Cumulative Impact Assessment study for MTKVARI HYDROELECTRIC POWER PLANT PROJECT

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Executive Summary

Section 1 "Introduction". Mtkvari HPP Project is a part of the program "Greenfield Investments in Hydropower Plants" of Government of Georgia (GoG). GoG has approved the standard terms and conditions for the Greenfield Investments in Hydropower Plants (HPPs) in April 2008. The Ministry of Energy (MoE) announced the solicitation of expressions of interest by investors in Greenfield HPPs and other renewable energy plants under the build-operate-own structure. The list of prospective Greenfield HPP sites, with an individual capacity ranging from 5 to 60 MW, has been published and regularly updated by the Ministry of Energy on its website.

The feasibility studies and the design for the project are prepared by Verkis IF and Ukrhydroproject Ltd. The reports are completed in July and August 2009, respectively. Mtkvari HPP Project is planned to be constructed on Mtkvari River, with a capacity of 43 MW. It will contribute to the development of the national economy, with an annual production of 245 GWh. The economic life of the project is predicted as 50 years. JSC Caucasus Energy and Infrastructure is the owner of the project. Funding for the project investment will be obtained from international finance sources.

The Project site is located in southeast of Georgia, on River Mtkvari, near the city of Akhaltsikhe, consisting of a concrete dam (with a height of approximately 25 m from the riverbed), a surface type powerhouse, and the associated switchyard site. The powerhouse will be located at a distance of 1 km to the Sakuneti Village (Akhaltsikhe District) while the location of headworks is 3 km away from the Village Rustavi (Aspindza District).

The Environmental Impact Assessment for Mtkvari HPP Project was prepared in accordance with Georgian Law on Environmental Impact Permit and the requirements of IFC and other lending institutions. All project activities should also comply with the requirements of both: Georgian legislation and international lending organizations involved in financing of the Project.

The purpose of this study is the assessment of potential cumulative or integrated impact that may be created by construction or operations of Mtkvari HPP together with other ongoing and planned activities in project area (Akhaltsikhe and Aspindza rayons), that are not addressed in the individual ESIA prepared for the Mtkvari HPP Project.

Section 2 "Description of the Projects in the Study Area" of the present Cumulative Impact Assessment report defines the study area and presents information regarding the proposed project, as well as information on all other existing hydropower installations, planned HPP's and HPP's under construction in the upstream water basin of the Kura River.

The proposed Mtkvari HPP project with a capacity of 43 MW comprises: a concrete dam and a 9.6-km long headrace tunnel diverting the inflow to a powerhouse with two units, by-passing an approximately 27-km long reach of the Mtkvari River, outlet channel, voltage build-up substation and the transmission line. The Project having a very small reservoir will be operated in run-of-river mode, in which the inflow is directly used for power generation and the surplus water is released from the spillway. According to the proposed schedule, construction of the project will take approximately 36 months considering the sequence of activities, from decision to commissioning of the first unit.

Upstream of the Mtkvari HPP under development there are few power plants under construction or in design phase, located on mainly Paravani River. The plants are Arakali HHP, Akhalkalaki HPP and Poka HPP. Also the construction of Abuli HPP is planned near to Akhaltsikhe City. One of the planned HHP is located on Uraveli River, which is on the main tributaries of Kura river in the district. From existing Hydropower plants, Chitakhevi HPP should be mentioned. The plant is located downstream from proposed Mtkvari hydropower plant in the middle between Borjomi and Akhaltsikhe cities. The HPP is owned by Energo-pro Georgia and currently is under the reconstruction. The EIA study for the rehabilitation was prepared in 2009 and environmental permit is granted to the project. Another existing small hydropower plant is located in Kakhareti village near to Akhaltsikhe. The power plant was rehabilitated and launched in 2009.

Section 3 "Legal and regulatory framework" of the present report indicates only important aspects of institutional and legal framework applicable for the Mtkvari HPP and other plants and potential projects can be developed in target region and which can have influence in terms of cumulative impacts. The detailed description of the Georgian laws and requirements applicable for HPP's is given in ESIA report prepared for the project. The framework summary also includes IFC Performance Standards and EBRD's requirements as contained in Environmental and Social Policy (2008) and Public Information Policy (2008), for Category A projects.

Section 4 "Environmental and Social Baseline" of the present Cumulative Impact Assessment report describes baseline data of the following resources in the area affected by the Project: physical environment (climate, topography and soils, surface water, geology, ground water, seismology, ambient air quality, etc); biological environment (terrestrial flora and fauna, aquatic life); socio-economic environment (socio-economic conditions, industries and infrastructure, transportation, power sources and transmission, land use, population and communities, healthcare and education facilities, cultural resources and archaeological sites). The methodology of the cumulative impact assessment studies indicate, that the baseline conditions for the target project have to cover the project broader area defined during the cumulative impact assessment. The characteristics of the area is practically uniform for Akhaltsikhe and Aspindza regions, so information collected during the ESIA study was used for the preparation of this section of the report.

Section 5 "Cumulative Impact Assessment" of the present report describes the methodology of analyzing cumulative effects as an enhancement of the traditional environmental assessment components: scoping, describing the affected environment, and determining the environmental consequences. Present cumulative impact assessment identifies impacts without considering the mitigation measures for these impacts. Cumulative impacts rated as low are of limited extent, less severe, considered acceptable, and mitigation measures are not necessary. Cumulative impacts rated as medium and high are of wider extent, more severe, considered significant, and require mitigation measures which are proposed in Environmental Mitigation and Monitoring Plan (Section 6). Some impacts of identified projects and activities within the area may accumulate in an "additive" manner, some impacts can be synergistic. Interactive impacts may produce a total impact greater than the sum of the individual impacts.

The impact study area was identified based on a combination of ecological characteristics, the boundaries of the Mtkvari sub-basins within the Akhaltsikhe and Aspindza rayons and the locations of the main river systems, using standard approach of upstream, downstream and immediate reservoir area as the main impact zones. For construction and operation phases impacts on physical, biological and socio-economic environment were assessed separately. In each case the projects are assessed within three scenarios: (A) the existing projects/activities plus proposed Mtkvari HPP, (B)

scenario A plus other projects under construction or completely approved; and (C) scenario B plus future planned or predicted projects in the area.

Based on analysis of the site-specific impacts for the proposed Mtkvari HPP project, the key impacts contributing in cumulative effect in priority order are identified:

- for the construction phase - air emissions and dust, waste (unsuitable materials/excavated waste, wastewater, hazardous waste, domestic waste), noise and vibration, flora, fauna, landscapes, cultural heritage, land acquisition, socio-economic issues;
- for the operations phase – inundation (loss of land and resettlement, flora, fauna, landscape, cultural heritage, if any), change in hydrology and water quality, waste and wastewater, socio-economic issues;

The cumulative impacts of construction and operation phases of the Project are assessed separately, in accordance with the methodology and approach for the impacts that contribute in cumulative effect, separately for physical, biological and socio-economic environment.

The most significant impact of the operation phase of HPP projects with dam on the physical environment is inundation resulting from damming the river. The area of physical land take by the Project includes the reservoir area and the footprint of the construction facilities (dam site, powerhouse site, camp facilities and access roads). The reservoir covers an area of only 0.5 km2, so the overall land take including all the project facilities will be less than 1 km2. Only about 0.1 km2 of this area is arable land and the rest is mainly composed of shrubby forms along the river and barren land. The Mtkvari Dam is not intended for storage, but for the diversion of the water to the powerhouse through a headrace tunnel. As a result, because inundation will occur in a limited area, only a few parcels will be affected within this project. The level of cumulative impact is rated as low because the extent of the impact for scenario A is restricted and the severity is moderate. For the scenarios B and C with construction of other HPPs in the area, the level of cumulative impact is rated as medium because the extent of the impact is medium and the severity is moderate.

Apart of change in flow regime resulting from the HPPs with dam, the hydrology of the river will also change due to the diversion of the river water within the run-of-river HPPs. There will be a decrease in water level between the weir and the powerhouse. This impact may be observed in Mtkvari HPP project (scenario A), because it is a run-of-river HPP. The level of cumulative impact is rated as medium because it is a severe impact but the extent is restricted. Within scenarios B and C, because other run-of-river HPPs and dams will be operating in Mtkvari basin, the hydrology of these rivers will change locally. While the quantity of the river water will decrease along run-of-river HPPs, the quality of water will change especially due to sedimentation observed in reservoirs. The overall level of cumulative impact is rated as high because the extent of the change in hydrology is medium and the impacts on quality and quantity of the river water are severe, because they may cause serious effects on aquatic life in the river.

Impoundment of the river leads to sediment reduction and change of water quality downstream of the dam. Also, reduction in sediment moving downstream from the dam leads to degradation of the river channel below the facility. This phenomenon also leads to potential impacts on the biological environment such as the degradation of aquatic habitats. Owing to small reservoir volumes and low retention times for the Mtkvari HPP project (scenario 1), no significant change in water quality is expected. Hence, the level of cumulative impact is rated as medium because it is a severe impact but the extent of the impact is restricted. As the number of projects with dams increase in a Mtkvari basin (scenarios B and C), the problem of sediment reduction and change of water quality in the downstream of the dam will become significant. The level of cumulative impact is rated as medium because the extent of the impact is medium and the severity is moderate.

Section 6 "Management Program" of the Report summarizes the cumulative impacts identified and describes framework and tools for the implementation of the mitigation measures and its monitoring. Based on the identified cumulative environmental impacts and respective mitigation measures proposed in Section 5, an Environmental Management and Monitoring Program (EMMP) for the Project has been prepared. The EMMP will help the Client (JSC Caucasus Energy and Infrastructure) to address the foreseen cumulative impacts of the Project in line with the impacts described in Mtkvari HPP ESIA prepared earlier, enhance the Project's overall benefits and introduce standards of good environmental practice. The EMMP will be integrated with Environmental and Social Action Plan prepared at ESIA stage and included in the contract documents to ensure the contractors comply with the EMMP.

The impacts with potential of cumulative effect and respective mitigation measures are presented in Table 6.1. To increase contractors' environmental awareness and ensure that they consider carefully and plan the implementation of each mitigation measure that is their responsibility, contractors will be required to prepare their own construction-phase environmental management plan (EMP) describing in detail the action they will take to provide each measure. The contractor's EMP should be further supported by site-specific method statements and management plans that have to be prepared and submitted by the Contractor to the Client for approval, prior to initiation of any construction works.

Environmental monitoring is a very important component of environmental management to safeguard the protection of environment at both construction and operation stages of the Project. In response to environmental impacts identified during this Cumulative Impact Assessment, an Environmental Monitoring Program has been developed to complement the Monitoring Plan prepared at Mtkvari HPP ESIA stage. This plan indicates the type, method, frequency of monitoring that should be conducted to ensure that the mitigation is provided. The table also indicates who should be responsible for the monitoring.

Most of the monitoring conducted by the Client or Supervision Consultant (SC) will involve periodically checking the activities conducted by the contractor, during regular site inspections, which the SC will conduct on a daily, weekly and monthly basis. The Environmental Management and Monitoring Program also places responsibility for conducting specific elements of environmental monitoring on the Contractor, to raise their awareness of the impacts of their activities through implementing internal Environmental Supervision as part of their own internal Environmental Management System.

The study has shown that a number of impacts from Mtkvari HPP, as well as from other HPP projects in study area be unavoidable, but that their significance can be reduced or offset by appropriate mitigation. It is important to note, that while many of these impacts are cumulative, such accumulation is additive not interactive, hence the total cumulative impact is not greater than the sum of the parts.

Section 7 "Conclusions and Recommendations" of the Report states, that all major adverse cumulative impacts can be mitigated to acceptable levels through the measures proposed, except for the following key residual negative impacts given below in the order of their importance:

- Change of flow regime system affecting the aquatic and terrestrial ecosystem in the vicinity.
- Loss of vegetation communities, flora and terrestrial fauna habitats resulting from construction of project facilities and inundation
- Change of water quality resulting from sediment reduction in the downstream of the dams

and in the reservoir.

These residual impacts will be monitored according to the program given in Section 6, and necessary management measures should be taken as appropriate by the responsible parties.

The institutional recommendations for prediction, avoidance, or reduction of environmental consequences of cumulative effects generated by the HPP development in Riv. Mtkvari basin, through applying the integrated river basin management instruments, are listed below :

Assessments:

- upgrade the hydro-meteorological database and information;
- model and monitor changes in river flow, sediment and river quality;
- evaluate impacts of individual projects on request;
- conduct pilot sustainability assessment of projects;
- establish baseline aquatic data and monitor changes;
- carry out economic valuation of basin fisheries;
- model cumulative impact on peoples' livelihoods.

Management planning:

- integrate economic, social and environmental aspects in basin planning;
- support power optimization studies;
- maintain database of hydropower projects;
- develop policy options for benefit sharing;
- assess consequences of climate change;
- develop sustainable watershed management plans;

1. Introduction

1.1. Background of the Project

Mtkvari HPP Project is a part of the program "Greenfield Investments in Hydropower Plants" of Government of Georgia (GoG). GoG has approved the standard terms and conditions for the Greenfield Investments in Hydropower Plants (HPPs) in April 2008. The Ministry of Energy (MoE) announced the solicitation of expressions of interest by investors in Greenfield HPPs and other renewable energy plants under the build-operate-own structure. The list of prospective Greenfield HPP sites, with an individual capacity ranging from 5 to 60 MW, has been published and regularly updated by the Ministry of Energy on its website.

The feasibility studies and the design for the project are prepared by Verkis IF and Ukrhydroproject Ltd. The reports are completed in July and August 2009, respectively. Mtkvari HPP Project is planned to be constructed on Mtkvari River, with a capacity of 43 MW. It will contribute to the development of the national economy, with an annual production of 245 GWh. The economic life of the project is predicted as 50 years. JSC Caucasus Energy and Infrastructure is the owner of the project. Funding for the project investment will be obtained from international finance sources.

The Project site is located in southeast of Georgia, on River Mtkvari, near the city of Akhaltsikhe, consisting of a concrete dam (with a height of approximately 25 m from the riverbed), a surface type powerhouse, and the associated switchyard site. The powerhouse will be located at a distance of 1 km to the Sakuneti Village (Akhaltsikhe District) while the location of headworks is 3 km away from the Village Rustavi (Aspindza District). Mtkvari River which is one of the significant surface water resources of Georgia rises in Turkey flows through southeast of Georgia. The river turns to eastwards near the town Akhaltsikhe and flows from there towards east through the capital city Tbilisi, onwards into Azerbaijan and into the Caspian Sea.

The Environmental Impact Assessment for Mtkvari HPP Project was prepared in accordance with Georgian Law on Environmental Impact Permit. All project activities should also comply with the requirements of international lending organizations (in particular IFC) involved in financing of the Project.

The IFC Performance Standard No.1 "Social and Environmental Assessment and Management System" require that risks and impacts should be analyzed in the context of the project's area of influence, which in addition to project sites and facilities comprises: "… (iii) areas potentially impacted by cumulative impacts from further planned development of the project, any existing project or condition, and other project-related developments that are realistically defined at the time the Social and Environmental Assessment is undertaken; and (iv) areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location. The area of influence does not include potential impacts that would occur without the project or independently of the project…".

This report will mainly discuss the impacts of the Mtkvari HPP in combination with the impacts of other existing and planned projects in the area (Akhaltsikhe and Aspindza rayons) that may interact to produce a cumulative effect.

1.2. Purpose and scope of Cumulative Impact Assessment

IFC describes cumulative impacts requirements in the Guidance Notes provided to assist in applying the IFC Performance Standards. Paragraph G22 of Guidance Note 1 on Social and Environmental Assessment and Management Systems (updated on July 31, 2007) defines IFC requirements as follows:

> *"…G22. The combination of multiple impacts from existing projects, the proposed project, and/or anticipated future projects may result in significant adverse and/or beneficial impacts that would not be expected in case of a stand-alone project. The Assessment should evaluate these cumulative impacts commensurate with the source, extent, and severity of cumulative impacts anticipated. As a result, the geographic and temporal boundaries of the cumulative impact assessment would depend on the potential cumulative impacts that are attributable to the project and those that affect the project as a result of reasonably foreseeable activities by third parties, and will influence the final definition of the project area of influence…"*

The objective of the cumulative impact assessment is to identify those environmental and/or socio-economic aspects that may not on their own constitute a significant impact but when combined with impacts from past, present or reasonably foreseeable future activities associated with this and/or other projects, result in a larger and more significance impact(s).

Examples of cumulative impacts include: (i) the recurring loss of habitat in areas that are disturbed and re-disturbed over an extended period; (ii) additional emissions as a processing plant is extended and expanded over a period of time, and (iii) the ongoing development of employment opportunities and enhancement of local labour skills base as successive projects (related or unrelated) come on stream.

Activities proposed under the Project should be assessed in terms of their potential to: cause impacts including transboundary impacts; contribute to existing environmental stresses and impacts, and contribute to cumulative impacts in their own right due to the fact that the project may be immediately followed by further phases of development.

The purpose of this study is the assessment of potential cumulative or integrated impact that may be created by construction or operations of Mtkvari HPP together with other ongoing and planned activities in project area (Akhaltsikhe and Aspindza rayons), that are not addressed in the individual ESIA prepared for the Mtkvari HPP Project. The methodology described above has been generally applied to assess the significance of identified potential project cumulative impacts.

The scope of present cumulative impact assessment comprises the following:

- identification of geographic and temporal scope of the Cumulative impact assessment based on an understanding of the project development plans;
- description of the affected environment including the physical, biological and socioeconomic conditions with an emphasis of ecosystem components and human dependence on natural resources for settlement and livelihoods;
- assessment of potential cumulative environmental and social impacts associated with proposed project development in conjunction with other existing or planned activities; and
- identification of the mitigation measures based upon a review of the existing individual EIA and EMPs.

1.3. Information Sources

Information for this report was gathered from information available at JSC "Caucasus Energy and Infrastructure" headquarters regarding the Mtkvari HPP project. Additional information was collected from public information sources, such are the EIA's of the other hydropower plant projects, publicized reports on hydropower development, country potential etc, as well as from the official web sites of different governmental organisations and international institutions involved in energy sector studies.

1.4. Limitations of the Report

a) This report has been prepared for, and at the request of JSC "Caucasus Energy and Infrastructure" for the purpose of evaluation of environmental constrains and impacts estimated for the proposed project.

b) DG consulting acknowledges that it is being retained, in part, because of its knowledge and experience with respect to environmental matters. Company will consider all information provided to it in the context of DG Consulting's knowledge and experience and all other relevant information known to the company. To the extent that the information provided to DG Consulting is not inconsistent or incompatible therewith, company shall be entitled to rely upon and assume, without independent verification, the accuracy and completeness of all such information and DG consulting shall have no obligation to verify the accuracy and completeness of such information.

c) The content of this report represents the professional opinion of experienced environmental consultants. DG consulting does not provide specialist legal advice.

d) In the Summary of Findings and Conclusions section of this report and in the Executive Summary, DG consulting has set out its key findings and observations. However, other parts of this report will often indicate the limitations of the information obtained by consultants and therefore the Summary of Findings and Conclusions section and in the Executive Summary ought not to be relied upon until considered in the context of the whole report.

2. Description of the Projects in the Study Area

Cumulative impact assessment studies, in accordance to the international practice and common methodology requires the definition of the project area, where the cumulative impact on Natural or social environment will have place. For the definition of study the full information regarding the existing hydropower installations, planned HPP's and HPP's under construction in the upstream water basin of the Kura River was collected. The target area included all hydropower plants in Samtskhe Javakheti region.

In order to screen all information, the consultant's team has reviewed all information available for public access, especially the ESIA's and EIA's submitted to the ministry of Environment protection and natural resources. Also information available at Ministry of Energy of Georgia. The ministry with support of USAID project has prepared list of potential hydropower plants. The list was published on the ministry web site as well as other web pages. The study carried out for identification of potential hydropower plants included information on plants planned for the development in Samtskhe Javakheti region.

In order to define the study area, and analyze information regarding the locations of hydropower plants, consultant's team has prepared the visual material indicating location of all HPP's in Samtskhe Javakheti region. Please see Figure 2.1.1.1.

Figure 2.1.1.1 The locations of potential HPP's in Samtskhe Javakheti region of Georgia

2.2. Mtkvari HPP

Mtkvari HPP Project which is planned to be constructed on Mtkvari River with a capacity of 43 MW is located near the city of Akhaltsikhe. It will contribute to the development of the national economy, with an annual production of 245 GWh. The economic life of the project is predicted as 50 years.

The existent project layout comprises; the upper works, the headrace tunnel and the lower works. In more details, the facilities those will be implemented within the context of Mtkvari Project are composed of the headworks, diversion tunnel, leveling tank, and powerhouse with two units, outlet channel, voltage build-up substation and the transmission line. The facilities those will be constructed within the context of the project and their explanations are given in detail below.

- Headworks: Mtkvari HPP dam reservoir will have a limited area for making regulation. The structures in the headworks area are intake pond, diversion canal, main dam, cofferdam, spillway and intake structure. The crest level of the spillway and the highest regulating level is 1012 masl. The intake pond is some 3 km long with a maximum width of approximately 0.6 km. The lowest regulating level is 1010 masl.

- Headrace tunnel: The length of the headrace tunnel that would transmit the water that is obtained from Mtkvari Dam to the powerhouse is about 9.6 km with an optimized diameter of 5.6 m. However, it should be noted that the optimum diameter calculations were performed based on the assumption of excavation with drill and blast (D&B) method which is a less cost effective method than Tunnel Boring Machine (TBM) method. In such a case, it is concluded that the optimum diameter of the headrace tunnel will be less than 5.6 m as TBM method will be applied.

- Pressure tunnel: The pressure tunnel branches from the headrace tunnel some 100 upstream from the powerstation. The tunnel diameter will be a 6 m horseshoe section for about 70 m or where this otherwise distribute onto each power generating unit. The pressure tunnel, extending from the headrace tunnel down to the distributor will be inclined about 10%.

- Surge Shaft: The dimensions of the surge facilities are based on the presumed shut down time of the turbines, the pertinent size of the waterways and other relevant issues. The surge shaft and overlying basin will be located some 200 m upstream of the powerhouse cavern in the headrace tunnel.

- Powerhouse: According to initial investigations, a surface type powerhouse was considered to be a more feasible option. However, in the feasibility study it was determined that an underground powerhouse would be more economical by cutting steel lining and pressure tunnel concrete costs. Therefore, an underground powerhouse is proposed in the feasibility report. On the other hand, the project developer prefers to construct a surface type powerhouse.

- Tailrace: Harnessed river water will flow from the draft tubes onward into the tailrace. From each draft tube, tailrace tunnel branches merge into approximately 100 m long tailrace tunnel with the same size. The tunnel is followed by the canal that extends to the Mtkvari river course.

- Switchyard and Transmission Line: The switchyard will be located on the riverbank within the powerhouse yard area, parallel to the tailrace canal, and guarded by a 40 x 26 m safety

fence. Two power transformers along with the fence necessary substation equipment will be located within the switchyard area. The electricity, which is converted to 110 kV at the switchyard, is proposed to be transmitted to Akhaltsikhe substation that is 8 km away, by the 110 kV energy transmission line to be distributed to the consumption centers.

- The road along the river will be raised approximately 10 m over a length of about 2,150 m.

Mtkvari HPP will be linked into a new 110 kV transmission line connection from the Mtkvari switchyard to Akhaltsikhe Substation along 8 km distance.

Operation Mode: The Mtkvari Project is comprised of a concrete dam and a 9.6-km long headrace tunnel diverting the inflow to a powerhouse, by-passing an approximately 27-km long reach of the Mtkvari River. The Project having a very small reservoir will be operated in run-of-river mode, in which the inflow is directly used for power generation and the surplus water is released from the spillway.

Implementation Schedule: According to the proposed schedule, construction of the project will take approximately 36 months considering the sequence of activities, from decision to commissioning of the first unit. The critical path for the construction of hydropower plants is the construction of the powerhouse and installation and testing of the hydromechanical equipment.

The layout of the project components are presented on the Figure 2.2.1.1.

More details regarding the Mtkvari HPP project is given in ESIA report, which was prepared for the project earlier in 2010.

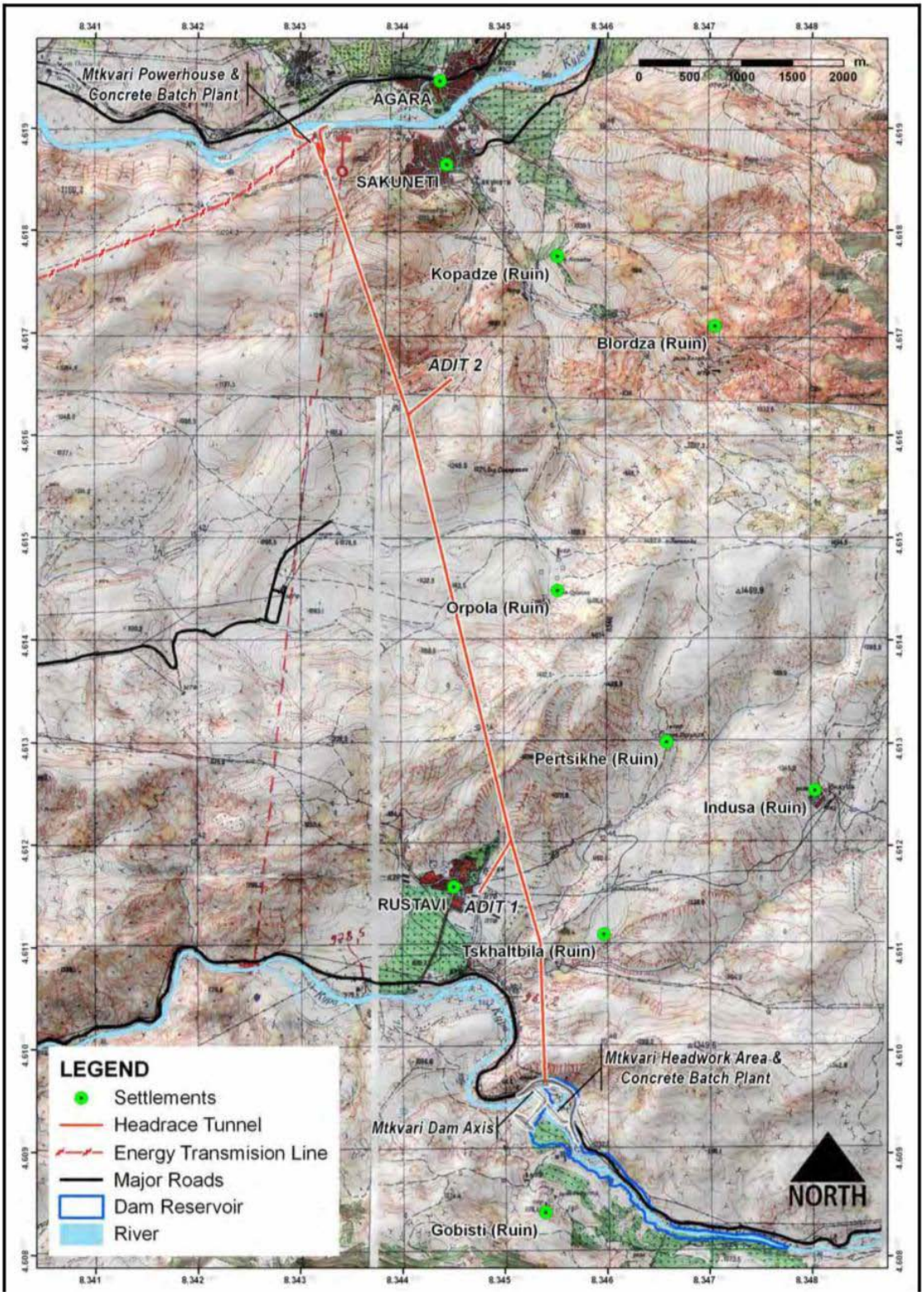

Figure 2.2.1.1 The layout of Mtkvari Hydropower plant

2.3. Other Hydropower stations

The target region for present cumulative impact assessment study was defined as Mtkvari (Kura) river basin in Samtskhe-Javakheti region inclusive Akhaltsikhe, Adigeni, Akhalaki and Ninotsminda districts covering the main stream and tributaries of the Kura river.

There are several plans and programs describing potential development of Hydropower plants in the target area inclusive the small size (less than 10MW – in accordance to the EU definition) and medium size hydropower plants located on Paravani, Mtkvari, Uraveli rivers. The ministry of Energy of Georgia in close cooperation with international organisations and donors has conducted few extensive studies to assess the potential of hydro resources. The study have identified several locations for potential hydropower plants in the region, inclusive potential schemes for hydropower plant network development.

In has to be stated, that upstream of the Mtkvari HPP under development there are few power plants under construction or in design phase, located on mainly Paravani River. The plants are Arakali HHP, Akhalkalaki HPP and Poka HPP. Also the construction of Abuli HPP is planned near to Akhaltsikhe City. One of the planned HHP is located on Uraveli River, which is on the main tributaries of Kura river in the district.

Table 2.3.1.1 Proposed Greenfield development HPPS in the region

Project Name	River Name	Projected Installed Capacity (MW)	Regulation Type
Uraveli	Uraveli	5	Run-of -River
Arakli	Paravani	18.2	Reservoir
Ninotsminda	Paravani	9.4	Reservoir
Abuli	Paravani	12.5	Reservoir
Poka	Paravani	0.5	Reservoir

From existing Hydropower plants, Chitakhevi HPP should be mentioned. The plant is located downstream from proposed Mtkvari hydropower plant in the middle between Borjomi and Akhaltsikhe cities. The HPP is owned by Energo-pro Georgia and currently is under the reconstruction. The EIA study for the rehabilitation was prepared in 2009 and environmental permit is granted to the project.

Another existing small hydropower plant is located in Kakhareti village near to Akhaltsikhe. The power plant was rehabilitated and launched in 2009.

More detailed information on mentioned hydropower stations id provided in subsections below.

2.3.2. Chitakhevi HPP

Chitakhevi HPP is located on the river Mtkvari, near village Dviri (Borjomi region), some 25 km downstream from the Akhaltsikhe. It belongs to the hydropower stations of medium Capacity, with installed capacity of the HPP is 21 MW. Annual average capacity of Chitakhevi HPP is 110 million kW/h.

Originally the plant was put into operation in 1949-51 years, was upgraded several times. In 2009 the rehabilitation of Chitakhevi power station was started after the station was privatised and overtaken by Enrgo-pro Georgia.

In accordance to the available project information, the main details of the plant consists of water intake on River Mtkvari, Derivation channel and derivation tunnel, Balancing tank, spillway and the powerhouse. The length of derivation channel is 2.5km, which is followed by 2.9 km long derivation tunnel with diameter of 4.6m. The average flow in the derivation system is 60m3/sec.

The main impact described in the documentation prepared in the framework of ESIA study for the plant rehabilitation project is dedicated to the impacts on local geology, hydrology, fish resources etc. The important issue is prevention of the erosion, the construction of bank protection structures and sediment transportation issues.

The location of Chitakhevi HPP on the Topography map is presented in figure below

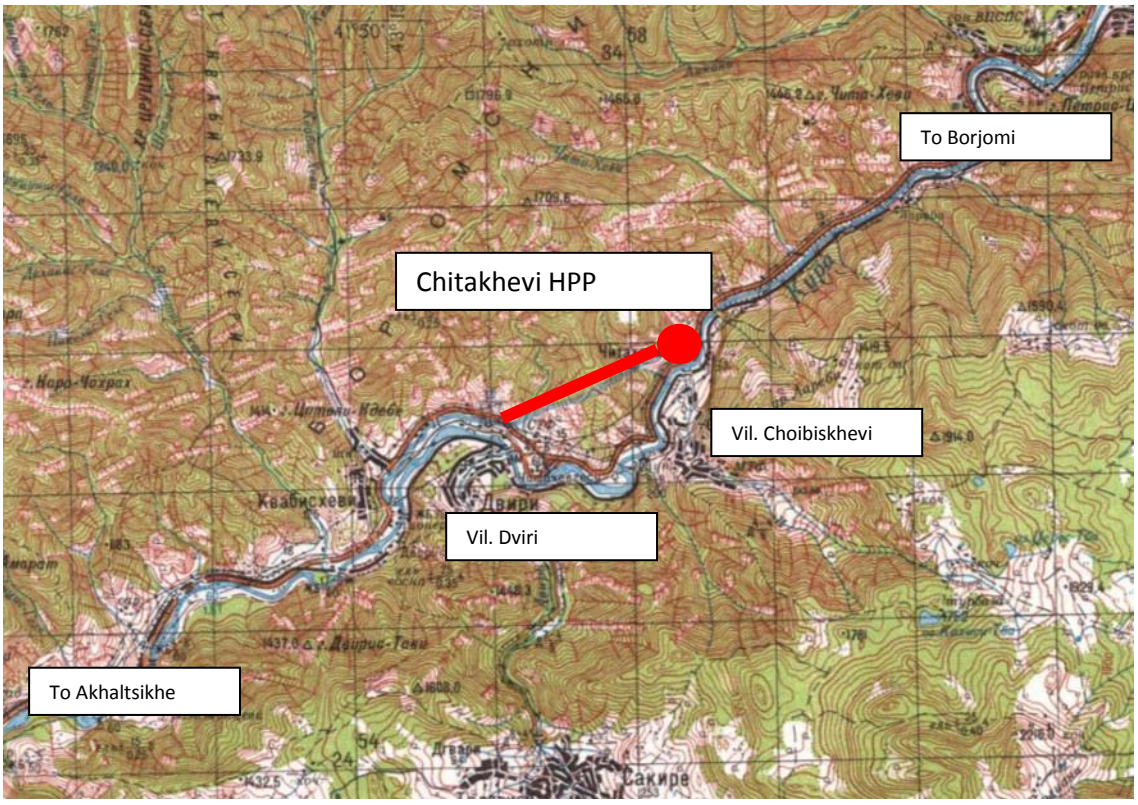

Figure 2.3.2.1 Location of Chitakhevi HPP on Topography map

2.3.3. Paravani HPP

According to the project developed by Coyne & Bellier facility will comprise: 9m high weir, 14 km long tunnel, 1km long penstock, HPP building and substation plus transmission line (two branches–

one to Akhaltsikhe, another, about 60km long line from the HPP to 154kV substation in Ardagan (Turkey)). For the needs of the project access road rehabilitation/arrangement and arrangement of temporary bridge s planned. There will be 250 m new road to powerhouse building, 1000 m road renewal to surge tank, 750 m road renewal to approach tunnel I, 2500 m road renewal to approach tunnel II, 50 m bridge to powerhouse building and 1250 m road "reshaping" at the weir site. Construction works will be carried out by contractor identified through tendering. Duration of construction works – 4 years. Detailed description of organizational management will be provided by the winner as requested under the contract signed with the company. General outline is given in the Draft ESIA

The water intake is located at the level of 1548 meters asml and is located on Paravani river near to Kokhristskali river. The water level in reservoir, after the construction is 1551. The dam construction is designed as reinforced concrete dam with spillway, the width of the dam is 44m. The design height of the dam equals to 9 meters. On the left bank of river the 4 gage water intake will be constructed, which is practically extension of the dam. The deep washout will be constructed to allow the maintenance of the reservoir during the operational phase of the reservoir and hydropower plant, the dimensions of washout is 2.5*2.5m .

After the water intake the derivation tunnel starts. The total length of tunnel is around 14km. The inlet is at 1544asml, slope i=0.00116 and the tunnel end datum is 1527m. The profile of the tunnel is horseshoe type. After the tunnel balancing tank will be installed with internal diameter of 20m and height 34m.

The water will flow in the derivation tunnel and will be discharged to the Mtkvari river near to the Khertvisi settlement, where the outlet, pressure tunnel and powerhouse will be constructed.
The general layout plan for the HPP is presented on figure overleaf.

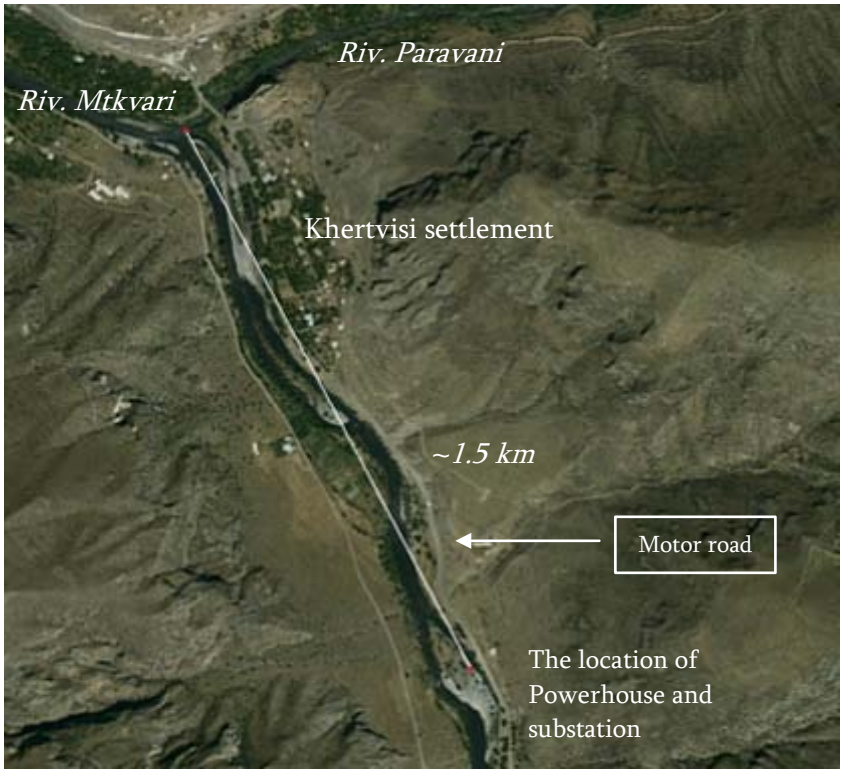

Figure 2.3.3.1 The location of Power house and outlet

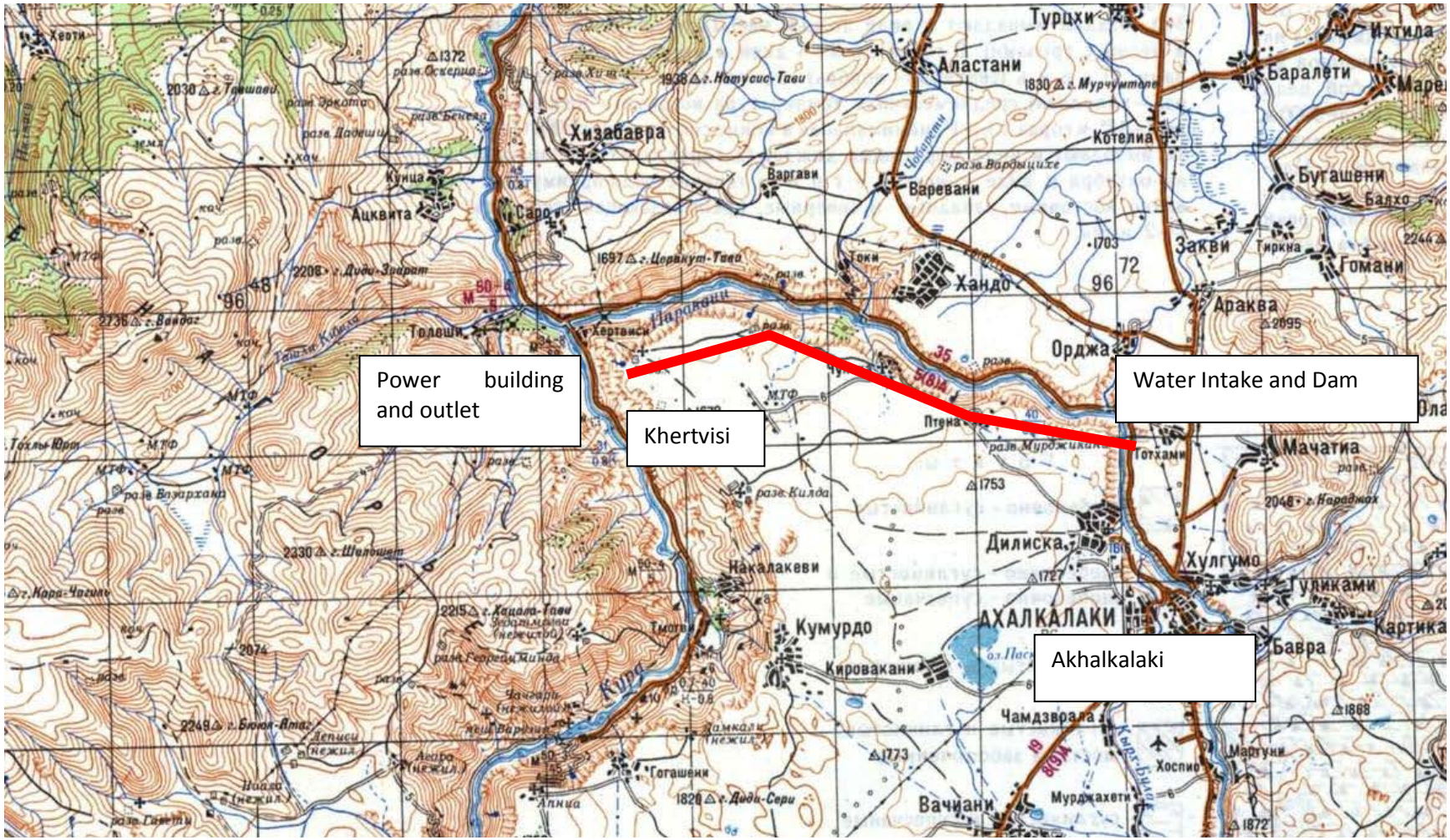

Figure 2.3.3.2 The location of Paravani Power Plant

2.3.4. Kakhareti HPP

Kakhareti HPP is located near to the Akhaltsikhe town. The hydropower station is in operation for at least 50 years, however it was rehabilitated during the last decade.

The installed capacity of the power plant is 2.4MW, which indicates, that the power plant belongs to the small power plants, having small size river bed water intake, derivation channel and the powerhouse. The power plant is already rehabilitated, and it is not expected to have any additional impacts caused by the construction activities.

In terms of impacts caused during the exploitation of power plan, it is not estimated as a facility having significant impact. In fact the head is around 42 meters and the length of the derivation channel does not exceed few Kilometers, so the impact on the river kvabliani is very limited, as soon only small part of flow is used, and water is discharged back to the natural channel within the short distance.
The general layout plan is presented on the figure overleaf.

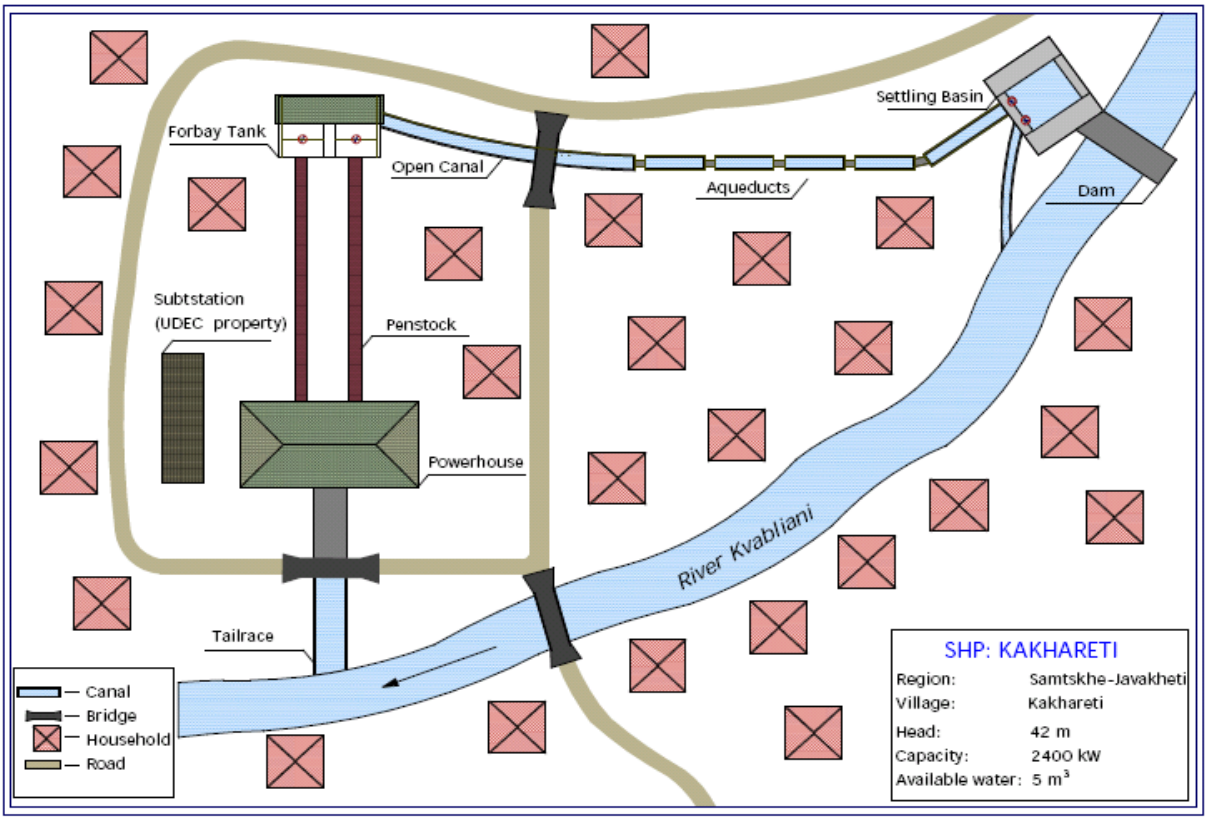

Figure 2.3.4.1 The general layout of Kakhareti hydropower plant

2.3.5. Akhalkalaki HPP

The General information and design parameters for Akhalkalaki power station also was prepared by Winrock international in the framework of USAID funded project. The Plant to be located on River

Paravani, in vicinity of Village Korkhi some 5 km away from Akhalkalaki. The main elements of the plant are following: head unit, diversion channel and free flow tunnel, pressure tank, turbine conduit, power house, tailrace channel.

The technical parameters of the plant are following: Head unit on the river Paravani conveys concrete dam, height - 28.0m, which ensures maximum water discharge, reinforced concrete water intake. Diversion is represented by free flow tunnel, diameter - 3.5m, length - 3.7km. Head unit on the river Janjgajuri conveys concrete dam, height - 5.0m, which ensures maximum water discharge, reinforced concrete water intake and silt basin. Diversion is represented by channel and free flow tunnel, diameter - 2.5m, length - 2.4km.

At the end of the diversion there is a reinforced concrete pressure tank, dimensions - 5.0x25.0m. Turbine conduit is represented by 2.0m diameter bifilar metal pipe. Power house dimensions - 17.0x30.0m , height - 15.0m. Tailrace covered channel is reinforced concrete rectangular construction, dimensions - 4.0x4.0m, length - 450.0m.

Table 2.3.5.1 The main Characteristics of Akhalkalaki HPP

Technical Parameters		
Installed Capacity	MW	14.6
Average Annual output	GWh	85.35
Autumn-winter (Oct-March) generation	GWh	38.3
Capacity usage ratio/Efficiency	%	66.7
Type of regulation		Reservoir
Scheme of energetic usage potential		Full
Hydrology		
Hydrological Data (number of years)	Year	58
Year of the average multi annual discharge	Year	1971
Catchment area	km^2	2020.0
High water flow	m^3/sec	25.11
Reservoir		
Full supply level (FSL)	masl	1638.0
Minimum Operation level (MOL)	masl	1623.0
Total volume at FSL	mln. m^3	3.3
Active reservoir level	mln. m^3	2.3
Dam		
Type		Low crest weir
Crest Elevation	masl	1638.1
Spillway		
Type		Surface
Crest Elevation	masl	1638.1
Length of spillway crest	m	25.0
Social and Environmental Parameters		
Special environmental requirements		
Social Impact		Additional workplace; Development of infrastructure
Ecological risks		Medium
Transmission lines		
Parameters	kV	35
Distance to inter connection point	km	4.5
Infrastructure		
Existing roads		Paved
Roads to be constructed	km	0.5

Source: Ministry of Energy Web site, USAID web site

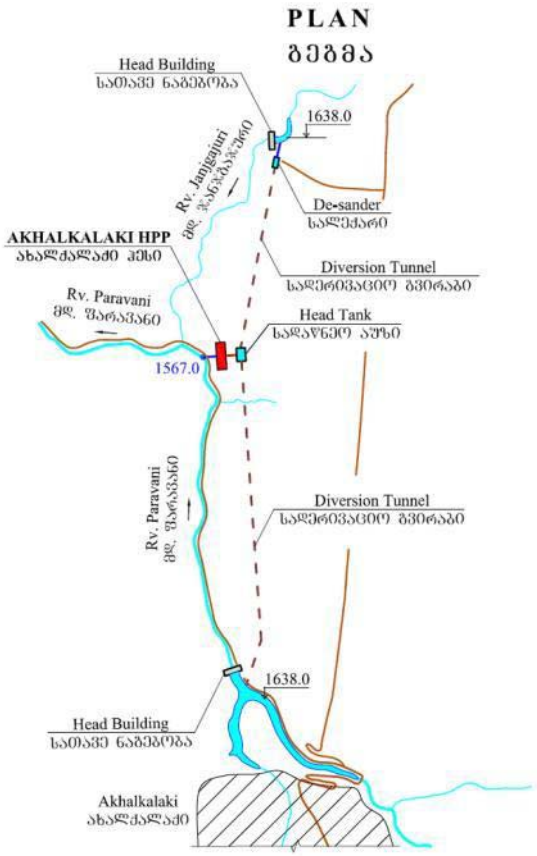

Figure 2.3.5.1 The plan of Akhalkalaki HPP

2.3.6. Poka Power station

The Poka power station will be located in vicinity of Ganzani Village. The power plant will be based on the Paravani River flow near to the Paravani Lake. The water will be diverted from run-off of Paravani river water intake. The main elements of plant are following: Head building, diversion pressure pipe, surge tank, turbine conduit, power house, tailrace channel.

The head building conveys low crest dam, height - 5.0m, which ensures maximum water discharge, reinforced concrete water intake and silt basin with sluice. Diversion conveys pressure metal pipe, diameter - 1.0m, width - 5.8 km.

At the end of the diversion there is a reinforced concrete head tank, dimensions - 4.0x16.0m. Turbine conduit is represented by 0.8m diameter metal pipe. Power house dimensions - 9.5x24.0m, height - 16.0m. Tailrace channel is rectangular reinforced concrete construction, dimensions - 1.5x1.5m, length - 100.0m.

Table 2.3.6.1 The main Characteristics of Poka HPP

Characteristics	Unit	Index
Technical Parameters		
Installed Capacity	MW	0.60
Average Annual output	GWh	3.07
Autumn-winter (Oct-March) generation	GWh	1.13
Capacity usage ratio/Efficiency	%	58.41
Type of regulation		Run-off-the-river
Scheme of energetic usage potential		Full
Hydrology		
Catchment area	km^2	272.00

High water flow	m^3/sec	2.12
Average water flow	m^3/sec	1.42
Low water flow	m^3/sec	0.97
Reservoir		
Full supply level (FSL)	masl	2075.30
Minimum Operation level (MOL)	masl	Unnecessary
Dam		
Type		Low crest
Crest Elevation	masl	2075.40
Spillway		
Type		Surface
Crest Elevation	masl	2075.40
Length of spillway crest	m	15.00
Reservoir elevation during PMF	masl	2076.80
Spillway capacity at reservoir level PMF	m^3/sec	47.80
Diversion		
Type of diversion		Conduit
Dimensions (w; l) or (d; l)	m	1,0; 5800
Social and Environmental Parameters		
Special environmental requirements		
Social Impact		Additional workplace; Development of infrastructure
Ecological risks		Low
Transmission lines		
Parameters	kV	10
Distance to inter connection point	km	0.50
Infrastructure		
Existing roads		Paved
Roads to be constructed	km	1.00

Source: Ministry of Energy Web site, USAID web site

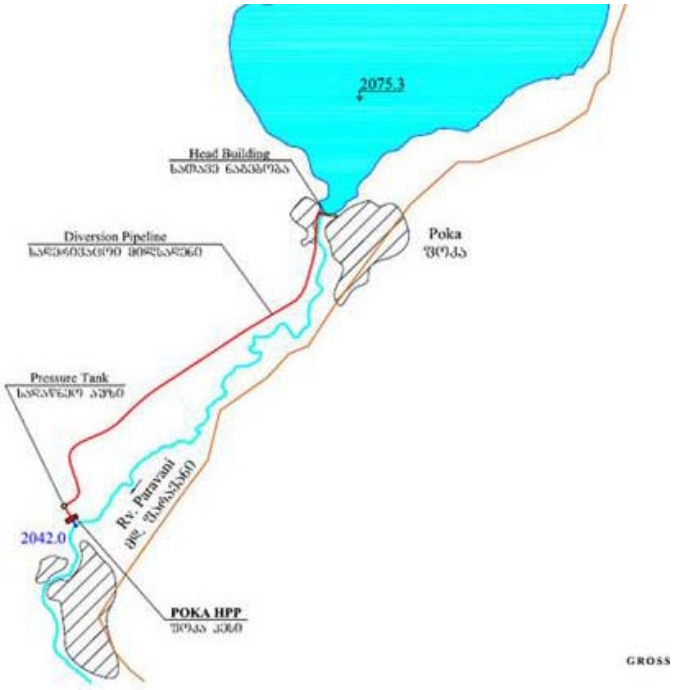

Figure 2.3.6.1 Poka HPP, Situation plan

2.3.7. Arakali HPP

The Arakali Hpp will be located in vicinity of Arakali village, downstream from Poka and Ganzani. The water will be used from Sagamo lake on Paravani river. The main parameters for the power plant is also prepared by Winrock international.

HPP Type: Diversion, Reservoir
Site Description: Head unit, diversion pressure tunnel, surge tank, turbine conduit, power cavern, tailrace tunnel.

Head unit conveys low crest spillway dam with weir, height - 5.0m, which ensures maximum water discharge, reinforced concrete water intake. Pressure diversion tunnel, diameter - 2.0m, length - 7.2 km.

At the end of the diversion there is a surge tank, diameter - 4.0m. Turbine conduit is represented by 2.0m diameter, metal faced tunnel. Power cavern dimensions - 19.0x52.0m , height - 45.5m. Tailrace tunnel is 2250.0m long reinforced concrete construction, dimensions - 2.5x2.5m.

Table 2.3.7.1 The main Characteristics of Arakali HPP

Characteristics	Unit	Index
Technical Parameters		
Installed Capacity	MW	10.80
Average Annual output	GWh	63.05
Autumn-winter (Oct-March) generation	GWh	27.57
Capacity usage ratio/Efficiency	%	66.64
Type of regulation		Reservoir
Scheme of energetic usage potential		Full
Hydrology		
Catchment area	km^2	551.00
High water flow	m^3/sec	7.18
Reservoir		
Full supply level (FSL)	masl	1997.00
Minimum Operation level (MOL)	masl	1996.20
Dam		
Type		Low crest
Crest Elevation	masl	1997.10
Diversion		
Type of diversion		Tunnel
Dimensions (w; l) or (d; l)	m	2,0; 7200
Stilling basin or shaft		
Dimensions (w x l) or (d)	m	4.0
Social and Environmental Parameters		
Special environmental requirements		
Social Impact		Additional workplace; Development of infrastructure
Ecological risks		Medium

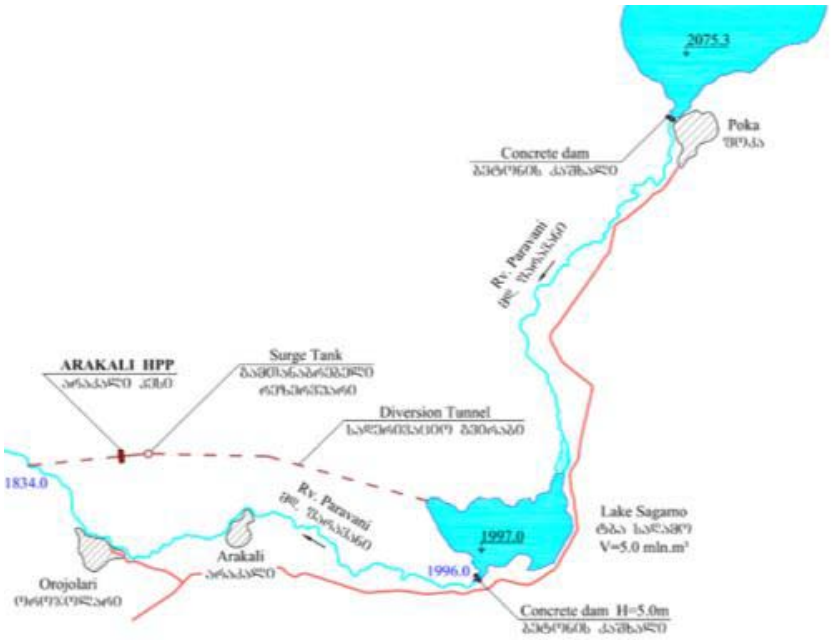

Figure 2.3.7.1 ***The plan of Arakali HPP***

2.3.8. Abuli HPP

The Abuli HPP is located in Samtskhe-Javakheti region, Akhalkalaki district, near to village Bavra. GPS The water is fed from Paravani river. The main units of HPP consists of Diversion, Reservoir Site Description: Head unit, diversion pressure tunnel, surge tank, turbine conduit, power house, tailrace tunnel. Head unit conveys fill dam, height - 35.5m, reinforced concrete water intake, surface and bottom spillways. Pressure diversion tunnel, length - 7.3 km, width - 2.5m.

At the end of the diversion there is a surge tank, diameter - 5.5m. Turbine conduit is represented by 2.0m diameter, metal faced tunnel. Power cavern dimensions - 19.0x52.0m , height - 45.0m. Tailrace tunnel is 200.0m long trapezoidal reinforced concrete construction, dimensions - 4.0x4.0m.

Table 2.3.8.1 The main characteristics of Abuli HPP

Characteristics	Unit	Index
Technical Parameters		
Installed Capacity	MW	20.0
Average Annual output	GWh	129.3
Autumn-winter (Oct-March) generation	GWh	59.6
Capacity usage ratio/Efficiency	%	73.8
Type of regulation		Reservoir
Scheme of energetic usage potential		Full
Hydrology		
Hydrological Data (number of years)	Year	58
Year of the average multi annual discharge	Year	1971
Catchment area	km^2	1251.0
High water flow	m^3/sec	14.3
Average water flow	m^3/sec	11.7
Low water flow	m^3/sec	9.42
Reservoir		
Full supply level (FSL)	masl	1833.0
Minimum Operation level (MOL)	masl	1812.0

Dam		
Type		Rock fill
Crest Elevation	masl	1835.5
Diversion		
Type of diversion		Tunnel
Dimensions (w; l) or (d; l)	m	2,5; 7300
Social and Environmental Parameters		
Special environmental requirements		
Social Impact		Additional workplace; Development of infrastructure
Ecological risks		Medium
Transmission lines		
Parameters	kV	35
Distance to inter connection point	km	1.9
Infrastructure		
Existing roads		Paved
Roads to be constructed	km	1.0

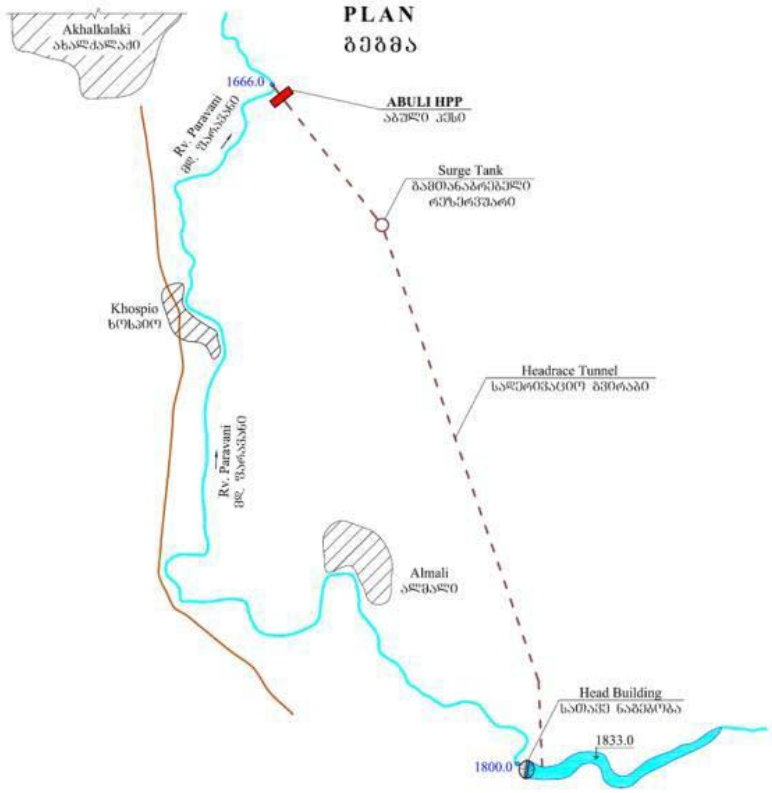

Figure 2.3.8.1 ***The plan of Arakali HPP***

2.3.9. Uraveli HPP

Site Location: Samtskhe Javakheti region, Akhaltsikhe district, village Minadze. GPS Coordinates: X=334673 Y=4598100 Name of the River: Uraveli HPP Type: Diversion, Run-off-the-river Site Description: Two head units, diversion pressure metal pipe, surge tank, turbine conduit, power house, tailrace channel. Head unit on the river Charkhaleti and river Rikosi conveys Tyrolean weir, height - 4.5m, which ensures maximum water discharge, reinforced concrete water intake and silt basin with sluice. diversion pressure metal pipe, diameter - 0.8m, length - 1.4 km and 1.3 km. At the end of the diversion there is a reinforced concrete surge tank, dimensions - 3.5mx16m, from where water through pressure metal pipe leads to the power house, pipe diameter - 1.0m, length - 3.6km.

At the end of the diversion there is a metal surge tank, diameter - 1.6m. Turbine conduit is represented by 0.8m diameter, metal pipe. Power house dimensions - 9.5x24.0m, height - 16.0m. Tailrace channel is rectangular reinforced concrete construction, dimensions - 1.5x1.5m, length - 80.0m.

Characteristics	Unit	Index
Technical Parameters		
Installed Capacity	MW	5.00
Average Annual output	GWh	19.21
Autumn-winter (Oct-March) generation	GWh	5.70
Capacity usage ratio/Efficiency	%	43.86
Type of regulation		Run-off-the-river
Scheme of energetic usage potential		Full
Hydrology		
Hydrological Data (number of years)	Year	35
Year of the average multi annual discharge	Year	1953
Catchment area	km^2	73.00
High water flow	m^3/sec	1.38
Average water flow	m^3/sec	0.87
Low water flow	m^3/sec	0.57
Reservoir		
Full supply level (FSL)	masl	1700.00
Minimum Operation level (MOL)	masl	Unnecessary
Dam		
Type		Tyrol
Crest Elevation	masl	1699.60
Spillway		
Social and Environmental Parameters		
Special environmental requirements		
Social Impact		Additional workplace; Development of infrastructure
Ecological risks		Low
Transmission lines		
Parameters	kV	110
Distance to inter connection point	km	7.00
Infrastructure		
Existing roads		Gravel
Roads to be constructed	km	2.50

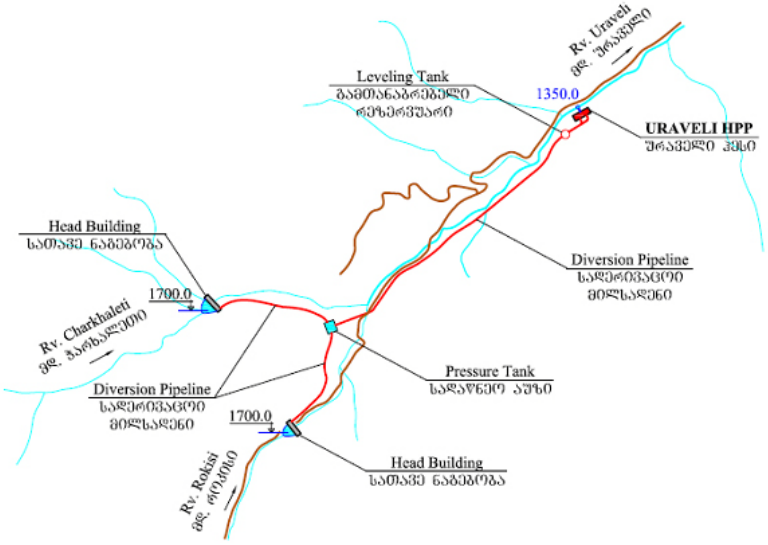

Figure 2.3.9.1 ***The plan of Uraveli HPP***

3. Legal and Regulatory Framework

The legal and regulatory framework section of the present report indicates only important aspects of institutional and legal framework applicable for the Mtkvari HPP and other plants and potential projects can be developed in target region and which can have influence in terms of cumulative impacts. The detailed description of the Georgian laws and requirements applicable for HPP's is given in ESIA report prepared for the project. The framework summary also includes IFC Performance Standards and EBRD's requirements as contained in Environmental and Social Policy (2008) and Public Information Policy (2008), for Category A projects.

3.1. Protection of environment

The legal framework for environmental protection is based on the Constitution of Georgia. The Constitution guarantees the legal framework for public access to information, stating that an individual has the right to obtain full, unbiased, and timely information regarding his working and living environment (Parliament of Georgia, 1995).

In terms of administration, the Ministry of Environment Protection and Natural Resources (MoE) is the responsible body for all environmental issues. The Ministry is responsible for the implementation of policies adopted for protection and conservation of the environment, and for sustainable development and management of natural resources. The major responsibilities of the Ministry are to control the activities that have a potential to have adverse impacts on the environment and natural resources, to issue environmental based licenses and permits and to monitor the implementation of the projects that are responsible for utilization of natural resources. The system can be described as following:

The licensing department of the ministry of environment is responsible for the assessment of project ESIA's and issue of the corresponding Environmental permits, for the activities listed in the regulations on EIA assessment and law on state ecological expertise. The Environmental inspectorate is responcible to overview and monitor the project implementation process; i.e. to ensure, that the project is developed in compliance to the environmental permit requirements, construction is carried out in the way described in documentation and impact mitigation measures are in place. For the operation stage of the project, the inspectorate monitors compliance of the operation with Environmental Permit requirements and project relevant documentation.

The very short description of environmental laws having importance to the present cumulative impact assessment study is given below:

> ***Law of Georgia on Environmental Protection:*** This Law regulates the legal relationship between the bodies of the state authority and the physical persons or legal entities within the scope of environmental protection and in the use of nature on all Georgian territory including territorial waters, airspace, continental shelf and special economic zone. The major purpose of the Law is to promote education and scientific research in the context of environment, environmental management, licensing, environmental impact assessment and related issues. Protection of natural ecosystems, protected areas, global and regional administration of environmental protection, and protection of ozone layer, biodiversity and

protection of the Black Sea against pollution are the major issues are also regulated by the Law. The Law is adopted in 1996.

Law of Georgia on Environmental Impact Permit: Within the scope of this Law, a comprehensive list of activities subjected to mandatory ecological examination and the legal bases for public participation and awareness in the decision-making processes is given (Parliament of Georgia, 2007).

The Law of Georgia on Ecological Examination: This Law defines the ecological assessment as a mandatory process for obtaining environmental impact permits. The major objective of this Law is to "secure the maintenance of ecological balance in conformity with the environmental protection requirements, the environmental conservation and sustainable development principles" (Parliament of Georgia, 2007).

3.2. Land Use

Four major laws govern the land use issue namely, Law on Land Registration of 1996, Law on Agricultural Ownership of 1996, Law on Privatization of State- Owned Agricultural Lands of 2005 and Law on Soil Protection of 1994. Furthermore, regarding expropriation, Law of Georgia on the Procedure for Expropriation of Property for Necessary Public Needs (adopted on 23rd of July 1999) governs expropriation issues where necessary.

According to this Law, the Republic of Georgia can expropriate any property that is within the scope of the projects that are crucial for public needs. The expropriation procedure can be resulted in decision realized through a Regional Court that is preceded by a Presidential Decree indicating the significance of public need. The description of the property to be expropriated and the instructions on the necessity to pay due compensation are included in the decision. The properties to be expropriated should be confiscated by negotiation as much as possible. Another legislation regarding the land use is the Law of Georgia on Payment of Substitute Land Reclamation Cost and Damages in Allocating Farm Land for Non- Farming Purposes (adopted on 2nd of October, 1997).

Compensation procedure for affected landowners (fixed and variable costs for the land according to its location and quality) is defined in the extent of this Law. According to the Law, certain payments must be done for compensation of profit losses in the case of cultivation of a parcel if the agricultural use of the land is changed.

3.3. Common requirements of IFI's

3.3.1. The World Bank Requirements

According to the World Bank screening criteria, described in Operational Policy 4.01, projects are classified as Category A, Category B and Category C based on their potential environmental impacts. These categories can be summarized as follows:

Category A – Projects with potential significant adverse social or environmental impacts those are diverse, irreversible or unprecedented.

Category B – Projects with potential limited adverse social or environmental impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures.
Category C – Projects with minimal or no social or environmental impacts.

3.3.2. European Bank for Reconstruction and Development (EBRD) Requirements

The purpose of Environmental and Social Policy of EBRD is to provide environmental and social sustainability by integration of environmental and social issues into the activities, establishing environmental and social performance requirements to the clients, defining roles and responsibilities for the Bank itself and the clients and promoting projects that are environmentally and socially sound. It should be noted here that generally European Investment Bank (EIB) also follows the same sort of policy. In short, EBRD has adopted a set of "performance requirements" regarding social and environmental issues and impact for its clients to be met. Thus, the following "performance requirements" are of concern in the Project.

PR 1: Environmental and Social Appraisal and Management
PR 2: Labour and Working Conditions
PR 3: Pollution Prevention and Abatement
PR 4: Community Health, Safety and Security
PR 5: Land Acquisition, Involuntary Resettlement and Economic Displacement
PR 6: Biodiversity Conservation and Sustainable Natural Resource Management
PR 7: Indigenous Peoples
PR 8: Cultural Heritage
PR 9: Financial Intermediaries
PR 10: Information Disclosure and Stakeholder Engagement

3.3.3. International Finance Corporation (IFC) Performance Standards

IFC adopted 8 Performance Standards on Social and Environmental Sustainability in order to manage social and environmental risks and impacts and to enhance development opportunities in its private sector financing in its member countries eligible for financing. Clients shall meet the Performance Standards throughout the life of an investment.

These Performance Standards are as follows:

Performance Standard 1:	Social and Environmental Assessment and Management System
Performance Standard 2:	Labor and Working Conditions
Performance Standard 3:	Pollution Prevention and Abatement
Performance Standard 4:	Community Health, Safety and Security
Performance Standard 5:	Land Acquisition and Involuntary Resettlement
Performance Standard 6:	Biodiversity Conservation and Sustainable Natural Resource Management
Performance Standard 7:	Indigenous People
Performance Standard 8:	Cultural Heritage

4. Environmental and social baseline

The methodology of the cumulative impact assessment studies indicate, that the baseline conditions for the target project has to cover the project broader area defined during the cumulative impact assessment. The characteristics of the area is practically uniform for Akhaltsikhe and Aspindza regions, so information collected during the ESIA study was used for the preparation of the chapters covering socio-economic aspects as well as public information available in country. The location of power plants in study area is presented on Figure 4.1.1.1.

Figure 4.1.1.1 The location of target HPP's in study area

4.1. Environmental Baseline

4.1.1. Physical environment

Topography:
The region surrounding the project area is presented by middle mountainous, erosive-denudation relief. The project area is located in the western part of Trialeti ridge of sub latitudinal direction, which is confined from three sides (southern, western, and northern) by the Valley of Mtkvari River. Practically all projects are placed in Paravani-Mtkvari river gorges.

The mountain flood plains, volcanic mountains and foot hills are present in project area partly covered with grass vegetation. In lower parts the forest landscape is present.

Geology:
The study area broadly consists of unstable clayey and sandy tuffogenic formations dated back to the Upper Eocene. The Middle Eocene volcanogenic and sedimentary units of commonly seen media can be lithologically divided into three series which are layered tuffogenic series of sediments, tuff-breccia series and layered tuffogenic series. The oldest formation of the studied area is 1,036 m thick Middle Eocene Formation. Above the Middle Eocene formation, there exists 400 m of Middle Eocene Series consisting of tuff layers and thin layers of andesites and argillites, mainly.

Above the Middle Eocene Series there exists Middle Eocene Upper formation consisting of sandstone and relatively thinner tuff layers. Onto the Middle Eocene Upper formation, Upper Eocene series sits with. Upper Eocene series consist of tuffs, argillites and sandstones. Overlying the Upper Eocene series, Upper Miocene Lower Pliocene Kisatib formation is present. Kisatib formation consists of dolerite and andesite lavas and their pyroclastics with diatomite layers in places at the upper part.

At the top of all series, there exist 20 m Quaternary dolerite stream and Quaternary sediments of terraces, alluvium, di-alluvium and pro-alluvium. Morphologically the study area is mainly positioned on the Erusheti upland, which is described as a form of tectonic relief and the volcanogenic processes in the region matching the project area are of secondary importance. Since the floodplain terrace of the Mtkvari at the dam axis area is formed with highly permeable alluvial shingle, the dam will be based on the less permeable, but water saturated rocks underlying the shingle. The permeability level of the bedrock is generally weak, but there are some zones with increased permeability due to physical effects. Thus, once the comparatively high permeability bedrock zones are treated, it can be stated that the reservoir area is relatively watertight and the possible main leakage paths will be through the dam foundation and abutments.

Soils:
Generally, in Akhaltsikhe; cinnamon soils are very common. However, around the centre of Akhaltsikhe, brown forest soils and mounting-forest peat soils are dominant.

Land Use:
The steep topography of the Mtkvari and Paravani valleys are typical of steppe vegetation, and affects the formation and distribution of vegetation in the project area. The plateu areas are mostly covered with Grasslands.

The natural forests in the area were generally destroyed by the settlers for the cultivation of potato, which is the major source of income in the region. Examples of natural forest free of anthropogenic effects are found only on the steep slopes and cliffs that cannot be used for the cultivation of hazelnut.

Climate and Air Quality:
The project is located between two warm seas namely, the Black Sea and the Caspian Sea, in the subtropical latitudes. However, the climate of the Kura River basin is mainly influenced by its location in the mountainous area isolated from the subtropical affects of the warm seas and the cold air masses from the north of Eurasia. As a result, the typical climate observed in the project area can be described as cold winters with small amount of snow and long warm summers. The annual precipitation is 520 mm in Aspindza and increases to about 560 mm in Akhaltsikhe.

The highest precipitation is observed in June in both Akhaltsikhe and Aspindza Districts with about 82 mm and 81 mm of rainfall, respectively. Meanwhile, the lowest precipitation is observed in January and February (32 mm) in Akhaltsikhe and in December (22 mm) in Aspindza.

The annual mean temperatures in Akhaltsikhe and Aspindza are 9.0C and 9.4C, respectively, August being hottest and January being coldest. The direction of the prevailing wind is from west and northwest in Akhaltsikhe and Aspindza, respectively. Additionally, the wind speeds recorded in Akhaltsikhe and Aspindza Weather Stations are 1.6 and 2.0 m/sec, respectively. Hydrology: The drainage areas of Minadze Flow Monitoring Station and dam axis are 8,208 ha and 7,950 ha, respectively. The average flow of Minadze station is 57.65 m3/sec based on hydraulic data for 1938-1973 period.

Sediment Transport:
There is no glacier in the catchment area of Mtkvari and and Paravani Rivers, so the streams is carrying rather low levels of suspended material. Thus, the total suspended sediment load at the dam sites are estimated as low.

Water Quality:

The surface waters of the project area are classified according to their treatment needs for utilization using the regulation on “Surface Water Quality to be used or planned to be used as drinking water” document as reference. According to the results of in-situ tests and laboratory analyses of the surface waters, all the waters taken from sampling points excluding headworks area, are classified as Category A1 with respect to high DO concentrations. Headworks area surface waters belonged to Category A2 in respect to its relatively lower DO concentration value.

Additionally, neither phosphate nor nitrate levels observed in the samples analyzed exceed Regulation on the Quality of Surface Waters Used or Planned to be Used for Drinking Water. Fecal coliform level at Potsckhovi River indicates that Potsckhovi River water is in A1 category. On the other hand, fecal coliform levels in other waters (i.e. Mtkvaripowerhouse area, Uravelli Stream, Mtkvari-headworks area) exceed the level of A1 category. However, fecal coliform levels at those stations are not beyond the level of A2 M category.

As a consequence of chemical analyses of samples from Mtkvari River water, it is determined that Mtkvari River water is not suitable for drinking water and domestic purposes but may be utilized for agricultural irrigation. Groundwater: Groundwater quality in the project area is influenced by the

geological background, no significant sources of pollution are known. Groundwater use is basically non-commercial for domestic and irrigation purposes.

Surface Water Use:
Mainly springs and groundwater are used for agricultural purposes in the villages. The river is used by the fauna species and by livestock to some extent. There are a number of alluvial water wells for irrigation purpose located close to Akhaltsikhe. Therefore, there is no significant use of river water by the locals living in the area for drinking, irrigation or production purposes.

The irrigation network is not well developed in the area, and it is not estimated that irrigation needs will increase significantly in the future.

4.1.2. Biological Environment

Flora and Vegetation Communities
The steep topography and riparian habitats of the Mtkvari Valley is typical of the South Caucasus Region, and affects the formation and distribution of vegetation in the target area. The natural forests in the area were generally destroyed by the settlers for cultivation. Examples of natural forests free of anthropogenic effects are found only on the steep slopes and cliffs that cannot be used for the cultivation.

The steep slopes in the project area are covered with scattered vegetation. In general, scattered trees exist at small villages and along the river, and there are irregular short trees on mountain sides. The hills and slopes that are covered with vegetation are occupied by shrubs and juniper and oak communities. In addition to these, shrubby forms of tamarisk, berry, and rose were also recorded in this zone. Occasionally, berries are observed. This limited vegetation is suitable habitats for various mammals, reptiles and birds.

It is very difficult to estimate the characteristics of vegetation around the area, however specific information can be found in ESIA's prepared for each project discussed.

Birds:
In the study area 78 bird species have been identified through observations and confirmed by the other identification methods. There is no bird species classified by IUCN and CITES categories. However, 45 species are included in the list of protected fauna species in accordance with the Annex 2 of the Bern Convention. Furthermore, 27 species are included in the list of protected fauna species in Annex 3 of the Bern Convention. In addition, 3 species (Ciconia ciconia; white stork, Tadorna feruginea; ruddy shelduck and Buteo rufinus; long-legged buzzard) are classified as VU (vulnerable) according to GRDB.

Reptiles:
In Georgia 54 species of reptiles were recorded. In the study area, In the list of reptiles, 8 species are listed in Bern Convention Annex 2, while 11 of them are classified in Annex 3. According to IUCN, 9 species are classified as LC (Least Concern). No reptilian species are listed in GRDB and CITES categories.

Amphibians:

There are 12 species of amphibians found in Georgia and 6 of them are distributed within the study area. According to Annex 2 of Bern Convention, 2 of them are strictly protected fauna species while 4 of them are listed as protected fauna species in Annex 3. In addition, 1 (Mertensiella caucasica: Caucasian salamander) amphibian species are classified as VU (vulnerable) in IUCN Red List and GRDB.

Fish species:

13 fish species were identified in the target area. However, none of these fish species are endemic for Georgia. Due to the nature of the project, the potential impacts on the fish species are more important when compared with the possible impacts on other biological resources. Therefore, the biological characteristics of the fish species are given special importance.

The studies carried out within ESIA study, revealed that Cyprinidae Family, Balitoridae Family, and Salmonidae Family exist in the Mtkvari River System. Among those families; Alburnoides bipunctatus (Spirlin), Aspius aspius (Asp), Barbus lacerta (Kura barbel), Capoeta capoeta (Transcaucasian barb), Chondrostoma cyri (Kura nase), Gobio gobio (Gudgeon), Squalius cephalus (European Chub), Tinca tinca (Tench); Barbatula brandtii (Kura loach) and Salmo trutta fario (Brown trout) are listed in Annex 3 of Bern Convention. Moreover, Salmo trutta fario which is considered to exist in the tributaries of the main Mtkvari River is classified as “VU: Vulnerable” in GRDB.

4.2. Socio-Economic Baseline

The project area as it was mentioned in the previous chapters of present report covers the territory of Akhaltsikhe and Aspindza municipalities, respectively we have analysed and presented below characteristics of socio-economic conditions in the mentioned districts. Is should be stated, that more detailed socio-economic characteristics of the target area focusing on the conditions at direct impact areas for Mtkvari HPP development projects.

The Samtskhe-Javakheti which is one of 12 administrative regions in Georgia, is located in the southern part of the country, bordering Armenia and Turkey. The administration of Samtskhe-Javakheti region is headquartered in Akhaltsikhe. There are 353 settlements in the region including 6 cities – (Adigeni, Akhalkalaki, Akhaltsikhe, Borjomi, Vale and Ninotsminda), 7 towns (Bakuriani, Bakuriani - Andesite, Tsagveri, Akhaldaba, Adigeni, Abastumani, Aspindza) and 254 villages.

4.2.1. Demography

According to 2002 census, the overall populations are 46,134 and 13,010 in Akhaltsikhe and Aspindza Districts, respectively. Among those populations, females constitute 51.7% and 51.4% while males constitute 48.3% and 48.6% in Akhaltsikhe and Aspindza Districts respectively.

The 2008 UN Human Development Report states the age distribution for Georgia as a whole is trending upward, with a decline in birth rates since 2000. Some 17.5 percent of the population is under 15 years of age, 67.9 percent is from 15 to 64 years, and 14.7 percent is over 64 years As of 2007, the average life expectancy at birth is 70.8 years, with life expectancy of 75.5 years for women and 67.0 years for men. The probability of not surviving past age 40 is 7.9 percent, according to the UN Human Development Report. (UNDP, 2009)

4.2.2. Infrastructure

Roads. Secondary roads in the Akhaltsikhe and Aspindza municipalities are generally in poor condition, with better-maintained and more travelled primary roads are already rehabilitated and provide connections between the major towns. The Borjomi-Akhaltsikhe and Akhaltsikhe-Aspindza roads are of acceptable quality and correspond to the requirements applicable to the road categories assigned.

The secondary and village access roads usually are in very poor condition. If the secondary roads have been asphalted in the past, they have not been well-maintained and have been degraded by weather and excessive use.

Additional roads are being built in the southern portion of Georgia, funded by the U.S. through Millennium Challenge Georgia. The Samtskhe-Javakheti Road Rehabilitation Project aims at restoring the road and transport network in the region.

The railway network is connecting Akhaltsikhe to Khashury ad other railway stations of Georgia. In Aspindza there is no railway network available.

Access to energy.
The local people report, that they generally have regular energy supplies. The power network and access to the power is practically available to the most settlements in the districts. Only certain, very remote settlements does not have access to the power. The service is usually of good quality, however the power cuts and no power supply cases are happened mostly during the winter or spring autumn periods.

While energy is officially available in 99 percent of households in Georgia (UNDP 2009) the main source of heating in many rural areas is firewood. Both gas and electricity are felt to be too expensive to heat with. It is noteworthy that there are environmental impacts associated with heating with wood due to deforestation, which leads in turn to land and mud slides and long term soil degradation. It is also noteworthy that the interview subjects did not foresee using electricity for heating in the future.

Economic Conditions

The overall economic conditions in Georgia are improving (UNDP 2009) but largely vulnerable to fluctuations in the world market (UNDP, 2009). Since the August 2008 conflict with Russia, significant amounts of foreign assistance have come into the country to restore and improve infrastructure and provide support to internally displaced people. The resulting economic “boom” has been fuelled by construction and foreign investment, combined with increased government spending and improved tax collection mechanisms.(US Central Intelligence Agency, 2009)

Gross domestic product (GDP) and employment. The GDP rose by close to 10 percent in both 2006 and 2007 before slowing to less than 7 percent in 2008, with an anticipated decline in 2009 due to the global economic conditions. The growth rate in the economy is reflected in the increase in *per capita* GDP, adjusted for Purchasing Power Parity which climbed from US$4000 in 2006 to US$4700 in 2008 (US Central Intelligence Agency, 2009).

GDP sectoral composition in 2008 was weighted heavily toward the service sector, with 58.8 percent of GDP being derived from services. Agriculture accounted for 12.8 percent and industry for 28.4 percent. This contrasts with sectoral employment, which is 53.4 percent in agriculture, 10.5 percent in industry, and 36.1 percent in the services sector. This is presented in below. Each sector is described below.

Table 4.2.2.1 Georgia economic and employment contributions by sector

Sector	*Percent of GDP*	*Percent of total employment*
Agriculture	12.8	53.4
Industry	28.4	10.5
Services	58.8	36.1
Sources: Ministry of Economic Development of Georgia, 2009 and U.S. Central Intelligence Agency, 2009		

The discrepancy of the agricultural sector accounting for 53.4 percent of the employment, but contributing only 12.8 percent of the GDP reflects the prevalence of subsistence farming. This probably contributes to what was reported in the UN Human Development Reports, which is that 54.5 percent of the population was living below the poverty line in Georgia between 1990-2004. (UNDP 2009)

The national employment rate is 86.7 percent of which 31.8 percent are hired workers and 54.9 percent are self-employed. The rates of unemployment in the rural areas are much higher. The national unemployment rate is 13.3 percent, whereas in the areas impacted by the transmission line, the unemployment rates range from 30 percent to 39 percent, as shown in Table 4.2-5. (Ministry of Economic Development , 2009)

Table 4.2.2.2 Unemployment rates by administrative region/district near transmission line

District	*Unemployment rate*
Georgia	13.3%
Samtskhe-Javakheti	
Borjomi	39%
Akhaltsikhe	30%
Ministry of Economic Development of Georgia, 2009.	

As soon the employment ratio is low, the most population had tendency towards resettlement to the cities, those who stayed in town the local farming and work in service sector is generating the income. Both Akhaltsikhe and Aspindza regions are characterised of agricultural character. Practically all industrial facilities were shut due to economic changes and crisis during the last two decades.
The main activities are split between the agricultural activities – farming, cattle breeding etc and service sector. There are no heqavy industry sites in the region as mining, natural ore processing etc.

Agriculture and animal husbandry are the most important income sources. Within agricultural products, tomato and potato are mostly cultivated. In animal husbandry, cattle are commonly preferred. In addition, apiculture is also widespread.

In both municipalities the people follow mostly Christianity, however there are some villages where the other religion representatives live. The literacy level is 100% and women and men have equal rights.

In the area, primary education of 11 years is obligatory for all the children.

5. Cumulative Impact Assessment

5.1. Proposed Approach and Methodology

The process of analyzing cumulative effects is an enhancement of the traditional environmental assessment components: scoping, describing the affected environment, and determining the environmental consequences. Scoping is the key to analyzing cumulative effects as it provides the best opportunity for identifying important cumulative impact assessment issues, setting appropriate boundaries for analysis, and identifying relevant past, present, and future actions. The criteria for judging significance of cumulative effects are not different from those for other types of environmental assessment, but threshold effects and irreversible changes in the use of critical resources will generally be key concerns.

Present cumulative impact assessment identifies impacts without considering the mitigation measures for these impacts. Cumulative impacts rated as low are of limited extent, less severe, considered acceptable, and mitigation measures are not necessary. Cumulative impacts rated as medium and high are of wider extent, more severe, considered significant, and require mitigation measures which are proposed in Environmental Mitigation and Monitoring Action Plan (Section 6).

Some impacts of identified project and activities within the area may accumulate in an “additive” manner, some impacts can be synergistic. Interactive impacts may produce a total impact greater than the sum of the individual impacts. For instance, environmental impacts that can accumulate in an additive manner include those such as changes in water temperature or concentrations of dissolved gases, erosion, sedimentation, and habitat losses.

The impact study area was identified based on a combination of agro-ecological characteristics, the boundaries of the Mtkvari sub-basins within the Akhaltsikhe and Aspindza rayons and the locations of the main river systems, using standard approach of upstream, downstream and immediate reservoir area as the main impact zones.

For construction and operation phases impacts on physical, biological and socio-economic environment will be assessed separately. In each case the projects will be assessed within three scenarios: (A) the existing projects/activities plus proposed Mtkvari HPP, (B) scenario A plus other projects under construction or completely approved; and (C) scenario B plus future planned or predicted projects in the area.

Information on existing, approved and planned HPPs in Akhlkalaki and Aspindza rayons is presented in chapters describing the existing and planned projects in the region.

There are four HPPs identified in the study area: Kakhareti HPP (operating), Uraveli HPP (approved, not started), Akhaltsikhe HPP (operating), Chitakhevi HPP (under reconstruction) and Paravani HPP (approved, not started) which will be included in the cumulative impact assessment (at operation phase, since the construction of these HEPPs has already been completed or construction are is far More than 10km from Project implementation area). Where necessary, some assumptions have been made when dealing with the other planned projects within study area, due to lack of detailed technical information on these projects. It should be noted also that there are no large-scale irrigation developments planned for the Mtkvari basin within study area.

5.2. Summary of Mtkvari HPP Impacts and Mitigation

5.2.1. Impact on Physical Environment

Impact on Topography and Loss of Land

The area of physical land take by the Project includes the reservoir area and the footprint of the construction sites and facilities (dam site, camp facilities, access roads etc). The reservoir covers an area of 0.5 km2. The area to be inundated is covered with mostly steppe vegetation. No loss of forestry areas is of concern. Loss of agricultural land is negligible. Additionally, no loss of land will be an issue along the headrace tunnel as the structure will be constructed underground. The areas for switchyard and owners camp facilities outside of the reservoir consist of semi-arid shrubs.

Geology and Seismic Impact

As the site has sufficiently firm geological characteristics, subsidence due to the weight of the reservoir water is not anticipated to be an issue of concern, neither is watertightness. Project engineering design will include the calculations of dynamic and seismic loads during both construction and operation phases. The Mtkvari Dam structural design will meet all the engineering standards.

Landslides and Erosion

Construction activities may increase the potential of occurrence of landslides and erosion in various ways, which include destabilization of soils by cuts on slopes, improper stockpiling of materials, destruction of vegetative cover during site clearing and uncontrolled surface run-off (slope wash) during storms. The content may cause erosion and landslides at various points along the banks of Mtkvari River and in some lateral ravines. These are the main geohazards that are of local site-specific nature. The specific mitigation measures such as proper drainage, slope stability, sediment run-off, erosion control during both construction and operation phases are included in the EMP.

Reservoir Sedimentation

Carried suspended material by Mtkvari River to the dam site is limited. The size of the reservoir is relatively small. However, the bottom elevation of the headrace tunnel intake that is about 5 m above the riverbed, allows trapping of considerable amount of sediments (about 1.5 million m3) without affecting the flow in the intake. In this scope, considering that the reservoir is to divert the water to the headrace tunnel but not for water storage, the Mtkvari Project will not significantly hinder the transport of sediment, thus nutrients and alluvium to the delta. Therefore, sedimentation in the Mtkvari Reservoir would neither affect the downstream water quality nor the delta significantly.

Impacts on Local Climate

The concern regarding the impacts of dams and reservoirs projects on local climate is microclimate changes. The significance of this change is related to the surface area and volume of the reservoir and to the prevailing climatic conditions in the area. The phenomenon is generally storing energy of the reservoir from solar radiation received during summer in the upper water body and dissipating this stored heat during the winter. This is a general moderating effect causing a trend of milder conditions resulting in increases in humidity and increased average winter temperatures and less hot conditions in summer. The effect of colder air from the slopes meeting the relatively warmer reservoir water surface might also result in a tendency to mist and fog occurrence especially in winter. However, Mtkvari Project will have a very small reservoir (0.5 km^2), so it will not lead to a significant change in the climate of the area or the region.

Global Warming Issues

In particular; shallow, tropical reservoirs with high volumes of residual organic compounds in the flooded reservoir, intensive aquatic primary production and high influx of organic material by their tributaries are of concern in global warming relevance. Mtkvari HPP reservoir area however, is very small and only sparsely covered with vegetation, has a weak soil cover and low influx of organic material. Furthermore, the climate of the project area of Mtkvari HPP is not favorable for contribution to the greenhouse gas emissions. As a result, Mtkvari HPP project will not contribute to the climate change.

Impact on Ambient Air

Impacts on air quality are of concern only during the construction phase. The gaseous and particulate matter emissions during construction activities were estimated by modelling studies based on the provided construction schedule (detailing construction activities and their durations), construction work plan (detailing amounts of fills and excavations). The results of the model include both the maximum values of the annual average and the maximum value of the daily average. None of these maximum values are predicted to occur at the settlements. These were observed at the receptors closest to the sources (construction sites). When the results for other locations are analyzed, it is seen that they are substantially lower. In order to evaluate the significance of the impacts of PM emissions, the calculated PM concentrations are compared with the EU Directive of 2008/50/EC and WHO Guidelines. As a result of this comparison daily PM10 concentration is above the limit values indicated in the EU Directive, while it is under the limit value of the WHO Guidelines. PM10 concentrations are much lower near the settlements closest to the construction sites. It has been noted that these maximum values reflect the worst case close to the source and under adverse conditions (i.e. maximum values generally occur at calm conditions when dispersion is minimum and conservative assumptions for the vehicle fleet). Furthermore, it should be pointed out that the nearest settlement to the dam site, Rustavi Village, is about 3 km to the north-east of the dam site and the nearest settlement to the powerhouse, Sakuneti Village, is about 1 km to the south of powerhouse.

Noise Impact

The noise levels were estimated to be below the 55 dBA limit for construction works set out in Environmental, Health, and Safety (EHS) Guidelines (General EHS Guidelines: Environmental Noise Management) of International Finance Corporation of the WB. Noise levels exceed the maximum allowable in neither of the project affected villages. It should also be pointed out that due to the fact that the noise level estimations are based on a worst case scenario in which the set of machinery is assumed to operate at the same place and at the same time (that is in fact physically impossible), actual noise level are expected to be much lower. The only noise source of the Project foreseen in operation phase will be generator and turbines located in the powerhouse. However, there will not be any considerable noise nuisance since they will be located in a closed building. In addition, it will be somewhat an isolated facility since it will be located at a distance of 1245 m to Sakuneti Village, which is the nearest settlement.

Impacts on Hydrology

Construction Phase. For construction, the Mtkvari River will be diverted to diversion tunnel via cofferdam to create a dry work area at the dam site. The natural flow pattern will not be affected by this.

Impoundment Impact. Reservoirs having a relatively large storage capacity with respect to inflow generally have large surface areas exposed to solar heating and a long enough detention time. Thus, they develop stratification and the consequent changes in temperature, dissolved oxygen, and nutrient content. However, Mtkvari HPP reservoir will have a very small surface area and will be rather shallow, since the purpose of the Project is not water storage, but just diverting the river. Therefore, problems that are anticipated in deep reservoirs due to stratification will not occur in Mtkvari Project. According to the results of the chemical analyses of Mtkvari River water, the levels of phosphorus and nitrogen are quite low. Thus, the Mtkvari Reservoir will not be under risk of eutrophication and will not pose a water quality problem in the reservoir or downstream.
Operation Impact: The Mtkvari HPP Project will be operated in a run-of-river mode, with very limited water storage. The inflow will be diverted to the powerhouse by a power tunnel, bypassing approximately a 27 km reach of Mtkvari River. However, it should be pointed out that Uraveli and Potschkovi Rivers, which have considerable flows, join Mtkvari River at distances of 8 km and 9.2 km downstream of dam axis, respectively. The decrease in the existing flow can decrease the tolerance of the river to pollution and also can adversely impact the continuity of the aquatic ecosystem. In order to maintain existing water quality and the biological resources in the by-passed reach; it is necessary to release a minimum flow from the reservoir to the bypass reach. For that purpose, a study was carried out to calculate the minimum flow to be released to the riverbed. The results of the study revealed that the minimum flow to be provided in the by-pass reach is 5.8 m3/sec (10% of the average flow).

Impacts on Water Quality

At the construction phase of the project the water usage will be due to concrete preparation, washing the concrete aggregate material, preventing dust and the domestic uses of the workers. The water required for the concrete batch plant, washing the aggregate material and preventing dust would be taken from Mtkvari River. Drinking water will be supplied from the groundwater sources of the villages in the vicinity; otherwise, the water will be purchased and brought to the project site. The daily water requirements for domestic purposes and washing aggregate material and concrete mixers are calculated as 18.75 and 26 m3, respectively. Water consumption for dust prevention is also taken into account considering that “10% moisture will be maintained at the topsoil layer”. If it is accepted that the whole of the water required for the domestic usage of the workers will be converted to domestic wastewater, the daily generation of the domestic wastewater will be 18.75 m3. Throughout the construction phase due to washing the concrete aggregate and mixers, 52 m3 of wastewater that has high suspended solid amount will be produced daily. For the protection of the water quality at the construction sites, a wastewater management plan will be implemented.

Sanitary Risk

According to the studies and statistics, none of the parasitic diseases is found in Georgia due to climatic conditions. The risk combined with realization of this dam project can also be assessed by observing similar projects in the same region. No such adverse health impacts have been reported to occur as a result of developed dam projects in the region. As the primary function of the Mtkvari Project will be power generation and not drinking water supply for the people in its vicinity,

development and spreading of bacterial diseases, such as diarrhea, are not anticipated. Because of these reasons, the Mtkvari Project will not impose any increased risk to human health.

5.2.2. Impacts on Biological Environment

Impacts on Flora and Terrestrial Fauna

The vegetation at and around the dam site and other construction areas will be destroyed by the construction activities and the plant populations below the high water level of the reservoir will be lost. The destruction of the vegetative cover in turn affects the terrestrial fauna that depends on these habitats.

The construction of access roads, diversion and power tunnels and the dam can have negative impacts on biological environment, as existing habitat in and around these areas would be degraded to some extent. Most medium to large mammals and birds will leave the area, due to noise, dust, and human activity of construction. Such activities, however, will take place in a limited area and therefore will affect a limited population in the project area. In addition, since the vegetative cover is rather homogeneous and evenly distributed throughout the project area, the destruction of vegetation at tunnel will not cause the loss of any critical habitat for the biological species living in the area. Based on these findings and the project characteristics, the impacts of the project on flora species would be insignificant. In the development of water resource projects, feeding, breeding, resting and dwelling habitats of terrestrial animals are destroyed by construction activities and inundated by the filling of the reservoir. In most cases, self-rehabilitation takes place since terrestrial fauna elements escape to suitable habitats in the vicinity after impoundment. This in turn, may push the carrying capacity of the receiving sites to its limits, overloading the ecosystems for a certain period of time. As the area to be inundated by Mtkvari dam is only 0.5 km2, impacts on both the terrestrial fauna and the flora will be quite limited. In addition, the proposed reservoir is only 3.5 km long and, hence will not pose a significant obstruction for terrestrial animals to cross to the other side of the river. The Mtkvari Project will be operated as run-of -river and therefore no significant changes in surface elevation of the Mtkvari Reservoir are anticipated. The development of water dependent vegetation along the shoreline, which may occur in hollows and depressions, is beneficial for water birds and some mammals. For biological species, this water dependent vegetation will serve as a nesting place and feeding area.

Impacts on Aquatic Fauna

Fish: The changes in aquatic habitats and biota due to the formation of the Mtkvari Reservoir will be to a limited extent, in accordance with its small size. Most of the fish species identified are adaptable to living in lakes as well as rivers. Thus, formation of a very small reservoir, which will develop slightly lentic conditions, will not have a significant impact on the fish species of the river. Among the fish species *Salmo trutta fario* (brown trout) is a sensitive species to water quality and river habitat. This species can be found in the tributaries joining the Mtkvari River and hence the small reservoir of Mtkvari will not have a considerable effect on this species. Ten fish species (Asp, Kura barbel, Spirlin, Transcaucasian barb, Kura bleak, Kura nase, European Chub, Gudgeon, Tench and Kura loach) identified in the project area are listed in Annex 3 of the Bern Convention. The habitats of these species include stony and sandy bottoms, which form the river bottom of the Mtkvari River throughout the project area. Due to the presence of these types of habitats evenly throughout the bypass reach, it is expected that this situation will not be altered significantly during the operation of Mtkvari Project, as long as the critical flow is maintained. As stratification and the consequent

changes in temperature, dissolved oxygen (DO) and nutrient content will not be of concern in the operation phase of the project, no conditions related to thermal stratification will be developed due to the small reservoir size. In relatively small reservoirs, long detention times and solar heating due to large surface areas is not observed. As a consequence, it is highly unlikely that thermal stratification will occur in the Mtkvari Reservoir, which has a surface area of only 0.5 km2 and a maximum depth of approximately 25 m. Therefore, Mtkvari Reservoir is expected to remain isothermal throughout the year and will not pose any adverse impacts on the water quality and the aquatic biota downstream of the powerhouse.

5.2.3. Impacts on Socio-Economic Environment

Demographic Impacts

The impacts on demography will be of concern mainly for construction phase and would be related with the mobility of the population. Considering the construction phase, it is possible to speak of two different kinds of population mobility. Former is the forthcoming workers coming for construction and other staff. Latter is the population mobility due to the construction in the area. It has been planned to employ 250 workers in the construction activities of Mtkvari Project. The required staff will first be chosen among local people. For the rest of the staff, worker dormitory, engineer dormitory and guesthouse will be constructed nearby.

For the workers to be selected among local people, the impact of migration mobility will be limited. In addition, those who will come to work in the construction will be directed to work in the determined parts of the project; and this will also reduce the negative impact of migration mobility. The low rate of workers coming from outside compared to local population will additionally decrease the impact on the socio-cultural structure of the region. It is not expected that there will be migration to or from the area resulting from positive or negative effects of the project. Since the construction activities will be held in a limited area, and there is no loss of settlements, local people are not forced to emigrate. Therefore, the impact of the project on the demography and any migration movement is extremely low, which can be called as insignificant. In addition to this, the migration movement that takes place in the operation phase is different from those in construction phase. Within the operation phase, the number of workers will be just 10% of all workers employed in the construction. Considering the low number of staff at the operation phase, no significant impact on the local population is anticipated.

Economic Impacts

As the workers and staff coming to the region for construction activities would increase, the demand for the goods and such is also expected to increase. Thus an increase in demand might cause an increase of prices for certain goods at the regional level. However, the limited incoming population and the economically integrated character of region to the bigger settlement areas are predicted to reduce the inflationist impact resulting from demand increase and finally would remain at low level. On the other hand, this would bring the opportunity for trade in the area. The goods and services needed during project activities will be purchased from the region. Therefore, trade in the region will increase as a result of construction activities. If all activities are conducted simultaneously, a significant increase in the economy of the region is expected. In addition, transportation infrastructure for the project activities within the region will be improved and this will allow local people to reach easily to the district centres. As a result, the economic integration will increase,

which is a positive impact. As the agricultural land loss due to project activities constitutes a very small percentage of the total agricultural lands, it is expected that the households doing agriculture will not lose their economic gains. In addition, the areas to be used by project facilities are not utilized by animal husbandry activities either. No one living in the region will lose his/her house, job, and social networks because of project activities. On the contrary, project activities will create a source of job opportunities and enable people to participate more actively to the social networks, and finally social integration will increase. In addition to that, the improved transportation network will additionally give increase to the dynamic social structure. Within and across region, the interaction will be increased. With the realization of the project, local people are expected to join and participate to the civil society related with the project.

Impacts on Social Structure

In the respect of construction of Mtkvari HPP, the social network would receive a limited impact. The selection of workers from the local people and the construction of houses in the construction area for workers coming from outside will reduce this impact. The transportation facilities made up for construction will additionally give rise to a more dynamic social structure. Within and across region interaction will be increased. With the start of the project, local people are expected to join and participate to the civil society organizations related with the project. Within the project, the improvement of the transportation infrastructure in the construction and operation phases and the increase in the environmental and social awareness will be effective in the formation of active participation of local people to the social life. It has been analyzed that improved social relations will positively influence the region.

Impacts on Landscape

Anthropological stress is not of concern in the project area and its vicinity. However, the most significant formations that affect the natural landscape characteristics are the Chitakhevi HPP which is at a distance of approximately 20-25 km in the downstream of Mtkvari HPP and limited agricultural and animal husbandry activities that compose the sources of income of the locals. Natural landscape elements are observed at the headworks and powerhouse areas of the Mtkvari Project. Some of the landscape characteristics will be altered temporarily with the construction period, while some of them will be irreversibly changed by the formation of the reservoir and starting of the operation period. There would be visual disturbance during the construction phase of the project due to construction operations. This impact, which would be experienced close to the construction sites, will only be local. However, this impact will be temporary, such that disturbances on local population would be only during the construction phase.

The most significant visual change in the area will be formation of a reservoir, despite the small size of it. This will have a positive visual impact due to the small surface area of the reservoir to be formed. Furthermore, reservoir formation will not change the landscape characteristics of the surrounding area significantly. There are no houses in the immediate downstream of the dam site, whose views would be blocked due to the dam. Therefore, no settlements would be affected due to the blocking of the view by the dam body. The transmission line would be built for connecting the electricity produced to the national system. Also, a switchyard would be constructed for connecting to the transmission lines. The switchyard would be a new structure in the landscape. The visual impacts of the transmission line would not be significant, since the route is selected to be as far from settlements as possible considering the vegetation and land use characteristics. The switchyard will be located at a rather visible site, but would be a part of the power plant structure and the visual impact would be permanent, but local.

The Mtkvari Project is not located within any areas of designated landscape importance, such as landscape protection area, at either a local or regional/national/international scale. The impact on landscape would not be significant since the reservoir is rather small. In fact, water bodies, such as lakes or reservoirs, may be considered to create pleasant scenery.

5.2.4. Impacts of Transmission Line

The electric transmission line (ETL) to be built for transmission of the electricity produced by Mtkvari Project is rather a short (8 km) low voltage line (110 kV), which is factor decreasing the potential adverse impacts of the ETL. The ROW is selected as the shortest possible route both technically, economically and environmentally. Negative environmental impacts of transmission lines are caused by construction, operation and maintenance of transmission lines. Clearing of vegetation from sites for the towers and ROWs and construction of service roads, and substations are the primary sources of construction related impacts. Furthermore, fauna disturbance and loss of land use are also adverse environmental impacts of transmission line.

Runoff and sedimentation from grading for tower pads and alteration of hydrological patterns due to maintenance roads and erosion potential pose risk for the physical environment. Additionally, dust and noise emissions, solid wastes due to construction machinery are also of concern during construction phase of the project. Concerns regarding generation of domestic wastewaters due to workers are also valid for the transmission line construction. Avian hazards due to bird deaths and visual impacts are of concern during operation phase. However, as migrating birds fly high about 100 m from the land surface electrocution of birds will be prevented. Additionally, the route of the transmission line is selected by considering cultural and aesthetic resources and hence there is no area with high landscape/visual value on the ROW or its close vicinity. Another considerable impact of operation phase is the induced effects from electromagnetic fields due to magnetic field created by the current in the lines and cables. Since the voltage of the line is rather low a significant impact is not expected.

5.2.5. Project Impacts Contributing in Cumulative Effect

Based on analysis of the above listed site-specific impacts identified for the proposed Mtkvari HPP project, the key cumulative impacts in priority order are:

- for the construction phase - air emissions and dust, waste (unsuitable materials/excavated waste, wastewater, hazardous waste, domestic waste), noise and vibration, flora, fauna, landscapes, cultural heritage, land acquisition, socio-economic issues;
- for the operations phase – inundation (loss of land and resettlement, flora, fauna, landscape, cultural heritage, if any), change in hydrology and water quality, waste and wastewater, socio-economic issues;

The main environmental impact identified for Paravani HPP are similar to the Mtkvari HPP project, because the construction of dam, creation of water reservoir, construction of tunnel, power house etc. requires similar operations like in case of Mtkvari river HPP. The main difference is scale and the length of access roads to be built for the project purposes. Also the volume of extracted material to be disposed and the scale of construction activities. In terms of the water reservoir, the issues are different, because, with bigger dam and deeper water reservoir the sedimentation in the reservoir for Paravani river will be much more than in case of Mtkvari river.

The HPPs with dams usually cause a change of flow regime from a river to a lake system. This change will lead to sediment reduction and change of water quality in the downstream of the dam during operation phase. The riverbed downstream of the dams will be deteriorated due to sediment reduction. However it should be stated, that the Mtkvari HPP reservoir will be working as balancing and not like the lake, so the sedimentation will be limited and therefore the effect on downstream will be negligible. In any case the sedimentation in the reservoirs will have cumulative impact and will be more important as intensive development of the project area is in place.

5.3. Summary of Impacts of other HPPs Projects

There are a number of HPP projects within the Mtkvari basin already under construction or completely approved, where construction phase will start in the nearest future. Taking into consideration the scale/capacity of these HPPs, the distance between HPPs, and specific characteristics of river Mtkvari basin, only three of them are identified as potentially contributing in cumulative impact, interacting with proposed Mtkvari HPP within study area (Akhaltsikhe and Aspindza rayons). These are: Paravani HPP (85 MW, upstream tributary, r.Paravani), Uraveli HPP (5.0MW, downstream tributary, r.Uraveli) and Chitakhevi HPP (21 MW, downstream r.Mtkvari). To develop a worst-case scenario, it has been assumed that the construction phases of Paravani and Uraveli HPP's projects overlap. The projects given below are included for the assessment of cumulative impacts in the Cumulative impact assessment Study Area

The all mentioned projects are located in Mtkvari river basin within Akhaltsikhe and Aspindza municipalities. The Chitakhevi power plant is already operating, the reconstruction of plant was done, and current status is not known, presumably the reconstruction was finished. Regarding the Paravani and Mtkvari HPP projects, the technical documentation for both power plants are developed, the environmental and construction permits are granted and most probably the implementation of construction activities will be in parallel. The Kakhareti power plant was not considered in scenarios because of it's location and installed capacity of 2 MW.

Other projects we have described and are planned or in construction phase will not have cumulative effect on the proposed project because of the location and other technical and natural conditions. In fact those power stations are small size and even in closer location they will not cumulative adverse impacts in relation with Mtkvari HPP project.

The cumulative effects of the power plants on each other and on surrounding environment are discussed in detail in later sections, however it should be stated, that both planned projects (Mtkvari and Paravani) consider construction of small size dams which will be used for water management. In fact the Mtkvari Hydropower station is considered as run off type power plant, because the reservoir is used only for increase of water surface level and not for the flow regulation.

In addition to those projects in Scenario B, there are some planned projects in the Cumulative impact assessment Study Area. These projects are still in the planning phase, hence, their construction is unlikely to overlap with construction of all other projects in Scenario B as soon they are of small size, located upstream near to Paravani Lake, Akhalkalaki, Ganzani etc. These planned projects are listed below.

- Kakhareti HPP;
- Akhalkalaki HPP;

- Poka HPP
- Arakali HPP;
- Abuli HPP;
- Uraveli HPP

The Akhalkalaki, Poka, Arakali and Abuli power stations will be located on Paravani River; The Uraveli will be located on Uraveli River, the tributary of Mtkvari and Kakhareti HPP will be on Kvabliani river Also tributary of Mtkvari river.

Planned projects have been assessed within Scenario C for the Cumulative impact assessment study. Since the construction phases of these projects will not overlap with those projects considered under Scenario B, it is assumed that there will be no additive impacts under Scenario C beyond those already considered under Scenario B. However, these additional projects will still have individual impacts locally, and may even have additive impacts between themselves, depending upon their final construction schedules.

On the other hand, the projects in this group have been included for the assessment of cumulative impacts for operation phase, because after the construction phase, the projects in this group will be operating together with the projects mentioned under Scenario B.

Similarly as for Mtkvari HPP project, the key impacts contributing in cumulative effects for the coming and planned projects in priority order are as follows:

- for the construction phase - air emissions and dust, hydrology and water quality, waste (unsuitable materials/excavated waste, wastewater, hazardous waste, domestic waste), noise and vibration, flora, fauna, landscapes, cultural heritage, land acquisition, socio-economic issues;
- for the operations phase – inundation (loss of land and resettlement, flora, fauna, landscape, cultural heritage, if any), change in hydrology and water quality, waste and wastewater, socio-economic issues;
-

5.4. Cumulative Impacts at Construction Phase

The cumulative impacts of construction phase are assessed in accordance with the methodology and approach described in Section 5-1, for the impacts that contribute in cumulative effect as listed in Section 5.2.5.

5.4.1. Impact on Physical Environment

Cumulative impacts of the Mtkvari HPP project on physical environment during construction phase, its severity rating, proposed mitigation and monitoring, are presented in Table 6.2.1.1 and Table 6.2.1.2. Detailed assessment is presented below.

Air Quality

The air emissions modelling for Mtkvari HPP indicated that there will be no adverse impact on the receptors in nearest settlements. Also, due to significant distances between the project sites of each HPP, the nearest receptors will not be affected from other projects (Paravani HPP, Uraveli HPP and Chitakhevi HPP). Therefore, the cumulative impact of air emissions resulting from Mtkvari HPP Project (scenario A) is rated as low because the extent of the impact is restricted and the severity is moderate. Considering the geographic distances between the project sites, the air emissions for the

projects under scenarios B and C will not interact, but they may accumulate in an additive manner in the Cumulative impact assessment study area. The level of the impact is rated as medium because the extent of the impact is medium and the severity is moderate.

Water Quality

Surface water and groundwater may be contaminated due to improper handling and discharge of domestic wastewater from camps, wash water of construction machinery and/or other construction related activities. In addition, because of erosion that will result from excavation to be carried out during construction phase, sedimentation may occur in the river water. The quality of river water will also be affected from the turbidity resulting from in-river construction. The pH of river water may change as a result of improper handling and discharge of run-off water to be generated from concrete batching. Oil and grease spills may contaminate surface waters if they are also not handled properly. The cumulative impact of liquid effluents resulting from Mtkvari HPP Project (scenario A) is rated as low because the extent of the impact is restricted and the severity is moderate. Considering the geographic distances between the project sites, the air emissions for the projects under scenarios B and C will not interact, but they may accumulate in an additive manner in the Cumulative impact assessment study area. The level of cumulative impact is rated as medium because the extent of the impact is medium and the severity is moderate.

Solid Waste

Solid waste generation is expected from the personnel in the construction camps as well as excavation wastes resulting from construction activities on Mtkvari HPP project. Improper handling and disposal of solid wastes may cause land, surface water and groundwater contamination. The solid waste generation resulted from Mtkvari HPP project and disposal methods have been assessed in individual EIA. The cumulative impact of solid wastes resulting from Mtkvari HPP Project (scenario A) is rated as low because the extent of the impact area is restricted and the severity is moderate. Considering the geographic distances between the project sites under scenarios B and C, it should be noted that the solid waste resulting from these projects will not have any impact on the same area and will not interact. The level of cumulative impact is rated as medium because the extent of the impact is medium and the severity is moderate.

Hazardous Waste

Improper handling and disposal of hazardous wastes (lubricants, waste batteries, etc) generated during the construction phase of Mtkvari HPP may cause land, surface water and groundwater contamination. In addition, improper storage and handling and accidental release of hazardous substances such as fuels and chemicals may also cause land, surface water and groundwater contamination. Hazardous waste resulted from the project and related disposal methods have been assessed in individual EIA.

The cumulative impact of hazardous wastes and substances generated during construction of Mtkvari HPP (scenario A) is rated as low because the extent of the impact area is restricted and the severity is moderate. Although the hazardous wastes and substances may interact to produce a total impact greater than the sum of the individual impacts, this is unlikely because the geographic distances between the project sites under scenarios B and C means they will not impact on the same area. Therefore the level of cumulative impact is rated as medium because the extent of the impact is medium and the severity is moderate.

Landscape

Dust and machinery will disturb the local landscape during construction, but will be temporary and restricted to the construction site. In addition, the landscape will change permanently due to excavation works within construction. These activities will be carried out for project facilities, quarries, transmission lines and service roads to be constructed within Mtkvari HPP project.

The cumulative impact under scenario A is rated as low because the extent of the impact is restricted and the severity is mild. As the number of projects increases, there will be more construction activities therefore more change in the landscape. Considering that construction sites will not overlap, the impact will accumulate in the CUMULATIVE IMPACT ASSESSMENT study area in an additive manner. The extent of the impact become medium for scenario B and wide for scenario C, so the cumulative impact is rated as low for scenario B and medium for scenario C.

Archaeology and Cultural Heritage

Studies carried out within EIA processes of Mtkvari HPP project have indicated that there will be no adverse impact on archaeological and historic sites. However, chance finding procedure will be developed within the EMP to address archaeological issues arisen during construction. As a result, the cumulative impact of Mtkvari HPP (scenario A) is rated as low since there is no direct impact on monuments and the extent of the impact is restricted to the Mtkvari HPP site. Considering the long distances between the projects, no adverse impact on cultural heritage is expected. As a result, the cumulative impact level for the scenarios B and C is rated as low, similarly to scenario A.

5.4.2. Impact on Biological Environment

Cumulative impacts of the Mtkvari HPP project on biological environment during construction phase, its severity rating, proposed mitigation and monitoring, are presented in Table 6-1. Detailed assessment is presented below.

Terrestrial vegetation communities and flora

No threatened, protected or endemic plant species are believed to be present within the impact area of Mtkvari HPP project (scenario A). The cumulative impact of construction activities resulting from Mtkvari HPP project on the terrestrial vegetation communities and flora is rated as low because the extent of the impact is restricted and the severity is moderate. For the scenarios B and C, there will be more land to be excavated because of the increased number of projects and wider geographic area. Thus, the extent of the deterioration of the terrestrial vegetation communities and flora will increase. Considering the geographic distances between the project sites under scenarios B and C, it should be noted that the impact areas will not overlap. Therefore, the impacts will accumulate in an additive manner in the Cumulative impact assessment Study Area. The level of cumulative impact is rated as medium because the extent of the impact is medium and the severity is moderate.

Terrestrial Fauna

Mammals, birds, reptiles and amphibians whose habitats are affected from the projects will migrate to other locations. According to the fauna inventories prepared for Mtkvari HPP project, no threatened, protected or endemic species of terrestrial animal are believed to be present within the impact areas. Apart from some possible minor disturbance the wildlife will not be affected because the construction of transmission tunnel will be carried out underground. The cumulative impact of construction activities resulting from Mtkvari HPP project (scenario A) on the terrestrial fauna is

rated as low because the extent of the impact is restricted and the severity is moderate. For the scenarios B and C, there will be more terrestrial habitats to be affected because the increased number of projects covers a wider geographic area. Considering the geographic distances between the project sites under scenarios B and C, it should be noted that the impact areas will not overlap. Hence, the impacts will not interact and they will accumulate in an additive manner in the study area. The level of cumulative impact is rated as medium because the extent of the impact is medium and the severity is moderate.

Aquatic Life

The aquatic life will be affected negatively during the construction of Matkvari HPP due to: discharge of wastewater, diversion of river water from the river bed for the construction of the dam, increase in sediment amount and turbidity in river water. Although these impacts are significant, it should be noted that they are temporary impacts and can be mitigated considerably with the measures.

The cumulative impact of construction activities resulting from Mtkvari HPP project (scenario 1) on the aquatic life is rated as medium because it is a severe impact and the extent is restricted. Impacts on the aquatic life resulting from the construction phase within Scenario B and C will be the same type of impacts resulting from Scenario A. However, the extent of the impact will increase because the increased number of projects covers a wider geographic area. Considering the geographic distances between the project sites under scenarios B and C, it should be noted that the projects will not affect the same area in the rivers. The level of cumulative impact is rated as high because it is a severe impact and the extent is medium.

5.4.3. Impact on Socioeconomic Environment

Cumulative impacts of the Mtkvari HPP project on socio-economic environment during construction phase, its severity rating, proposed mitigation and monitoring, are presented in Table 6.2.1.1 and Table 6.2.1.2. Detailed assessment is presented below.

Loss of Land

With the filling of the reservoir, the area upstream of the dam will be converted to a water body. The area of physical land take by the Mtkvari HPP Project includes the reservoir area and the footprint of the construction sites and facilities (dam site, camp facilities, access roads etc). The reservoir covers an area of 0.5 km2. Approximately 2.150 m of the roads along the river will be raised about 10 m. The area to be inundated is covered with mostly steppe vegetation. No loss of forestry areas is of concern. Loss of agricultural land is negligible. Additionally, no loss of land will be an issue along the headrace tunnel as the structure will be constructed underground. No loss of dwelling and therefore no resettlement required. The cumulative impact level resulting from land acquisition for Mtkvari HPP project (scenario 1) is rated as low, because only few parcels are involved so the extent of the impact is restricted and the severity is moderate. There is no information on the loss of land within other three projects. The land acquisition, and expropriation procedures within scenarios B and C may also be carried out. The impacts of loss of land will accumulate in an additive manner in the Cumulative impact assessment Study Area. However The cumulative impact level is rated as medium because the extent of the impact is medium for Scenario B, wide for Scenario C and the severity is moderate.

Noise and Vibration

The noise to be generated from Mtkvari HPP project has been assessed within individual EIA. The results indicated that there will be no adverse impact on the nearest receptor. The cumulative impact level (for scenario A) is rated as medium since it is a severe impact and the extent of the impact is restricted. For scenarios B and C, there will be more personnel and community to be affected, because the increased number of projects covers a wider geographic area. Considering the geographic distances between the project sites under scenarios B and C, it should be noted that the impact areas will not overlap. Therefore, the impacts will not interact and they will accumulate in an additive manner in the study area. The cumulative impact level is rated as high for both Scenario B and C since it is a severe impact and the extent of the impact is medium.

Employment Opportunities

Apart of negative impacts resulting from the construction of HPPs, there are also positive impacts such as employment opportunities for local people. It has been planned to employ 250 workers in the construction activities of Mtkvari Project (scenario A). The required staff will first be chosen among local people. In addition to positive impacts on livelihoods and standards of living of people, this increase in the employment rates will contribute indirectly to development of the local economy. For the scenarios B and C there will be more people employed in the construction phase when the number of projects increases. Within Scenario B and C, as the employment rates increase, the positive impact on livelihoods and standards of living of people will also increase. Thus, improvement in the local economy and development will be valid in a wider geographic area.

Improvement of Infrastructure

Mtkvari HPP will also contribute to the local economy and development due to improvement of existing infrastructure. Furthermore new infrastructure will be constructed such as transmission lines and roads. As the increased number of projects covers a wider geographic area within scenarios B and C, more improvement is expected for the existing infrastructure and construction of new ones. Therefore there will be a greater contribution to local economy and development.

5.5. Cumulative Impacts of Operation Phase

The cumulative impacts of operation phase are assessed in accordance with the methodology and approach described in Section 5-1, for the impacts that contribute in cumulative effect as listed in Section 5.2.5.

5.5.1. Impact on Physical Environment

Cumulative impacts of the Mtkvari HPP and other projects on physical environment during operation phase, its severity rating, proposed mitigation and monitoring, are presented in Table 6.2. Detailed assessment is presented below.

Inundation

The most significant impact of the operation phase of HPP projects with dam on the physical environment is inundation resulting from damming the river. The area of physical land take by the Project includes the reservoir area and the footprint of the construction facilities (dam site, powerhouse site, camp facilities and access roads). The reservoir covers an area of only 0.5 km2, so the overall land take including all the project facilities will be less than 1 km2. Only about 0.1 km2 of

this area is arable land and the rest is mainly composed of shrubby forms along the river and barren land. The Mtkvari Dam is not intended for storage, but for the diversion of the water to the powerhouse through a headrace tunnel. As a result, because inundation will occur in a limited area, only a few parcels will be affected within this project. The level of cumulative impact is rated as low because the extent of the impact for scenario A is restricted and the severity is moderate. For the scenarios B and C with construction of other HPPs in the area, the level of cumulative impact is rated as medium because the extent of the impact is medium and the severity is moderate.

Hydrology and Water Quality

Apart of change in flow regime resulting from the HPPs with dam, the hydrology of the river will also change due to the diversion of the river water within the run-of-river HPPs. There will be a decrease in water level between the weir and the powerhouse. This impact may be observed in Mtkvari HPP project (scenario A), because it is a run-of-river HPP. The level of cumulative impact is rated as medium because it is a severe impact but the extent is restricted. Within scenarios B and C, because other run-of-river HPPs and dams will be operating in Mtkvari basin, the hydrology of these rivers will change locally. While the quantity of the river water will decrease along run-of-river HPPs, the quality of water will change especially due to sedimentation observed in reservoirs. The overall level of cumulative impact is rated as high because the extent of the change in hydrology is medium and the impacts on quality and quantity of the river water may be severe, because may cause some considerable effects on aquatic life in the river between the weir and the powerhouse.

Sediments and Water Quality

Impoundment of the river leads to sediment reduction and change of water quality downstream of the dam. Also, reduction in sediment moving downstream from the dam leads to degradation of the river channel below the facility. This phenomenon also leads to potential impacts on the biological environment such as the degradation of aquatic habitats. Owing to small reservoir volumes and low retention times for the Mtkvari HPP project (scenario 1), no significant change in water quality is expected. Hence, the level of cumulative impact is rated as medium because it is a severe impact but the extent of the impact is restricted. As the number of projects with dams increase in a Mtkvari basin (scenarios B and C), the problem of sediment reduction and change of water quality in the downstream of the dam will become significant. The level of cumulative impact is rated as medium because the extent of the impact is medium and the severity is moderate.

Wastewater

Land, surface water and groundwater may be contaminated due to improper handling and discharge of domestic wastewater. Necessary infrastructure will be present in the Mtkvari HPP in accordance with the related legislation. The wastewater generation resulting from Mtkvari HPP project (scenario A) and treatment methods have been assessed in individual EIA. The cumulative impact of domestic wastewater is rated as low because the extent of the impact is restricted and the severity is mild.

As the number of projects increase, there will be more personnel and the wastewater generation will be higher in quantity. In addition the extent of the impact will also increase because the increased number of projects covers a wider geographic area. Considering the geographic distances between the project sites under scenarios B and C, it should be noted that the domestic wastewater resulting from these projects will not have an impact on the same area and will be handled separately for each project. They will not interact, but will accumulate in an additive manner in the study area. The level

of cumulative impact is rated as low because the extent of the impact is medium and the severity is mild.

Solid Waste

Land, surface water and groundwater may be contaminated due to improper handling and disposal of solid wastes. The solid wastes resulting from Mtkvari HPP project (scenario A) and disposal methods have been assessed in individual EIA. The cumulative impact of domestic solid waste is rated as low because the extent of the impact is restricted and the severity is mild. As the increased number of projects covers a wider geographic area, the extent of the impact will also increase. Thus, land, surface water and groundwater contamination may be seen in a wider geographic area if the wastewaters are not handled and discharged properly. Considering the geographic distances between the project sites under scenarios B and C, it should be noted that the domestic solid wastes resulting from these projects will not have an impact on the same area and will be handled separately for each project. Therefore they will not interact, but they will accumulate in an additive manner in the study area. The level of cumulative impact is rated as low because the extent of the impact is medium and the severity is mild.

Greenhouse Gas Emissions

If the inundated land is heavily wooded and not cleared sufficiently prior to flooding, decomposition will form carbon dioxide and deplete oxygen levels in the water and subsequent anaerobic decomposition will form methane. As a result, significant amounts of these greenhouse gases could be emitted from the reservoirs. The reservoir of the Mtkvari HPP (scenario A) is relatively small (only 0.5 sq.km) and inundated lands are not heavily wooded - so greenhouse gas emissions are predicted to be insignificant. The level of cumulative impact is rated as low because the extent of the impact is restricted and the severity is mild. As the number of HPPs increase, there will be more reservoirs and extent of the greenhouse gas emissions will also increase. The level of cumulative impact for scenarios B and C is rated as low because the extent of the impact is medium and the severity is mild.

Evaporation

Since the reservoir surface of Mtkvari HPP is relatively small, water loss from evaporation will be limited. Previous experience indicated that the HPP plants with a small reservoir that is operated in run-of-river mode do not pose risk for thermal stratification of the reservoir. Therefore, Mtkvari Reservoir is expected to remain isothermal throughout the year and the water released to downstream of the powerhouse will not cause any significant impact on river water quality. The level of cumulative impact of evaporation from Mtkvari HPP (scenario A) is rated as low because the extent of the impact is restricted and the severity is mild. The level of cumulative impact for scenarios B and C is rated as low because the extent of the impact is medium due to small scale of the reservoirs and the severity is mild.

5.5.2. Impact on Biological Environment

Cumulative impacts of the Mtkvari HPP and other projects on biological environment during operation phase, its severity rating, proposed mitigation and monitoring, are presented in Table 6.2.1.2. Detailed assessment is presented below.

Terrestrial Vegetation Communities and Flora

There will be loss of terrestrial vegetation communities and flora due to inundation. However, the total area that will be inundated is very small. According to the fauna inventories prepared for Mtkvari HPP Project, no threatened, protected or endemic species are believed to be present within the impact areas. The cumulative impact of Mtkvari HPP project (scenario A) during operation phase on the terrestrial vegetation is rated as low because the extent of the impact is restricted and the severity is moderate. For the scenarios B and C more terrestrial vegetation will be affected due to inundation. Although there is no flora inventories prepared for these projects, no threatened, protected or endemic species are believed to be present within the impact areas. The level of cumulative impact of these projects on the terrestrial fauna is rated as medium because the extent of the impact is medium and the severity is moderate.

Terrestrial Fauna

During the operation phase of the HEPPs with dams, the terrestrial fauna will be affected due to (i) releases of water especially during test operations; (ii) inundation of the habitats. Mammals, birds, reptiles and amphibians whose habitats are inundated will move to other locations. Some smaller animals will not be able to cross the river when it becomes a series of lakes, and hence it will represent a local barrier to free movement. According to the fauna inventories prepared for Mtkvari HPP project, no threatened, protected or endemic terrestrial animal species are believed to be present within the impact areas. The cumulative impact of the Mtkvari HPP project (scenario A) during the operation phase on the terrestrial fauna is rated as low because the extent of the impact is restricted and the severity is moderate.
On the other hand, damming the river may also have a positive impact on terrestrial fauna. Formation of a lake-like environment will provide habitat for water birds and feeding area for other terrestrial animals. For the scenarios B and C more mammals, birds, reptiles and amphibians will be affected and be forced to move due to inundation. No threatened, protected or endemic terrestrial animal species are believed to be present within the impact areas. The level of cumulative impact of these projects on the terrestrial fauna is rated as medium because the extent of the impact is medium and the severity is moderate.

Aquatic Life

During the operation phase of the Mtkvari HPP, the most significant potential cumulative impacts will be observed in aquatic environment. None of the fish species identified in the project area is endemic for Georgia. There are ten fish species of international concern according to Annex 3 of Bern Convention that will be impacted by Mtkvari HPP Project. Under Bern Convention, the populations of these species need to be maintained.

As described in Section V.2.1, these species' spawning and maintenance habitats in the section of Mtkvari River to be bypassed needs to be maintained. To maintain these habitats, water will be released from Mtkvari Dam so as to provide a minimum flow in the bypass reach. The minimum flow needed in the bypass reach, and the minimum water release from the dam, are calculated and provided. Thus, by the provision of the minimum flow the necessary habitats for these species would be maintained in the by-pass reach in addition to the available habitats in the tributaries in this

section of the river. The level of this cumulative impact (under scenario A) is rated as low because the extent of the impact is restricted and the severity is mild.

For the scenarios B and C no significant change in water quality is expected due to the small reservoir volumes and low retention times. Therefore, the level of this cumulative impact on aquatic life is rated as low because the extent of the impact is restricted and the severity is moderate. The impacts expected from the projects within scenarios B and C are the same type of impacts discussed in Scenario A. Since there will be more HPPs, the extent of the impact will become wider. The overall level of cumulative impact on endangered fish species is rated as low because the geographic extent is medium and the severity of the impact is mild.

5.5.3. Impact on Socio-Economic Environment

Cumulative impacts of the Mtkvari HPP and other projects on socio-economic environment during operation phase, its severity rating, proposed mitigation and monitoring, are presented in Table 6.2.1.2. Detailed assessment is presented below.

Inundation

There will be minor loss of land (private agricultural lands) due to inundation. Loss of private property such as agricultural lands may lead to negative impacts on livelihoods and standards of living of people. Within Mtkvari HPP project, there will be some loss of private property due to construction. Expropriation procedures will be carried out for land acquisition in accordance with Georgian legislation. The cumulative impact level resulting from land acquisition is rated as low because the extent of the impact is restricted and the severity is moderate. Within scenarios B and C, there will be more private property to be inundated because the increased number of projects covers a wider geographic area. The impacts of loss of land will accumulate in an additive manner in the Cumulative impact assessment Study Area. However there is no information on the loss of land within these projects. The land acquisition, and expropriation procedures within Scenario B and C will also be carried out. The cumulative impact level is rated as medium because the extent of the impact is medium for Scenario B, wide for Scenario C and the severity is moderate.

Displacement of People

People will not be displaced due to project-related land acquisition or inundation within the Mtkvari HPP project. The cumulative impact level is rated as low because the number of people involved is low and the extent of the impact is restricted, and the severity is moderate. Within Scenario B and C, there will be more people to be affected from the construction of the HPPs because the increased number of projects covers a wider geographic area. Owing to the distances between the project sites, people to be affected from the construction of one project, will not be affected from another project. Therefore, the impacts of displacement will accumulate in an additive manner in the study area. The land acquisition, expropriation and resettlement procedures will also be carried out in accordance with the Georgian legislation. The cumulative impact level is rated as medium because the extent of the impact is medium for scenario B, wide for scenario C and the severity is moderate.

Health Issues

Damming the river and creating a lake-like environment will cause an increase in the potential of water- based insect-born diseases such as malaria. These diseases have a direct adverse impact on

human health. However, the reservoir of Mtkvari HPP (scenario A) is very small and the retention time is low. Therefore, the conditions supporting the proliferation of insects will not occur in these projects. The level of cumulative impact of water- based insect-born diseases is rated as low because the extent of the impact is restricted and the severity is moderate. For the scenarios B and C there will be more projects operating concurrently. Therefore the potential for water- based insect-born diseases is higher. In addition, because the increased number of projects covers a wider geographic area, the extent will also increase. Therefore, the level of cumulative impact of water- based insect-born diseases is rated as medium because the extent of the impact is medium and the severity is moderate.

Employment Opportunities

Apart of negative impacts resulting from the operation of HPP projects, there are also positive impacts such as employment opportunities for local people. Within Mtkvari HPP project it is foreseen that only about 50 people will be employed for the operation phase. There will be more people employed in the operation phase when the number of projects increases. Within Scenario B and C, as the employment rates increase, the positive impact on livelihoods and standards of living of people will also increase. Thus, improvement in the local economy and development will be valid in a wider geographic area.

Energy Production

Another positive impact of Mtkvari HPP project on socioeconomic environment is contribution to the local and national electricity interconnection system. In this respect, it is clear that Mtkvari HPP project will make a significant contribution to the local electricity production. There will be HPPs operating concurrently in the study area within Scenario. These amounts of energy will make a significant contribution to the local and national electricity interconnection system.

6. Management Program

The present Cumulative Impact Assessment studied the cumulative impacts on physical, biological and socio-economic environment that could be anticipated from implementation of the proposed Mtkvari HPP project in conjunction with other projects in River Mtkvari basin within Akhaltsikhe and Aspindza rayons of Georgia and grouped these impacts into construction and operation phases. The anticipated cumulative impacts and proposed mitigation measures of the Project are explained in Chapter 5 and are summarized in Table 6.2.1.1 and Table 6.2.1.2.

6.1. Environmental Management

Based on the identified cumulative environmental impacts and respective mitigation measures proposed in Section 5, an Environmental Management and Monitoring Program (EMMP) for the Project has been prepared. The EMMP will help the Client (JSC Caucasus Energy and Infrastructure) to address the foreseen cumulative impacts of the Project in line with the impacts described in Mtkvari HPP ESIA prepared earlier, enhance the Project's overall benefits and introduce standards of good environmental practice. The EMMP will be integrated with Environmental and Social Action Plan prepared at ESIA stage and included in the contract documents to ensure the contractors comply with the EMMP. The EMMP defines the:

(i) Responsibilities of the Client, Contractor and Supervision Consultant, in accordance with the Project phases (construction and operation);
(ii) Framework of the mitigation measures by providing the technical details of each Project impact and proposing implementation arrangements;
(iii) Monitoring mechanism, with monitoring parameters ensuring that all proposed mitigation measures are completely and effectively implemented and that they protect the environment as intended.

The impacts with potential of cumulative effect and respective mitigation measures are presented in Table 6.1. To increase contractors' environmental awareness and ensure that they consider carefully and plan the implementation of each mitigation measure that is their responsibility, contractors will be required to prepare their own construction-phase environmental management plan (EMP) describing in detail the action they will take to provide each measure. This may use the EMMP below as a template, but should describe implementation of each measure in more detail. The contractor's EMP should be further supported by site-specific method statements and management plans that have to be prepared and submitted by the Contractor to the Client and its Construction Supervisor for approval, prior to initiation of any construction works. These documents should comprise (but not be limited to) the following:

- Pre-construction (pre-condition) Survey Plan;
- Health and Safety Management Plan;
- Community Liaison and Community Safety Plan;
- Utilities Infrastructure Management Plan;
- Traffic Management Plan;
- Pollution Prevention and Abatement Plan;
- Waste Management Plan;
- Emergency Response Plan;
- Cultural Heritage Management Plan (with Chance Finds Procedure);

- Reinstatement Management Plan;
- Method statements per each category of work (tailored to site-specific conditions and containing environmental component with mitigation measures);
- Other, as required.

The contract documents should contain a listing of all required mitigation measures and a time frame for the compliance monitoring of these activities. The EMMP (of both Mtkvari HPP ESIA and the present Cumulative Impact Assessment) should be included in tender and contract documents so that the contractor is fully aware at bidding stage of what is expected of him in terms of environmental stewardship and can build the necessary costs into his tender pricing. The monitoring will comprise surveillance to check whether the contractor is meeting the provisions of the contract during construction and the executing agency during the operation of the Project.
Once the project is operating, responsibility for environmental management will pass to Operating Company as the operator of the HPP and they should produce their own operational-phase EMP describing how they will provide the mitigation allocated to them in Table 6.1. Although major negative impacts are not expected during operation of the HPP, it would be beneficial for a small proportion of the project budget to be allocated to institutional strengthening, to allow Client to employ an environmental specialist to set up and implement their mitigation measures and other environmental procedures in the operational phase, and to provide the environmental specialist with training and support.

6.2. Environmental Monitoring

Environmental monitoring is a very important component of environmental management to safeguard the protection of environment at both construction and operation stages of the Project. In response to environmental impacts identified during this Cumulative Impact Assessment, an Environmental Monitoring Program Table 6.2.1.1 and Table 6.2.1.2 has been developed to complement the Monitoring Plan prepared at Mtkvari HPP ESIA stage.

Environmental monitoring is conducted throughout the project development and implementation, with the aim of:

(i) Ensuring that action necessary to provide the required mitigation is taken;

(ii) Ensuring that the mitigation protects the environment as intended; and

(iii) Determining the actual environmental and social impacts that occur once mitigation has been applied, to establish whether there are any residual or unexpected impacts that require further action.

Two last columns of Table 6.2.1.1 show the proposed Environmental Monitoring Program for Project implementation. This indicates the type/method/frequency of monitoring that should be conducted to ensure that the mitigation is provided. The table also indicates who should be responsible for the monitoring.

Construction monitoring normally involves three main elements:

(i) Monitoring the work of the construction contractors (CC) to ensure that they provide the mitigation measures required by their contracts and do not cause additional environmental damage in conducting construction activities;
(ii) Liaising with other parties involved in the construction process (including the Design Consultant and Client) to ensure that they also fulfill their environmental and social responsibilities and provide the mitigation that is their responsibility;
(iii) Conducting additional monitoring activities to ensure that all parties (client, consultants and contractors) comply with any additional requirements imposed by the Environmental Permit or other documents and licenses issued by the national environmental regulator (MoE in this case).

Most of the monitoring conducted by the Client or Supervision Consultant (SC) will involve periodically checking the activities conducted by the contractor, during regular site inspections, which the SC will conduct on a daily, weekly and monthly basis. These checks will be mainly visual, but some will require review of documents, records, reports and drawings, as specified in Table 6.1. Any deficiencies will be reported to SC management, who, where necessary, will instruct the Contractor to take remedial action. Regular written accounts will be given to the Client as part of the normal procedure through which the SC reports on progress of the construction process.

The Environmental Management and Monitoring Program also places responsibility for conducting specific elements of environmental monitoring on the Contractor, to raise their awareness of the impacts of their activities through implementing internal Environmental Supervision as part of their own internal Environmental Management System. The SC will ensure that the internal Environmental Supervision is carried out by the contractor, and will review the results.

6.3. Environmental Mitigation and Monitoring Matrix (action plan).

Table 6.3.1.1 Mitigation Measures for Cumulative Impacts During Construction

Impact Reference	Impact Source According to Scenarios	Impact Type	Severity	Proposed Mitigation	Monitoring action and timing	Implementation/ supervision/ regulation
1. Air Quality	Scenario A	1. Dust generation 2. Gaseous pollutant generation	Restricted + Moderate	1. Work sites shall be watered under warm, dry and windy weather conditions. Material shall be loaded and unloaded properly; 30 km/hour speed limit shall be set on non-paved roads. Top of the trucks will be covered while carrying the excavation materials. Dust suppression system will be installed in the crushers. 2. Exhaust emissions of the heavy machinery shall regularly be measured, controlled and recorded by authorizedinstitutions. Low level residual impact	Review the emission reduction and air pollution prevention measures in Contractor's Pollution Prevention and Abatement Management Plan. Conduct observations and measurements on site. Check Contractor's schedule and records of vehicle and equipment servicing and repair. Observe implementation of dust suppression program. Observe concrete mixing operations.	Client , or Supervision Consultant on behalf of Client, MoEPNR local branch
	Scenario B		Medium + Moderate			
	Scenario C		Medium + Moderate			
2. Water Quality	Scenario A	Wastewater generation	Restricted + Moderate	Wastewaters will be collected in septic tank after treatment in a package treatment plant installed at the project sites. No residual impact	Review Pollution Prevention and Abatement Plan, submitted by Contractor. Conduct observations of drainage system on site. Observe site drainage during rainfall. Conduct observations of vehicle maintenance/repair and refuelling on site Observe waste and hazardous waste collection,	Client , or Supervision Consultant on behalf of Client, MoEPNR local branch
	Scenario B		Medium + Moderate			

	Scenario C		Medium + Moderate		transportation and disposal. Check oil and fuel storage bounded areas, integrity and level gauges of the fuel tanks.	
3. Solid Wastes	Scenario A	1. Domestic solid wastes 2. Excavation and demolition solid wastes	Restricted + Moderate	1. Domestic solid wastes will be collected in the closed containers at the project site and handled by related municipalities at their waste disposal sites. Solid wastes will be transported to the waste disposal sites by trucks with necessary license and transportation costs will be paid by the contractor. 2. Some portion of the excavated materials will be stored in the construction site to be used as backfill and aggregate material for concrete. Recyclable wastes will be collected separately and recycled. Remaining part will be transported by trucks with necessary license and disposed to the proper disposal sites. No residual impact	Review Waste Management Plan, submitted by Contractor. Observe waste and hazardous waste collection, transportation and disposal.	Client , or Supervision Consultant on behalf of Client, MoEPNR local branch
	Scenario B		Medium + Moderate			
	Scenario C		Medium + Moderate			
4. Hazardous Wastes and Substances	Scenario A	Hazardous waste generation Release of hazardous substances	Restricted + Moderate	Hazardous wastes will be handled in compliance with Georgian legislation (i.e., disposal of these wastes to a proper landfill or collection by a company certified by the MoENR for collection and disposal) No residual impact	Review Waste Management Plan, submitted by Contractor. Observe waste and hazardous waste collection, transportation and disposal.	Client , or Supervision Consultant on behalf of Client, MoEPNR local branch
	Scenario B		Medium + Moderate			
	Scenario C		Medium + Moderate			
5. Landscape	Scenario A	Temporary increase in dust and machinery	Restricted + Mild	No mitigation measure	Review Reinstatement Management Plan submitted by Contractor. Observe implementation of plan,	Client , or Supervision Consultant on behalf of Client, MoEPNR local branch
	Scenario B		Medium + Mild			

	Scenario C	disturbing local people.	Wide + Mild	Low level residual impact	landscaping.	
6. Historic, Cultural or Aesthetic Features	Scenario A	Disruption of historic, cultural or aesthetic features	Restricted + Severe	Construction activities and blasting works will not be carried out near archeological sites.	Review Chance Finding Procedure submitted by Contractor Observe implementation of procedure, when chance finding occurs.	Client , or Supervision Consultant on behalf of Client, Minstry of Culture
	Scenario B		Restricted + Severe			
	Scenario C		Restricted + Severe	Low level potential risk		
7. Transportation	Scenario A	Increased traffic load	Restricted + Mild	Drivers of the vehicles carrying materials to construction site should obey speed limit of 30 km/hr. Warning signals should be installed around the sites where heavy construction facilities are carried out. No residual impact	Review Transportation Management Plan submitted by Contractor	Client , or Supervision Consultant on behalf of Client, Traffic Police
	Scenario B		Medium + Mild			
	Scenario C		Medium + Mild			
Mitigation Measures for Cumulative Impacts on Biological Environment During Construction						
1. Terrestrial Vegetation Communities and Flora	Scenario A	Deterioration of vegetation communities and flora	Restricted + Moderate	Vegetative top soil will be stripped prior to excavation works and will be stored in the construction site separately to be used in landscaping. A forestation will be carried out in order to compensate the loss of forest areas. Low level residual impact, nature will compensate the impacts and losses in time	Review Reinstatement Management Plan submitted by Contractor Observe top soil stripping, implementation of tree planting and grassing.	Client , or Supervision Consultant on behalf of Client, MoEPNR local branch
	Scenario B		Medium + Moderate			
	Scenario C		Medium + Moderate			
2. Terrestrial Fauna	Scenario A	1. Damage to terrestrial fauna due to poaching 2. Migration of the animals due to	Restricted + Moderate	1. Construction personnel will be prohibited from hunting of the terrestrial fauna. 2. The provisions of Bern Convention and CITES (both conventions are adopted by Georgia) will be followed. The fauna species migrated from their habitats		Client , or Supervision Consultant on behalf of Client, MoEPNR local branch
	Scenario B		Medium + Moderate			

	Scenario C	degradation of terrestrial habitats	Medium + Moderate	will come back when the construction phase is over if their habitats are not degraded.		
3. Aquatic Life	Scenario A	Stress on aquatic life from: 1 Wastewater discharge 2. Diversion of river water 3. Sediment increase and turbidity	Restricted + Severe	1. Since the wastewaters will not be disposed to the rivers, there will be no impact on aquatic life resulting from the wastewater. 2. The impacts resulting from the diversion of the river will be minimized by ensuring sanitary flow. Low level of residual impact on aquatic life is expected.	Monitor hydrological regime of the Mtkvari river	Client , or Supervision Consultant on behalf of Client, MoEPNR local branch
	Scenario B		Medium + Severe			
	Scenario C		Medium + Severe			

Table 6.3.1.2 Mitigation Measures for Cumulative Impacts During Operation Phase

Impact Reference	Sub-section*	Impact Type	Severity	Proposed Mitigation	Monitoring action and timing	Implementation/ supervision/ regulation
Mitigation Measures for Cumulative Impacts on Physical Environment During Operation						
1. Water Quality	Scenario A	Domestic wastewater generation	Restricted + Mild	Domestic wastewater will be collected in septic tanks in accordance with the relevant national standard, and then will be transferred to the nearest municipality treatment plant. No residual impact	Review Pollution prevention Plan, submitted by Operating Company. Monthly or weekly inspections for waste and hazardous waste collection, transportation and disposal.	HPP operator Monitoring Consultant on behalf of HPP MoEPNR local branch
	Scenario B		Medium + Mild			
	Scenario C		Wide + Mild			
2. Solid Wastes	Scenario A	Domestic solid wastes generation	Restricted + Mild	Domestic solid wastes will be collected in the closed containers at the project sites and handled by related municipalities at their waste disposal sites. Domestic solid wastes will be transported to the waste disposal sites by trucks with necessary license. No residual impact	Review Waste Management Plan, submitted by Operating Company. Monthly or weekly inspections for waste and hazardous waste collection, transportation and disposal.	HPP operator Monitoring Consultant on behalf of HPP MoEPNR local branch
	Scenario B		Medium + Mild			
	Scenario C		Wide + Mild			
3. Inundation	Scenario A	Loss of land	Restricted + Moderate	No mitigation measure for loss of lands.. Loss of land – as residual impact	Not applicable	
	Scenario B		Medium + Moderate			
	Scenario C		Medium + Moderate			

4. Greenhouse Gas Emissions	Scenario A	Greenhouse gas emissions from the reservoirs	Restricted + Mild	The vegetation in the area to be inundated will be cleared prior to flooding. Low level greenhouse gas emissions	Check pre-construction survey and site clearing plans. Observe site clearing activities during construction.	HPP operator MoEPNR local branch
	Scenario B		Medium + Mild			
	Scenario C		Medium + Mild			
5. Hydrology	Scenario A	1. Change of flow regime	Restricted + Severe	1. Change of flow regime is a natural consequence of HEPPs with dam projects.. Change of flow regime as a residual impact	Monitor the amount of water to be released	HPP operator, Joint Monitoring program , with MoEPNR
	Scenario B		Medium + Severe			
	Scenario C		Wide + Severe			
	Scenario A	2. Decrease in water level	Restricted + Severe	2. The flow in the river will be monitored and if needed, the amount of water to be released will be adjusted in accordance with the project optimization. Decrease in water level as residual impact	Monitor the amount of water to be released	HPP operator, Joint Monitoring program , With MoEPNR
	Scenario B		Medium + Severe			
	Scenario C		Wide + Severe			
6. Sediment	Scenario A	1.Sedimentation of the reservoir 2.Change of water quality 3.Scouring of the riverbed	Restricted + Severe	1. Removal of sediments (flushing, sluicing) 2. Because of small reservoirs and low retention times for projects, water quality will not change. No mitigation measure is available. 3. Sediment will be released. Amount of sediment will be minimized in the reservoir	Monitor the sedimentation process. Monitor water quality downstream during the flushing	HPP operators. Water quality monitored Jointly by Operators and MoEPNR
	Scenario B		Medium + Severe			
	Scenario C		Medium + Severe			
7. Evaporation	Scenario A	Loss of water	Restricted + Mild	Although there is no mitigation measure for loss of water through evaporation, it should be noted that evaporation will not occur in significant amounts for projects because the surface areas of the reservoirs are relatively small. Relatively small amount of water loss		
	Scenario B		Medium + Mild			
	Scenario C		Medium + Mild			

8. Irrigation	Scenario A	Loss of water	N.A.	No mitigation measure is available	Loss of water	
	Scenario B		Restricted + Moderate			
	Scenario C		Restricted + Moderate			
Mitigation Measures for Cumulative Impacts on Biological Environment During Operation						
1. Terrestrial Vegetation Communities and Flora	Scenario A	Loss of terrestrial vegetation and flora due to inundation	Restricted + Moderate	There will be limited loss of forest area due to inundation. However, forestation and landscape works will be carried out in order to compensate the losses. In addition to mitigation measures, the nature will compensate the impacts and losses in time	Non periodic monitoring to indicate the effectiveness of forestration	Relevant structures of MoEPNR
	Scenario B		Medium + Moderate			
	Scenario C		Wide + Moderate			
2. Terrestrial Fauna	Scenario A	1. Flooding of terrestrial fauna	Restricted + Moderate	1. Warning of animals prior to release of water. In addition, instead of sudden release, water will be released gradually, so that animals will have enough time to leave the site. Despite of warning, animals will still be affected from the flooding	Not required	
	Scenario B		Medium + Moderate			
	Scenario C		Wide + Moderate			
	Scenario A	2. Migration of terrestrial fauna	Restricted + Moderate	2. There is no mitigation measure for the migration of terrestrial fauna. However they will find new habitats where they migrate. Migration of terrestrial fauna	Not required	
	Scenario B		Medium + Moderate			
	Scenario C		Wide + Moderate			
3. Aquatic Life	Scenario A	1. Adaptation and migration problem for endangered and endemic fish	Restricted + Mild	Bio-monitoring can be suggested periodically for continuing the gene flow constantly among the populations which are used the tributaries of streams for breeding, and take precaution for against the problems afterwards. . There still will be a low level risk	Optional	Specialised institutions and research structures
	Scenario B		Medium + Mild			
	Scenario C		Wide + Mild			

	Scenario A	2. Bioaccumulation	Restricted + Moderate	No mitigation measure is available. Because of small reservoirs and low retention times projects, there will be low level accumulation of pollutants. Bioaccumulation as a residual impact	Not Applicable	
	Scenario B		Medium + Moderate			
	Scenario C		Wide + Moderate			
	Scenario A	3. Hindered fish migration 4. Loss of in-stream spawning grounds	Restricted + Moderate	2. Fish migration in Mtkvari River to the upstream is hindered since there is no fish ladder in the downstream HEPPs; 3. No mitigation measure is available.	Not Applicable	
	Scenario B		Medium + Moderate			
	Scenario C		Wide + Moderate			
	Scenario A	5. Decrease in amount of water in the river bed	Restricted + Severe	4. Environmental flow will be released Although the environmental flow will be released, there will be residual impact	Monitor periodically sanitary level of the flow downstream	MoEPNR local branch
	Scenario B		Medium + Severe			
	Scenario C		Wide + Severe			
Mitigation Measures for Cumulative Impacts on Socio-economic Environment During Operation						
1. Inundation	Scenario A	Impact on livelihoods of local people	Restricted + Moderate	People will be provided compensation for loss of assets at full replacement cost and other assistance to help them improve or at least restore their standards of living or livelihoods. Low level residual impact	Not Applicable	
	Scenario B		Medium + Moderate			
	Scenario C		Medium + Moderate			
3. Health Issues	Scenario A	Water- based insect-born diseases	Restricted + Moderate	Vector control Minimized potential for diseases	Monitor the levels of deceases if increase of illnesses is increased	Ministry of Helath
	Scenario B		Medium + Moderate			
	Scenario C		Medium + Moderate			

7. Conclusions and Recommendations

7.1. Conclusions

The CUMULATIVE IMPACT ASSESSMENT study has shown that a number of impacts from Mtkvari HPP, as well as from other HPP projects in study area be unavoidable, but that their significance can be reduced or offset by appropriate mitigation. It is important to note, that while many of these impacts are cumulative, such accumulation is additive not interactive, hence the total cumulative impact is not greater than the sum of the parts.

As a result of this CUMULATIVE IMPACT ASSESSMENT it is concluded that all major adverse cumulative impacts can be mitigated to acceptable levels through the measures proposed, except for the following key residual negative impacts given below in the order of their importance:

- Change of flow regime system affecting the aquatic and terrestrial ecosystem in the vicinity.
- Loss of vegetation communities, flora and terrestrial fauna habitats resulting from construction of project facilities and inundation
- Change of water quality resulting from sediment reduction in the downstream of the dams and in the reservoir.

These residual impacts will be monitored according to the program given in Section 6, and necessary management measures should be taken as appropriate by the responsible parties.

7.2. Recommendations

The institutional recommendations for prediction, avoidance, or reduction of environmental consequences of cumulative effects generated by the HPP development in Riv. Mtkvari basin, through applying the integrated river basin management instruments, are listed below.

Assessments:

- upgrade the hydro-meteorological database and information;
- model and monitor changes in river flow, sediment and river quality;
- evaluate impacts of individual projects on request;
- conduct pilot sustainability assessment of projects;
- establish baseline aquatic data and monitor changes;
- carry out economic valuation of basin fisheries;
- model cumulative impact on peoples' livelihoods.

Management planning:

- integrate economic, social and environmental aspects in basin planning;
- support power optimization studies;
- maintain database of hydropower projects;
- develop policy options for benefit sharing;
- assess consequences of climate change;
- develop sustainable watershed management plans;