair and rehabilitation works. This impact is similar to the one on the construction phase though much smaller. Impact significance may vary according to type and volume of works.

6.10 Impact on socio-economic environment

Resettlement, migration or immigration of population is not expected. Temporary employment of local population at construction works and services sectors can be assumed as a positive impact. Background traffic intensity on the project territory is quite low. Motion of vehicles due to construction works will not affect traffic intensity on main roads or cause traffic related problems for local population. Notice that all the building sites are allocated reasonably far from residential zones, therefore there will be no significant impact of associated harmful factors on population health. Rehabilitation of roads and improved power supply can be considered as positive effects of the project. It is also noteworthy that on the operation phase local population will be employed at the HPP objects. Considering distances to residential zones there will be no noise impact on population. Considering distances from nearest receptors to substations and power transmission lines electromagnetic field impact on population is not expected. Sanitary flow left in the river will be enough for the Lukhuni River dependent fauna.

6.11 Impact on cultural heritage

According to the audit results of the HPP cascade infrastructure placement area, no historical, architectural or archeological sites were found in the areas allocated for building sites, access roads and power transmission lines. However some archeological sites can be discovered later during ground works. In this case a building contractor is obliged to invite specialists from organs authorized for the expertise by Georgian legislation in order to assess site importance and make decision about continuation of works. On the operation phase no impact on archeological and historical sites is expected.

6.12 Cumulative impact

As there are no industries or other impact sources in the project area no cumulative impact is considered.

6.13 Summary of anticipated impact.

Summarization of assessed anticipated environmental and social impact of the project is characterized in Table 6.13.1

Table 6.13.1. Summary of anticipated impact

Component	Physical Environment													Biological Environment							Social Environment							
	Air				Water					Soil				Fauna				Flora										
Impact Source/Activity	Vibration	Microclimate	Noise	Air quality	Flow regime	Sediment transportation	River-bed integrity	Surface water quality	Ground waters	Seismicity	Soil integrity	Soil quality	Bank integrity	Fish	Birds	Mammals	Endangered species	Vegetation	Endangered species	Landscape/visual	Archeological sites	Protected areas	Traffic, Transportation network	Waste disposal	Agriculture	Health	Employment	Living conditions
Preliminary Works																												
Camp development	-		-	-				-	-		-	-			-			-		-			-	-			+	+
Road development	-		-	-				-			-	-			-	-		--		-			-	-			+	+
Area preparation, ground works	-		-	-					-		-	-			-	-		-		- -							+	+
Construction Phase																												
Water intake	-		-	-	-		-	-			-	-	-	-	-			-		-							+	+
Tunnel	-		-	-				-	-																		+	+
Equalizer	-		-	-							-	-			-	-		-		-							+	+
Penstock	-		-	-							-	-			-	-		-		-							+	+
Power house	-		-	-				-			-	-			-	-		-		-							+	+
Substation	-		-	-				-			-	-			-	-		-		-							+	+
Operation Phase																												
Maintenance service/ repairs	-		-	-	-			-			-	-			-	-		-									+	+
Operation			-												-					-							+	+

+	High positive impact	-	Low negative impact
+	Medium positive impact	-	Medium negative impact
+	Low positive impact	-	High negative impact
	No impact		No impact

7. Actions to prevent, reduce or control impacts

Expected impacts can be managed and alleviated. The measures can be ensure:

- Impact avoidance/prevention;
- Impact reduction;
- Impact mitigation;
- Damage compensation.

Some impact can be avoided or reduced by optimum construction and operation practices. However, as not every impact can be avoided, ESIA presents a plan of mitigation measures for every stage of works. The measures are listed in the Table below:

Receptor/ Impact	Impact	Mitigation Measures	Characteristics
Construction phase			
Ambient air	• Flue gases from vehicles, building machinery and domestic generators; • Dust due to ground works; • Dust due to transportation operations; • Dust due to handling of building materials; • Welding aerosols	• Ensure proper working conditions of machinery; • Carry out measures for suppression o f dust emission as needed (e.g. water work area); • Provide preventive measures to avoid excessive dust emission during ground-works and handling of building materials (e.g. prohibition of material dropping from height during loading/unloading); • Ensure that vehicle's speed is optimal; • Equip personnel with proper protecting equipment (masks) as needed; • Instruct personnel before works are launched; • Register and response on complaints whenever occur.	**Impact significance and likelihood:** Low, expected **Responsible for implementation of mitigation measures:** Building contractor **Monitoring:** Maintenance checkup of machinery **Responsible for monitoring:** Building contractor **Monitoring expenses:** No additional expenses **Expenses for implementation of mitigation measures:** No expenses
Noise and vibration	• Noise and vibration due to transportation operations • Noise and vibration due to building machinery operations	• Ensure proper working conditions of machinery; • Execute "noisy" works in daytime; • Equip personnel with proper protecting equipment (ear-protectors) as needed; • Register and response on complaints whenever occur.	**Impact significance and likelihood:** medium, expected **Responsible for implementation of mitigation measures:** Building contractor **Monitoring:** Technical checkup of machinery **Responsible for monitoring:** Building contractor **Monitoring expenses:** No additional expenses **Expenses for implementation of mitigation measures:** No expenses
Activation of geohazards	• Formation of erosions and landslides throughout preparation of construction grounds and access roads	• Remove active landslide formations from upper parts of slopes and contour slopes at gradient ensuring stability • Drain surface- and ground- water so that prevent extra-watering lower of slopes • Arrange timber gabions below road subgrade to prevent road deformation • Provide concrete canals (ditches) along roads to prevent erosion and	**Impact significance and likelihood:** highly likely **Responsible for implementation of mitigation measures:** Building contractor **Monitoring:** current observations **Responsible for monitoring:** client and building contractor **Monitoring expenses:** No additional expenses

		landslides when constructing motor-roads • Direct storm water and slope runoffs from roadside ditches to Lukhuni River and its tributaries; • Recultivate and landscape construction grounds and penstock sites post construction.	**Expenses for implementation of mitigation measures:** shall be incorporated in the project design
Soil stability	• Risk to jeopardize soil stability and damage topsoil during construction works;	• Follow safety norms introduced for the projected works; • Provide protective works as needed; • Strip and temporarily stockpile topsoil till reused for recultivation; • Stabilize spoil within disposal area; • Instruct personnel before works; • Register all potential risks on time and ensure prompt response.	**Impact significance and likelihood:** Medium, possible **Responsible for implementation of mitigation measures:** Building contractor **Monitoring:** Current observations **Responsible for monitoring:** Building contractor **Monitoring expenses:** No additional expenses **Expenses for implementation of mitigation measures:** Cost of protective works depends on volume of work and market prices
Soil quality	• Soil pollution by waste • Soil pollution due to fuel/oil spilling	• Ensure proper working conditions of machinery to avoid fuel/oil spilling • Ensure proper material management; • Ensure proper waste management, including separation and reuse as possible, store waste not appropriate for reuse in special containers and move out of the territory ; • Localize and clean spilt fuel/oil; • Provide corresponding equipment (containers, spill collection implements, etc.); • Remove all potential pollutants when works are finished;	**Impact significance and likelihood:** Low, possible **Responsible for implementation of mitigation measures:** Building contractor **Monitoring:** Technical checkup of machinery; Waste management plan accomplishment control; Visual control of soil conditions; **Responsible for monitoring:** Building contractor **Monitoring expenses:** No additional expenses **Expenses for implementation of mitigation measures:** No additional expenses
Surface waters	• Pollution due to ground works; • Pollution due to improper waste management; • Pollution by fuel/oil spilling;	• Ensure proper working conditions of machinery to avoid fuel/oil spilling; • Whenever in-situ machinery maintenance is unavoidable, do it apart from water bodies; • Ensure proper material management; • Ensure wastewater management – construct settling ponds if needed • Ensure proper waste management, including separation and reusing as possible, temporarily store waste not appropriate for reuse in special	**Impact significance and likelihood:** Low, possible **Responsible for implementation of mitigation measures:** Building contractor **Monitoring:** Technical checkup of machinery; Waste management plan accomplishment control; Visual control of soil and water conditions; River water quality monitoring. **Responsible for monitoring:** Building contractor

		containers, follow safety norms and dispose of on the nearest landfill on the contractual basis; • Localize and clean spilt fuel/oil; • Instruct personnel before starting works; • Provide necessary equipment (containers, spill collection implements, etc.); • Remove all potential pollutants after finishing work;	**Monitoring expenses:** No additional expenses **Expenses for implementation of mitigation measures:** No additional expenses
Hydrological regime	• Disastrous alteration of water level and flow	• The impact is not anticipated; • Mitigation measures are not required; • During construction of the water intake the river will be temporarily diverted; however it will not alter the river's hydrological regime. Sanitary flow will be ensured;	**Impact significance and likelihood:** Low, less probable **Responsible for implementation of mitigation measures:** N/A **Monitoring:** No monitoring **Responsible for monitoring:** N/A
Ground water	• Quality deterioration due to polluted surface waters; • Water quality deterioration due to fuel/oil spilling during construction works	• Ensure all preventive measures against deterioration of surface water quality (see corresponding paragraphs); • Follow all preventive measures against ground water pollution during tunnel construction.	**Impact significance and likelihood:** Low, less probable **Responsible for implementation of mitigation measures:** Building contractor **Monitoring:** Technical checkup of machinery; Waste management plan accomplishment control; Visual control of soil and water conditions; **Responsible for monitoring:** Building contractor **Monitoring expenses:** No additional expenses **Expenses for implementation of mitigation measures:** No additional expenses
Landscape	• Landscape and visual alteration due to constructions of headworks, power houses and power transmission lines; • Landscape and	• Visual impact due to transportation operations is unavoidable, though it is quite low and short-term; • Landscape changes post-construction (due to presence of power transmission lines, power house and other permanent buildings) can be partially mitigated using natural materials and reasonable coloring for better merging with environment. • Clear and recultivate the territory post	**Impact significance and likelihood:** Medium, expected **Responsible for implementation of mitigation measures:** Building contractor in agreement with Rusmetali ltd. **Monitoring:** Not presumed **Responsible for monitoring:** Not presumed **Monitoring expenses:** No additional expenses

	visual alteration due to increased traffic flow	construction.	**Expenses for implementation of mitigation measures:** Cost of the measures depends on material price. Precise cost will be defined in the executive project design envisaging current market prices.
Flora	• Direct impact on vegetation cover • Indirect impact – dust, flue gasses	• Control traffic routes and building site borders; • Define optimal vehicle speed to reduce dust emission; • Instruct personnel before starting works; • Ensure proper working conditions of machinery to avoid fuel/oil spilling; • Carry out additional floristic survey within construction grounds and access roads • Wherever protected species are found, they shall be extracted in compliance with Georgian Law on Georgian Red List and Red Book, paragraph 24, clause 1, subclause 'v', what shall be done in agreement to the Ministry of Environment Protection and Natural Resources	**Impact significance and likelihood:** Low, possible **Responsible for implementation of mitigation measures:** Building contractor. **Monitoring:** Control of roads and work site borders; Technical checkup of machinery; **Responsible for monitoring:** Building contractor **Monitoring expenses:** No additional expenses **Expenses for implementation of mitigation measures:** No additional expenses
Fauna	• Impact on ichthyofauna due to deterioration of surface water quality throughout ground works and construction operations in whole • Temporary disturbance of local fauna due to vehicle/machinery and personnel motion (direct impact – collision, indirect impact – dust, flue gases)	• Control traffic routes and building site borders; • Define optimal vehicle speed to minimize dust emission; • Define optimal vehicle speed to reduce direct impact (collision) risk; • Prohibit machinery horning to minimize fauna disturbance; • Ensure proper working conditions of machinery to reduce noise/vibration; • It is recommended to fence working sites during ground works to avoid falling of small mammals in ditches; • Ensure proper waste management to avoid water pollution; • Follow all preventive measures against water turbidity increase while working next to water objects; • Ensure proper operation of fish passes; • Execute works during periods when terrestrial and ichthyic faunas are less sensitive to impact; • Instruct personnel before starting works	**Impact significance and likelihood:** Medium, possible **Responsible for implementation of mitigation measures:** Building contractor. **Monitoring:** Waste management plan accomplishment control; Technical checkup of machinery; **Responsible for monitoring:** Building contractor **Monitoring expenses:** No additional expenses **Expenses for implementation of mitigation measures:** No additional expenses
Waste	• Building waste	• Use stones for construction and ditch	**Impact significance and likelihood:** Low, possible

	• Domestic waste	filling. Collect other building waste and move out of the territory post construction; • Deliver scrap metal to corresponding company; • Part of waste wood will be used locally. Waste wood not fitting for local use will be handed over local population as firewood. • Domestic waste from the construction camp should be disposed of at Ambrolauri City landfill. Domestic waste from construction grounds should be landfilled locally; • Explosive materials should be moved out by adequately licensed contractor; • Special storage facility shall be provided at the camp site for temporary storage of hazardous waste. Construction grounds shall be provided with adequately labeled watertight containers. • Properly trained personnel shall be assigned for waste management operations. They should be periodically trained and tested. • From construction camp hazardous waste shall be removed by adequately licensed contractor.	**Responsible for implementation of mitigation measures:** Building contractor. **Monitoring:** Waste management plan accomplishment control; **Responsible for monitoring:** Building contractor **Monitoring expenses:** No additional expenses **Expenses for implementation of mitigation measures:** No additional expenses
Socio-economic environment	• Impact on traffic flow and infrastructure; • Discomfort due to landscape alteration; • Electromagnetic radiation; • Restriction of free passage; • Employment	• Impact of transportation operations on traffic intensity and corresponding visual discomfort will be insignificant on construction phase. No mitigation measures needed; • During preliminary works roads will be reconditioned- positive effect; • Ensure that population's/passenger's passage is minimally obstructed during road rehabilitation/construction; • Notify population about work time-frame; • Landscape changes due to construction can be mitigated using materials merged with environment by its color and texture; • Local population will be employed for preparatory and construction works; • Considering distances from substations to the nearest receptors electromagnetic field impact on population is not expected. No mitigation measures needed;	**Impact significance and likelihood:** Low, expected **Responsible for implementation of mitigation measures:** Building contractor together with Rusmetali ltd. **Monitoring:** No monitoring. **Responsible for monitoring:** N/A

Historical/ archeological sites	• Damage	• Stop works whenever any artifact is discovered. Ensure that artifact is examined by qualified archeologists. Ensure its conservation or delivery to a vault if necessary. Continue works only after permission is obtained; • Protect/preserve residue of the terrace after power house construction;	**Impact significance and likelihood:** Low, expected
			Responsible for implementation of mitigation measures: Building contractor together with Rusmetali ltd.
			Monitoring: Observation
			Responsible for monitoring: Building contractor
Occupational safety	• Traumatism	• Provide instructions; • Equip personnel by personal protection equipment (PPE);	**Impact significance and likelihood:** Low, expected
			Responsible for implementation of mitigation measures: Building contractor together with Rusmetali ltd.
			Monitoring: Regular control
			Responsible for monitoring: Building contractor
Due to similarities between construction works and works to be done for the cascade or one of the HPPs suspension/decommissioning their environmental impacts are also similar. (Notice that after decommissioning the territory should be reinstated to the original state to the extent possible)			

Some small and short-term environmental impact may occur due to repairs/maintenance service. Character of the impact is similar to the one expected on the construction phase. Impact significance depends on spatial- and time-frame of repairs/maintenance operations.

8. Residual Impact

Impacts will be reduced to an acceptable level assuming that the Company follows the agreed ESAP and monitoring requirements and that national requirements and good EU practice are implemented.

9. Potential Accidents

The detailed list of potentially possible accidents has been developed and considered in ESIA document. Response on accidents will be defined in pertinent instructions. The HPPs shall have evacuation plans, implements/equipment to response small scale accidents, personal protection equipment and communication (phone, fax) equipment to notify emergencies and call for corresponding rescue service (firefighting service, ambulance). Every accident will be registered and its causes will be determined. If necessary, remediation will be ensured. The HPPs will be provided with first aid means and firefighting equipment. Personnel will be periodically instructed/trained regarding operation and safety issues.

10.Environmental and Social Action Plan

Environmental and social action plan developed for the project is presented as a separate document.