Draft Environmental and Social Impact Assessment – Part 2

Project Number: 47919
June 2013

GEO: Adjaristsqali Hydropower Project

Prepared by Mott MacDonald for Adjaristsqali Georgia LLC

Adjaristsqali Hydropower Project ESIA

Volume II ESIA Final Report

October 2012

Adjaristsqali Georgia LLC (AGL)

Clean Energy Group

Mott MacDonald

Adjaristsqali Hydropower Project ESIA

Volume II ESIA Final Report

October 2012

Adjaristsqali Georgia LLC (AGL)

1. Abashidze Street 6, 6010 Batumi, Georgia

Mott MacDonald, Victory House, Trafalgar Place, Brighton BN1 4FY, United Kingdom
T +44(0) 1273 365 000   F +44(0) 1273 365 100,   W www.mottmac.com

Mott MacDonald

Issue and revision record

Revision	Date	Originator	Checker	Approver	Description
A	07/02/2012	Mott MacDonald Ltd and Gamma Ltd	Vanessa Hovland Ian Scott	Lucy Chapman	Draft for Client Comments
B	19/03/2012	Mott MacDonald Ltd and Gamma Ltd	Vanessa Hovland	Lucy Chapman	Draft for Public Disclosure
C	30/03/2012	Mott MacDonald Ltd and Gamma Ltd	Vanessa Hovland	Lucy Chapman	Final Draft for Public Disclosure
D	October 2012	M ott MacDonald Ltd and Gamma	Vanessa Hovland	Lucy Chapman	Final Report

Mott MacDonald, Victory House, Trafalgar Place, Brighton BN1 4FY, United Kingdom
T +44(0) 1273 365 000   F +44(0) 1273 365 100,   W www.mottmac.com

Content

Glossary

A	Amperes
AC	Alternating Current
AGL	Adjaristsqali Georgia LLC
AoI	Area of Influence
Asl	Above Sea Level
AP	Action Plan
BBM	Buildings Block Method
CBD	Convention on Biological Diversity
CCGT	Conventional Combined Cycle Gas Turbine
CEG	Clean Energy Group
CEI	Clean Energy Invest AS
CESMP	Construction Environmental and Social Management Plan
CFC	chlorofluorocarbons
CLO	Community Liaison Officer
CMS	Catchment Management Schemes
CRTN	Calculation of Road Traffic Noise
CUMEC	Cubic Metres per Second
DC	Direct Current
DEM	Digital Elevation Model
DEMP	Decommissioning Environmental Management Plan
DMRB	Design Manual for Roads and Bridges
d/s	Downstream
DTM	Digital Terrain Model
ECIA	Ecological Impact Assessment

EHS	Environment, Health and Safety
EIFAC	European Inland Fisheries Advisory Committee
EL	Elevation (above mean sea level)
EMP	Environmental Management Plan
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
E&M	Electrical and Mechanical
EWC	European Waste Catalogue
FAO	Food and Agriculture Organisation
FDC	Flow Duration Curve
GBP	Great British Pounds
GEG	Gross Energy Group
GEL	Georgian Lari
GERCC	Grout Enriched Roller Compacted Concrete
GFCM	General Fisheries Commission for the Mediterranean
GI	Ground Investigation
GIIP	Good International Industry Practice
GIS	Geographical Information System
GNSS	Global Navigation Satellite System
GoG	Government of Georgia
GPS	Global Positioning System
GSE	Georgia State Electrical System
GWh	Gigawatt Hour
ha	Hectare

HAZOP	Hazard Operational Standards
HPD	Historical Preservation Division
HPP	Hydropower Plant
hr	Hour
HRT	Headrace Tunnel
HV	High Voltage
HYSIM	Hydrological Simulation Model
Hz	Hertz
ID	Internal Diameter
IFC	International Finance Corporation
IHT	Institution of Highways and Transportation
ILO	International Labour Organisation
IPM	Integrated Pest Control
IRR	Internal Rate of Return
IUCN	International Union for Conservation of Nature
IVM	Integrated Vector Management
k	Ratio of Inter
kg	Kilogram
km	Kilometre
kV	Kilovolt
kW	Kilowatt
l	Litre
LRF	Livelihood Restoration Framework
LV	Low Voltage

LVIA	Landscape and Visual Impact Assessment
m	Metre
M	Million
Masl	Meters above sea level
MDE	Maximum Design Earthquake
M&E	Mechanical and Electrical
MEFRIQ	Marine Ecology and Fisheries Research Institute
MENR	Ministry of Energy and Natural Resources
MIV	Main Inlet Valve
MoA	Ministry of Agriculture
MPC	Maximum Permissible Concentrations
MW	Megawatt
NACEE	Network of Aquaculture Centres in Central and Eastern Europe
NBSAP	National Biodiversity Strategy and Action Plan
NGO	Non Governmental Organisation
NO_x	Oxides of Nitrogen
NPV	Net Present Value
OBE	Operating Basis Earthquake
OD	Outside Diameter
OCGT	Open Cycle Gas Turbine
OHL	Overhead Lines
OHS	Occupational Health and Safety
O&M	Operation and Maintenance
PAPs	Project Affected Peoples

PEMEA	Power and Energy Modelling Excel Add-in
PGA	Peak Horizontal Ground Acceleration
PMF	Probable Maximum Flood
PPE	Personal Protective Equipment
ppm	Parts per million
PPV	Peak Particle Velocity
PRs	Performance Requirements
PS	Performance Standards
PTW	Permit to Work
Q	Rock Mass Quality
RAP	Resettlement Action Plan
RCC	Roller Compacted Concrete
RMR	Rock Mass Rating
RQD	Rock Quality Designation
SCADA	Supervisory Control and Data Acquisition
SCR	Solid Core Recovery
SEP	Stakeholder Engagement Plan
SI	Site Investigation
SIA	Social Impact Assessment
SO_2	Sulphur Dioxide
SPT	Standard Penetration Test
SPV	Special Purpose Vehicle
SRTM	Shuttle Radar Topography Mission
SWMP	Site Waste Management Plan

t	Tonnes
TBM	Tunnel Boring Machine
TCR	Total Core Recovery
TDS	Total Dissolved Solids
TMP	Traffic Management Plan
ToR	Terms of Reference
TRRL	Transport and Road Research Laboratory
TRY	Turkish Lira
UCS	Unconfined Compressive Strength
UK	United Kingdom
UNDP	United Nations Development Programme
USAID	United States Agency for International Aid
USD	United States Dollars
u/s	Upstream
vs	Versus
WHO	World Health Organisation
ZVI	Zone of visual influence

Units	
bar	bar = 105 Pa (pressure)
°C	degree Centigrade (temperature)
dB	decibel (sound pressure)
dS/m	electrical conductivity
g	gram
GWh	Giga Watt Hour (energy)
hr	hour (time)
Hz	Hertz (frequency)
K	degree Kelvin (temperature)
kg	kilogram (mass)
J	Joule (energy)
l	litre
m	metre (length)
m^2	square meter (area)
m^3/s	cubic meters per second
Mm^3	million cubic metres = 106 m^3
ppm	parts per million
ppb	parts per billion
Pa	Pascal (pressure)
s	second (time)
t	tonne = 1000 kg (mass)
tpy	tonne per year
kV	Kilo Volt (electrical potential)
W	Watt (power)
Wh	Watt hour (energy)

Symbols	
CO	-Carbon Monoxide
CO_2	-Carbon Dioxide
NO_x	-Nitrogen Oxides
NO_2	-Nitrogen Dioxide
Nm^3	-Normal cubic metre
O_2	-Oxygen
PM_{10}	-Particulate Matter with a mean diameter less than 10µm
$PM_{2.5}$	-Particulate Matter with a mean diameter less than 2.5µm
pH	-A scale of relative acidity/alkalinity
SO_2	-Sulphur Dioxide

1. Introduction

1.1 Overview

Adjaristsqali Georgia LLC (hereafter referred to as AGL) is undertaking the development of the Adjaristsqali Hydropower Cascade Project (the Project) in the Autonomous Republic of Ajara, Georgia. The Project is expected to have a total installed capacity of 400 MW of renewable energy.

The Project is comprised of three separate hydropower schemes operating in cascade along the Adjaristsqali River. Each scheme consists of a combination of dams and weirs, reservoirs, headrace and transfer tunnels, powerhouse, power evacuation, and access roads.

1.2 The Project

The Project is part of GoG's energy policy to achieve economic independence and sustainability of the sector as well as provision of energy security through domestic sources. In addition Georgia considers electric power to be an export commodity and is aiming to develop this potential.

The Project consists of three cascade schemes, Shuakhevi 185 MW, Koromkheti 150 MW, and Khertvisi 65 MW providing an annual average production of between 500 and 1200 GWh of renewable electricity depending on whether one or all three schemes are constructed. The Project is expected to supply the Georgian and Turkish power markets. The Project will also enable Georgia to use more of its energy resources to meet electricity demand during the winter months of December, January and February.

The Project will require transmissions lines for transmitting the generated electricity to substations for eventual use by consumers[1]. This requires the upgrade of an existing 110 kV transmission line supplying the area and connection to the national grid. It is proposed that a new transmission line will be constructed connecting into Batumi. The GoG will be developing the transmission line as a separate project in accordance with national permitting requirements (this includes requirement to develop a stand alone ESIA). The development of the transmission line is not included as part of the activities for which AGL are seeking finance, however as it will be an associated facility high level comment has been made to the extent possible in accordance with IFC requirements.

The Feasibility Study for the Project (also being undertaken by Mott MacDonald Limited) has been undertaken in parallel with the ESIA and as such has undergone an iterative process where by the design has been adapted where possible according to constraints identified throughout the design development.

1.3 Project Parties

Clean Energy Group (CEG) has been set up to develop greenfield hydropower projects in countries with an untapped hydro potential and a sustainable energy framework. Adjaristsqali Georgia LLC (AGL), part of CEG, has been set up as a special purpose vehicle (SPV) to develop the hydro potential in the Adjaristsqali River and its tributaries. AGL is developing the Project in cooperation with the International Finance Corporation's (IFC) InfraVentures, an early stage project development fund launched by IFC, a member of

[1] Transmission lines will be subject to separate technical, environmental and social studies. Broadly it has been identified that a new 220kV transmission line will be constructed following the existing transmission line corridor running through the valley from Batumi.

the World Bank Group. The IFC is currently the key financial institution whom AGL have approached to provide funding. It is anticipated that the European Bank for Reconstruction and Development (EBRD) will also be approached by AGL.

The Georgian Ministry of Energy and Natural Resources (MENR) launched the competitive tender, and awarded the rights, to develop the hydro potential of the Adjaristsqali River. The competitive tender for the hydro power concession through an expression of interest was initiated in March 2010. CEG was one of three bidders (Limak and Kolin) who submitted competitive bids for the license in April 2010. Being the successful bidder, CEG were awarded the concession in May 2010 and signed the implementation agreement for project (approved by Cabinet of Ministers Georgia) in June 2011.

AGL has commissioned Mott MacDonald Ltd as their International Environmental Consultant to undertake the Environmental and Social Impact Assessment (ESIA), and associated Environmental and Social Management Plan (ESMP) of the Project in compliance with national permitting requirements as well as international finance requirements. Supporting Mott MacDonald are local consultants Gamma Consulting Limited (hereafter referred to as Gamma) who have undertaken baseline studies, local consultation activities, and development of documentation required in accordance with national permitting requirements. In addition Mott MacDonald Limited are also lead international technical consultants developing the project Feasibility Study.

1.4 Purpose of this Document

The purpose of this ESIA is to: i) identify and assess the potential environmental and social impacts that the Project may have on the environment and communities[2] within its area of influence; ii) to avoid, or where avoidance is not possible, minimise, mitigate or compensate for adverse impacts on the environment and communities; iii) to ensure that affected communities are appropriately engaged on issues that could potentially affect them; and iv) to promote improved social and environmental performance through the effective use of management systems.

A scoping exercise was undertaken and consulted on to define the terms of reference for this assessment. Therefore the degree of appraisal required for each potential impact identified will differ in accordance with potential significance of the risk. While this ESIA aims to identify both positive and negative impacts associated with the development of the Project, it is inherently more focused on describing and mitigating potential negative impacts. However, where possible opportunities to enhance positive impacts have been identified.

The ESIA and ESMP have been developed in accordance with the requirements of Georgia's national legal permitting system, guidelines from the World Comission on Dams, and the policies and performance standards of international financing institutions (IFIs), full details of which are elaborated in Chapter 4.

Other documents produced in support of the financing requirement`s of the Project, and that should be read in conjunction with this ESIA, include:

- Stakeholder Engagement Plan, Mott MacDonald Ltd July 2011
- ESIA Scoping Report, Mott MacDonald Ltd, August 2011

[2] Reference to communities includes consideration of impacts on labourers.

- Land Acquisition and Livelihood Restoration Framework, Mott MacDonald Ltd, January 2012.

Studies and Reports which have been undertaken by Mott MacDonald and used to support the assessment undertaken in this ESIA include:

- Shuakhevi Scheme Feasibility Study Report, Mott MacDonald Ltd, February 2012
- Koromkheti Scheme Feasibility Study Report, Mott MacDonald Ltd, February 2012
- Khertvisi Scheme Feasibility Study Report, Mott MacDonald Ltd, February 2012
- Geotechnical and Geological Report, Mott MacDonald Ltd, February 2012.

1.5 Structure of the Report

The ESIA is comprised of four volumes organised as follows:

- Volume I: Non Technical Summary;
- **Volume II: Environmental and Social Impact Assessment (this volume);**
  - Chapter 1 Introduction
  - Chapter 2 Project Description
  - Chapter 3 Need for the Project and Analysis of Alternatives
  - Chapter 4 Policy, Legal and Institutional Framework
  - Chapter 5 Assessment Scope and EIA Process
  - Chapter 6 Information Disclosure, Consultation, and Participation
  - Chapter 7 Social Impact Assessment
  - Chapter 8 Ecology and Biodiversity
  - Chapter 9 Water Resources and Water Quality
  - Chapter 10 Environmental Flows
  - Chapter 11 Geology, Landslides and Seismic Risks
  - Chapter 12 Materials and Waste Management
  - Chapter 13 Traffic and Transport
  - Chapter 14 Noise and Vibration
  - Chapter 15 Air Quality
  - Chapter 16 Greenhouse Gas Emissions
  - Chapter 17 Cultural Heritage and Archaeology
  - Chapter 18 Landscape and Visual Amenity
- Volume III: Appendices / Supporting Documents; and
- Volume IV: Environmental and Social Management Plan.

Key Experts included within the ESIA:

Specialists	National	International
Socio-economics	Gamma	Hannah White
Ecology and Biodiversity	Flora – Ms. Nino Tsqvitishvili; Mr.Gia Chelidze; Ms. Mariam Qimeridze Cultural Heritage: Mr. Iulon Gagoshidze Fauna – Mr. Bukhnikashvili Alexander; Mr. Gia Edisherashvili; Mr. David Bekoshvili Fisheries – Mr. Archil Partsvania	Mark Johnston (terrestrial ecology), Nicole Price and Celia Figueira (aquatic ecology)
Water Resources and Water Quality	GEG	Alison Stuck

Specialists	National	International
Geology, Landslides and Seismic Risks	GEG	Anthony Drake
Materials and Waste Management	GEG	Nick Stone
Traffic and Transport	Gamma	Dan Friel
Noise and Vibrations	Gamma	Max Forni
Air Quality	n/a	Matt O'Brien
Cultural Heritage and Archaeology	Gamma	Phillipa Adams
Landscape and Visual Amenity	Gamma	Jeremy Purseglove

Contact details for enquires on this ESIA are listed below:

Project Proponent	Information
Name of Company	Adjaristsqali Georgia LLC (AGL)
Address	I. Abashidze Street 6, 6010 Batumi, Georgia
Telephone	+995 422 27 12 17
E-mail	info@adjaristsqali.com
Website	www.adjaristsqali.com

2. Project Description

2.1 Introduction

This Chapter provides a description of the Project location, a description of the key components which make up a hydropower scheme, description of the project layout, summary of the key project activities during both construction and operation, and final project programme. Additional technical details such as scheme drawings are available in Appendix A of Volume III where relevant to support the ESIA.

2.2 Project Location

The Project is located within the Autonomous Republic of Adjara (hereafter referred to as Adjara) situated on the Black Sea littoral in the south-west of Georgia, as shown in Figure 2.1. The status of Adjara as an autonomous republic was confirmed by the Constitutional Law of Georgia on 20 April 2000. Adjara remains part of Georgia and is governed in accordance with the principles of the national constitution.

Adjara is bordered by Turkey to the south, the Meskheti mountain range to the north; the Arsiani mountain range to the east and the Black Sea to the west. The area comprises 2,900 km^2 and constitutes 4.2% of the whole territory of Georgia. Adjara is made up of five administrative units (municipalities) – Kobuleti, Khelvachauri, Keda, Shuakhevi and Khulo. The Project has a direct influence (although to greater and lesser extent depending on the scheme) on all four municipalities. The Project area of influence is illustrated in Figure 2.2.

Figure 2.1: Project Location within Georgia

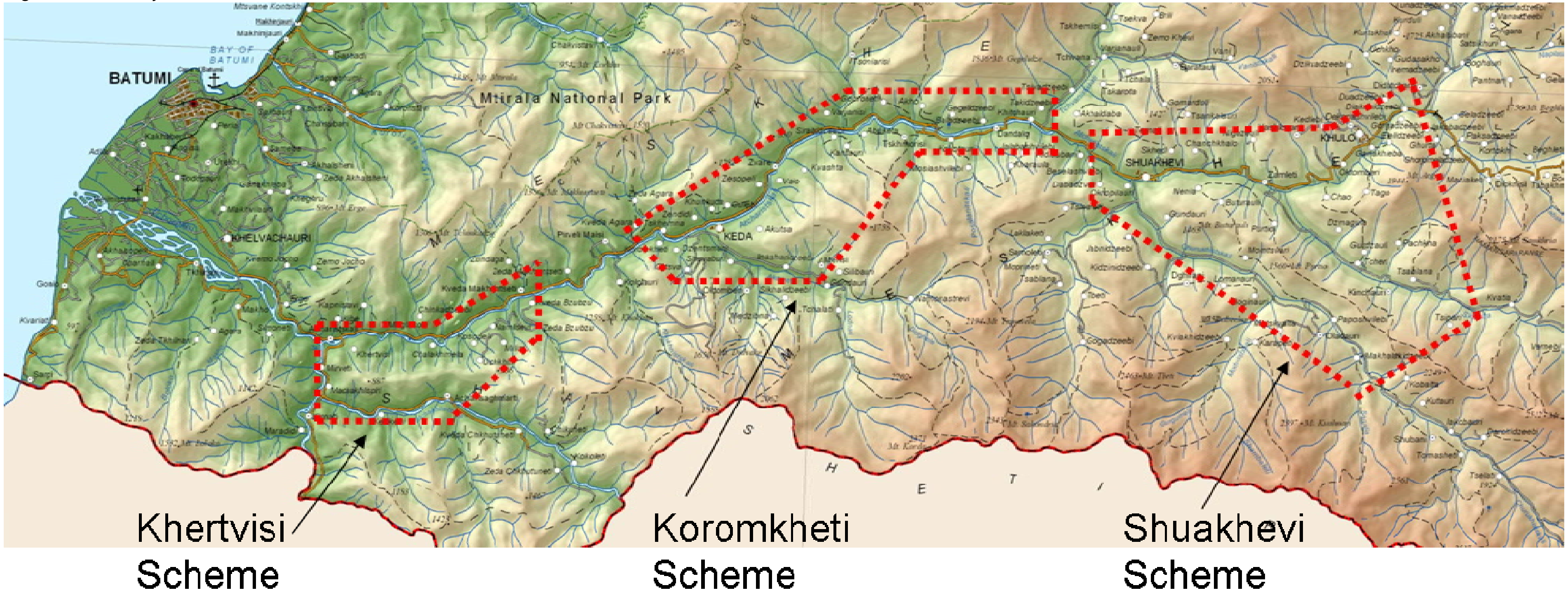
Source: Mott MacDonald Ltd

The municipalities are mostly rural with a total population of approximately 176,000. Ethnic Georgians (largely of Christian Orthodox and Muslim denomination) represent the majority of the local population. Depending on the altitude the main income source for the local population consists of growing vegetables (potatoes and tomatoes among others), fruits, tobacco, grapes, and cattle farming.

The region as a whole is highly sensitive to various natural hazards including mudflows, erosion and landslides. The Adjaristsqali River originates from the western part of the Arsiani mountain range, 2,435 m above sea level. The total length of the river is 90 km, total fall – 2,397 m, average inclination – 26.6%. The catchment area is 1,540 km^2 with an average height of 1,400 m. The river joins the Chorokhi River from the right side some 17 km from the outfall of the Chorokhi River into the Black Sea.

Most of the area is covered by the forests. In the downstream area, 1,000-1,200 m, leaf bearing forest is present, at 1,200 – 2,000 m elevation conifer forest is present and above 2,000m only Alpine valleys are present and make up only 15-20% of total basin area. The Adjaristsqali River inflows are provided by snow, rain and ground water. The primary input is rainfall which is the main source of river water inflow (44%); groundwater and snow respectively contribute 30% and 26%. There are no glaciers in the catchment.

Figure 2.2: Project Area of Influence



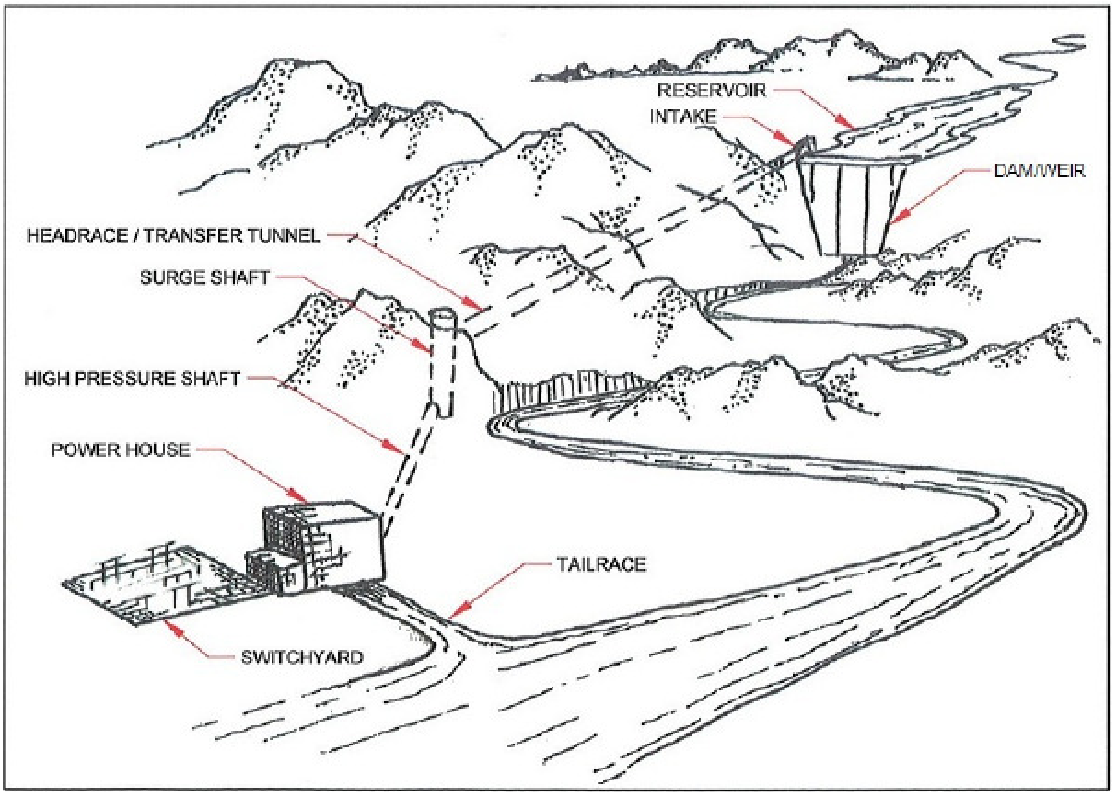
Source: Mott MacDonald Ltd

2.3 Project Components

2.3.1 Overview

Each Scheme consists of at least one dam and short term storage reservoir, weir, tunnels, powerhouse, and switchyard. This Section provides an overview of the key project components and construction methods. Figure 2.3 below provides an illustration of the key components which make up each Scheme.

Figure 2.3: Hydropower Key Components



Source: Mott MacDonald Ltd

2.3.2 Dams and Hydraulic Structures

2.3.2.1 Dams and Weirs

There are two main types of hydropower projects, reservoir storage schemes and run of river schemes. Run of river schemes rely on having a good difference in elevation (gross head) between an area suitable for the intake upstream and an area suitable for the powerhouse downstream and a good sized catchment area (watershed) from which water will drain into the river. The Project is considered to be a run of river scheme with diurnal storage where the dams create a hydraulic head in the river to divert some portion of the river flows but have only limited daily storage capacity. Conversely reservoir storage schemes create large impoundments to capture seasonal and annual storage and also regulation of the river, which is not the case for this Project.

.

Dams are defined as large if they are 15 m in height or greater from their foundations, or between 5 and 15 m in height and also have a reservoir volume of greater than 3 million m^3 (ICOLD[3] definition). The Project consists of several different types of dams and weirs depending on the in-situ geological conditions and design requirements. All the dams in the scheme have been designed based on results of dam safety analysis and requirements for sediment management arrangements. The following types of weirs and dams are included within the Project design:

- Concrete barrage dam – this type of dam consists of a series of large gates that can be opened or closed to control the amount of water passing the dam.
- Mass concrete gravity dam – conventional concreting, i.e. with the concrete being placed in blocks and lifts or as roller compacted concrete (RCC), it is possible to include low level gates at the bottom of this type of dam to pass floods and flush sediments.
- Embankment dam – this can have either a central impermeable zone and gravel shoulder zones or a concrete faced rockfill dam (CFRD); a spillway is required to pass floods over this type of dam.
- Concrete weir – low concrete weirs, designed to pass floods over the top of the structure.

All dams need to be "waterproofed" and prevent water from seeping underneath them and damaging stability of foundations, therefore depending on the in-situ geological conditions; grouting curtains may be required below and to the side of the dams. Grouting consists of pumping a mixture of cement and water under pressure into the ground to seal fissures in the rock foundations.

The programming of construction for the dams, weirs and intake structures has been timed to benefit from periods of low flow in the rivers (generally in June). The highest flow period generally occurs during the period from early April to the end of May. There are two general construction methods which will be employed to construct the dams and weirs of the Project:

- coffer dams and diversion tunnels which allows for the entire dam to be constructed in dry by diverting the river through a tunnel (required at some sites where there is insufficient space to create a diversion channel, or unfavourable geological conditions).
- diversion channel on either side of the river to enable the dam on the opposite side to be constructed.

Technical drawings of all the dams in the Project can be found in Appendix A.

[3] International Commission on Large Dams

Figure 2.4: Existing Machakhlistsqali HPP Concrete Weir

Source: Mott MacDonald Ltd

2.3.2.2 Reservoir

As the Project is a run of river scheme with diurnal storage, the storage available within each of the schemes is to enable the project to take advantage of daily peaking prices. Diurnal storage means that the reservoirs only have sufficient storage to respond to fluctuations in daily energy demands as opposed to storage schemes where reservoirs can store water in the summer, which can then be used to generate electricity in the winter. The following dams have reservoirs and daily storage capacities, Skhalta, Didachara, Khichauri, and Khertvisi (see Tables 2.1 to 2.3 for details of reservoir volumes). The waters within the reservoir are unlikely to be deep enough to be impacted by thermal stratification (where very cold water remains at bottom of reservoir and warm water at the top) due to the daily fluctuations in water levels due to draw down for generation. The water levels in the reservoirs will go up and down by approximately 2 to 10 m everyday depending on the scheme.

2.3.2.3 Intakes

Intakes are situated behind a dam or weir which is used to create enough water storage to allow the intake channel/pipe to have sufficient water and head before entering the headrace/transfer tunnel. Depending on the intake design, construction may require a coffer dam to be built to protect the construction area.

2.3.2.4 Sediment Basin

In some parts of the scheme a sediment basin/trap is required at the intake to prevent sediment passing into the transfer tunnel that may otherwise settle within the tunnel and/or pass through the turbines. The traps (basins) are designed to slow the water to velocities below that which will occur in the tunnel, for sufficient time to remove sand and gravel. These are relatively unobtrusive structures but they can have a large footprint as they need to be large enough to slow down the flow of water from the river. Figure 2.5 provides an example of the sediment basin from an existing hydropower plant on the Adjaristsqali River, Asti HPP.

Figure 2.5: Existing Asti HPP Sediment Basin

Source: Mott MacDonald Ltd

2.3.2.5 Spillway, flushing gates and diversion tunnels

All dam structures are required to have a system which enables them to pass a controlled release of flows over or around the dam in the event of a flood or during maintenance/stoppage of the hydropower plant to prevent flows damaging the dam. This is achieved either through a spillway structure, gates designed within the dam, or diversion tunnel which takes water around the dam through the mountain/hillside and back into the river.

2.3.2.6 Fish Passes

The construction of a large dam will create a physical barrier in the river to the movement of fish species. Where species found in the river are migratory this can have potentially significant effects on populations. The Project has made an assessment for each of the dam structure to identify the requirement for a fish pass based on the presence of migratory species and risk of fragmenting breeding populations, as part of the detailed design the most suitable type of fish pass will be defined for each dam.

There are a number of types of fish passes that have been developed to allow passage of fish through dam obstructions, the main ones are listed below:
- Pool and traverse pass
- Baffled pass
- Fish locks and lifts
- Pre-barrages / ponds.

Fish passes have been included on all the Project dams and weirs apart from the Didachara and Skhalta dams which are located at a higher elevations in the catchment and have dam heights of over 20 m and with less of an impact on short range migration. Any impacts that may result can be mitigated through stocking of fish into water courses above and below the dams if necessary. See Section 2.4 for a summary of dams with fish passes.

Figure 2.6: Examples of different fish pass structures

2.3.3 Tunnels and Underground Works

2.3.3.1 Low pressure tunnels

Hydroelectric power stations generate power from water flowing from a high level to a lower level. For this project the water transfer will occur in underground tunnels. For low head schemes the tunnel can slope directly from the high to the low point, but in higher head schemes, such as the Adjaristsqali Project, this can require additional strengthening of tunnels to withstand higher pressures at the downstream end of the scheme. As part of this project, the majority of the tunnels required will be underground low pressure tunnels carrying water from the intakes to the powerhouse and are referred to as either transfer tunnels or headrace tunnels.

There are two main methods available for constructing tunnels, conventional drill and blast (D&B) method and tunnel boring machine (TBM) method. A brief description of both methods is provided below.

Drill and Blast Method

It is anticipated that the majority of works will be constructed by conventional D&B method as it offers greatest flexibility in terms of the number of faces that can be excavated at any time. The following is the typical excavation sequence in D&B excavation:

- drilling
- charging
- blasting
- scaling
- mucking
- rock support installation (rock bolts and steel fibre reinforced shotcrete and steel ribs where necessary).

The maximum length of tunnel that can be constructed (without intermediate adits) by the D&B method is dictated by the construction programme and tunnel excavation rates. The Project has assumed maximum tunnel lengths of 5,000 m, but this may change depending on the construction programme requirements.

Tunnel Boring Machine Method

Excavation by TBM offers less flexibility than the D&B method and has a longer mobilisation period; there is also a risk that a TBM can get stuck due to collapse of highly fractured or weathered ground or squeezing in low strength rock masses. However, there are advantages of TBM excavation including the greater advance rates achievable with the TBM method compared to the D&B method, the roughness of the excavated surface is reduced and typically there is less disturbance caused by TBM excavation, thereby, requiring less rock support. In addition use of TBM reduces the need for access adits and thus the number of construction faces is reduced.

Both open gripper and single or double shield TBM will be used for excavation. The gripper machine braces itself against the rock using gripper plates and therefore the same rock support measures are used as those in the conventional D&B method. Alternatively single or double shield TBM requires installation of segmental lining. The lining is made from concrete segments cast in-situ, and is used as both initial support and for the final lining of a tunnel.

2.3.3.2 Pressure and surge shafts

Pressure Shaft

Projects which operate on a relatively high head will have increased pressure at the downstream end that can require tunnel strengthening. It is often cheaper to keep the majority of the tunnel at high level in a "low pressure" tunnel. The low pressure tunnel is then connected to the power station through a steep and often vertical pressure shaft. This minimises costs and the nearly horizontal pressure tunnel is easier and safer to construct.

Surge Shaft

Hydroelectric turbines have to be able to react quickly to maintain the stability of the electrical system to which they are connected. They have to be able to increase and decrease the flow passing through them within a few seconds. When the turbine flow is reduced it causes a pressure wave to pass upstream through the pipe to decelerate the flow. This pressure wave is known as a waterhammer (because the effects can sometimes sound like someone hammering on a pipe). The waterhammer waves will pass along the pipeline until they reach a free surface at which point they are reflected as a negative pressure wave and the waves move backwards and forwards within the pipework system. If the waterway system is long then there is a lot of momentum in the flowing water and very high pressures are required to slow down the flowing water.

A reverse condition occurs when it is necessary to increase flows. In order to accelerate the water the pressure at the downstream end falls to maximise the pressure difference with the upstream. If fast changes are required then under extreme conditions pressures can reduce to full vacuum with severe effects.

Designing waterways to resist these high and low pressures can be costly and surge chambers are introduced into waterway systems to limit the effects of waterhammer. The surge chamber provides a local free surface that prevents the waterhammer waves from passing along the complete tunnel. They also allow the rate of change of flow in the upstream waterway to be different to that leading to the turbine thereby allowing faster turbine response without affecting the complete waterway system.

Each of the schemes in the Project will have a surge shaft, these are permanent visible structures on the surface, approximately 5 m high and have a diameter of approximately 20 m ($62m^2$). Figure 2.7 below provides an example of what a surge shaft looks like in situ.

Figure 2.7: Example of surge shaft

Source: Mott MacDonald Ltd

The following section provides a description of the construction method used to develop pressure and surge shafts.

Raise-boring Method

The raise-boring method is proposed for excavation of surge and pressure shafts. Raise-boring can only be carried out in rock and therefore when shaft sinking is being carried out from the ground surface, raise-boring can only commence once rockhead has been achieved. A raise-boring rig is used to drill a pilot hole from the top of the shaft to its base. The pilot hole is then enlarged by pulling a reverse reamer head back up to the top of the shaft – typical diameters of raise-bores range from 1.8 m to 3.0 m although diameters as large as 7 m have been used. No support can be installed in a raise-bore; hence the raise-bore diameter is controlled by the need for the rock to be self supporting. The surge shaft and pressure shaft for the Project have been designed to be constructed by raise-bore and then enlarging the raise-bore to the full diameter of the shaft by D&B methods. The blasted rock is disposed of down the raise-bored hole and the muck is then removed from the base of the shaft.

Raise-boring has significant time and cost saving advantages over conventional development methods and results in less disturbance of the rock mass structure and greater safety for the operating personnel.

2.3.3.3 Access Portals and Adits

Both temporary and permanent access portals and adits will be required for the Project, initially to construct surge shafts, pressure shafts, transfer and headrace tunnels etc. and subsequently during operation for ongoing maintenance purposes. Where D&B methods are used for tunnelling, adits will be used to allow a greater number of construction faces from which to progress tunnelling and therefore reduce construction times and risks. Construction method for development of access portals will depend on the in-situ ground conditions, either D&B or mechanical excavation will be used. It will be necessary to excavate into the slope to create a vertical face for the tunnel drive.

Where access tunnels are designed to only provide temporary access during construction, the tunnel will be sealed permanently with a concrete plug. Where permanent access is required the access tunnels will be sealed with a concrete plug with a built in door enabling future access for inspection and maintenance of the tunnels.

Figure 2.8: Example of Tunnel and Portal Construction

Source: Mott MacDonald Ltd

2.3.3.4 Rock trap

A rock trap is a structure within a tunnel which collects loose rock associated with the unlined length of a tunnel. It is envisaged that rock trap would be accessed approximately every 5 years.

2.3.4 Powerhouse and civil works

2.3.4.1 Powerhouse

The powerhouse contains the turbines and generators for the production of electrical power as well as ancillary equipment. The structure can be located either above ground or underground. The Shuakhevi and Khertvisi schemes will have an above ground surface powerhouse as illustrated in Figure 2.9 below, approximate footprint of surface powerhouse proposed at Shuakhevi and Khertvisi is 0.5 ha. Koromketi will have an underground powerhouse with only a small switchyard visible on the surface.

Figure 2.9: Existing Asti HPP Surface Powerhouse

Source: Mott MacDonald

Figure 2.10: Existing Asti HPP Tailrace

Source: Mott MacDonald

2.3.4.2 Tailrace

The tailrace is the outlet of the powerhouse, returning waters back to the river once the water has been through the turbines (see Figure 2.10).

2.3.5 Power Evacuation

2.3.5.1 Transformer and Switchyards

To export the electricity generated at the powerhouse, it will have to be stepped up (increased in voltage) using a transformer and switchyard to allow the powerhouse to connect into a new proposed 220 kV transmission line. Transformers can be located either above ground or below ground, Shuakhevi and Khertvisi are both above ground structures with a footprint of approximately 1.4 ha each.

Figure 2.11: Example of Transformer and Switchyard location

Source: Mott MacDonald

2.3.5.2 Transmission line

Power will need to be exported from the area to the wider national grid as well as connected to the grid for export to Turkey. The Project will be connected to a double circuit 220 kV transmission line which will be constructed connecting Batumi to the new grid connection currently under construction at Akhaltsikhe. No details are available at this time on routing of the transmission line which will be undertaken by the GoG. From a high level review of the most direct route (see Figure 3.1), it is unlikely that any proposed or existing protected areas will be affected by a new transmission line. The Project connection requirements are the subject of a separate study and routing and design will also undergo an environmental assessment in accordance with national requirements.

Figure 2.12: Existing 110 kV transmission line

Source: Mott MacDonald

Figure 2.13: Existing 110 kV transmission line

Source: Mott MacDonald

2.3.6 Associated Activities

To support the main works the following activities are identified as key to the construction phase operations and on-going maintenance requirements:

- Land acquisition associated with temporary and permanent structures
- Development of borrow pits to provide aggregate for road building
- Temporary workers accommodation
- Temporary storage and work sites at dam and powerhouse locations
- Spoil disposal locations required for significant amounts of material to be excavated from tunnels
- Batching plants for the production of concrete to support foundation works
- Upgrade to existing access roads to support delivery of equipment to site
- New permanent access / maintenance roads
- Construction of temporary access roads.

A summary of construction infrastructure requirements is provided in Section 2.5 below.

2.4 Scheme Layouts

2.4.1 Overview

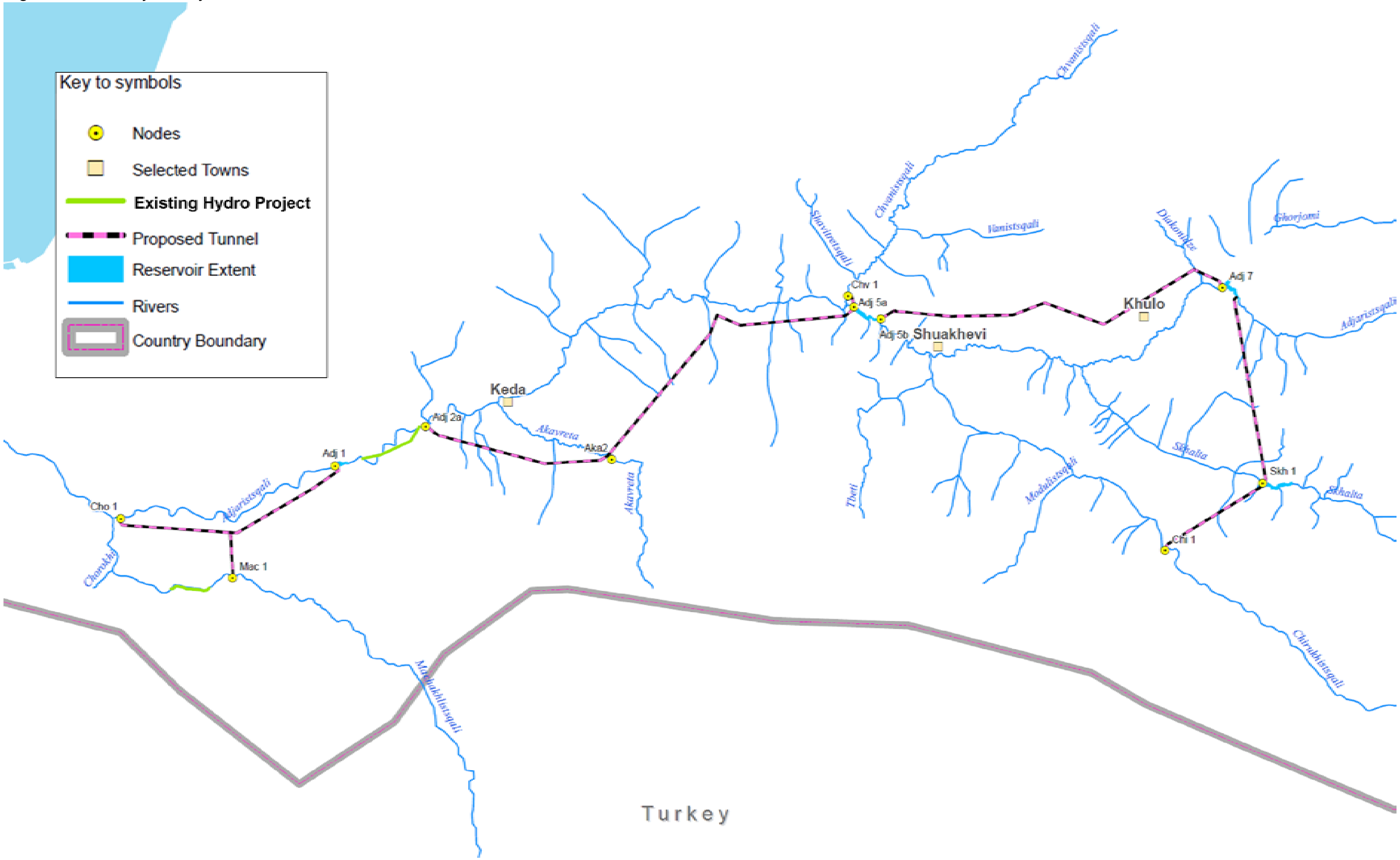
The Project consists of three cascade schemes, Shuakhevi 185 MW, Koromkheti 150 MW, and Khertvisi 65 MW. This would be an annual average production of between 500 and 1200 GWh of renewable electricity depending on whether one or all three schemes are constructed. The Project is expected to supply the Georgian and Turkish power systems. The Project will also enable Georgia to use more of its energy resources to meet electricity demand during the winter months of December, January and February. The Project will require transmissions lines for transporting the generated electricity to substations for eventual use by consumers. Details of the individual cascade schemes are:

- **Shuakhevi Scheme** – will have an overall installed capacity of 185 MW (as well as an additional 9.8 MW on Skhalta River) and is comprised of two dams with reservoirs and one weir on the Adjaristsqali, Skhalta and Chirukhistsqali Rivers respectively. A series of transfer and headrace tunnels connect the reservoirs to the Shuakhevi Powerhouse to be located just upstream of the Adjaristsqali and Chvanistsqali confluence. A small powerhouse will also be constructed on the Skhalta dam using the water being transferred from Chirukhistsqali River.
- **Koromkheti Scheme** – will have an installed capacity of 150 MW and is comprised of one large dam and reservoir on the Adjaristsqali River (immediately downstream of the Shuakhevi powerhouse), one low dam on the Chvanistsqali River, and a weir on the Akavreta River. The project includes transfer tunnels from the dam to the powerhouse located downstream on the Adjaristsqali River.
- **Khertvisi Scheme** - will have an installed capacity of 65 MW scheme and is comprised of one dam and reservoir on the Adjaristsqali River as well as a weir on the Machakhlistsqali River. A headrace tunnel from the main dam to the Khertvisi powerhouse located just upstream of the confluence of the Chorokhi and Adjaristsqali Rivers, with a transfer tunnel from the Machakhlistsqali River.

The Project under consideration does not include for the development of transmission lines to export power generated to the national grid. The transmission line is part of an overall transmission line expansion for Georgia and will be the subject of a separate ESIA to be developed by the Government of Georgia on behalf of the Georgian State Electro System LLC (GSE) in accordance with national requirements. Initial studies for the development of the transmission line are already underway and contracts under negotiation for full studies and development. Construction of the transmission line will take approximately three years with commissioning planned for the end of 2015.

Figure 2.14 provides an overview of the project layout components.

Figure 2.14: Project Layout



2.4.2 Shuakhevi Scheme

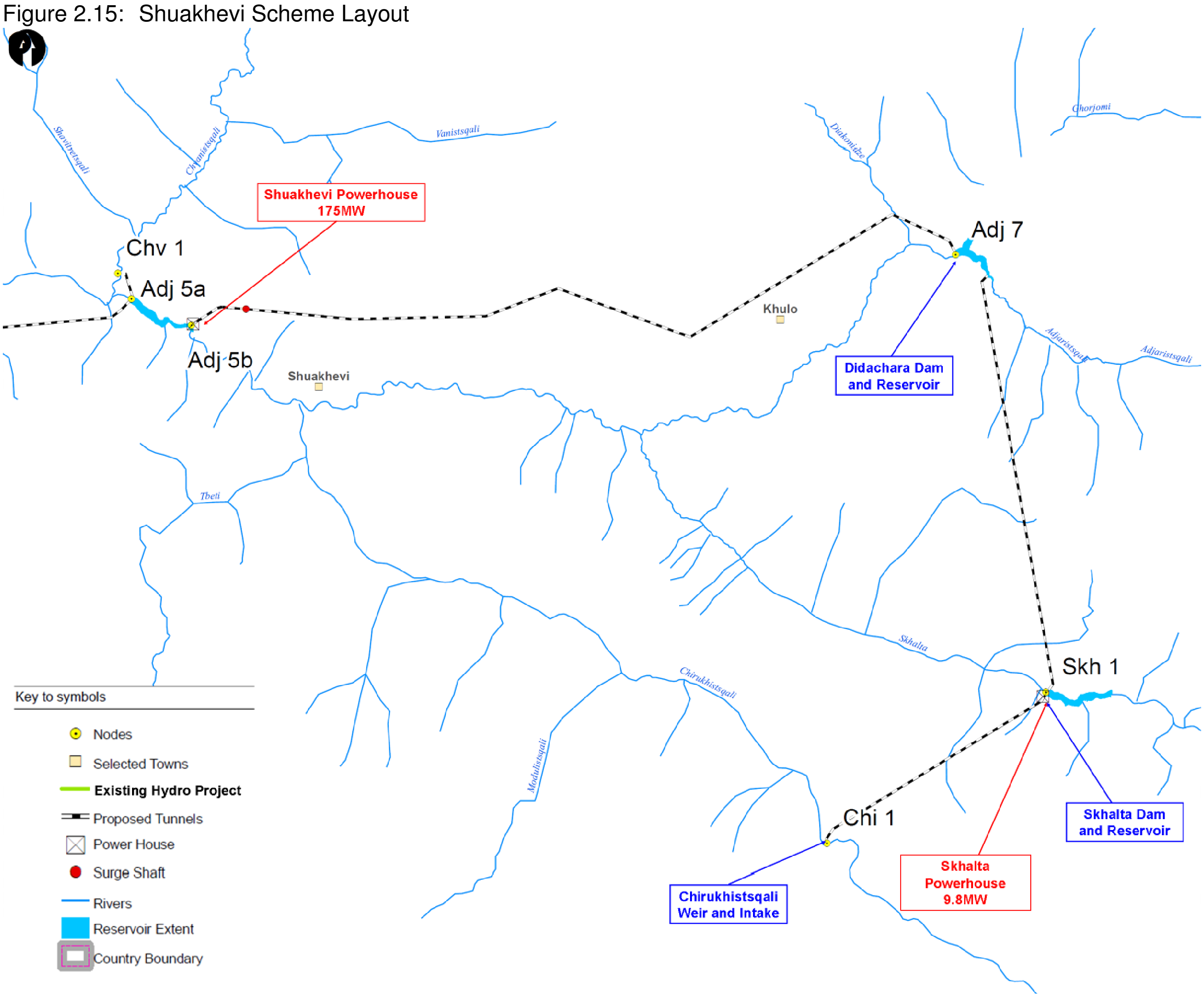
The Shuakhevi scheme will be based on diverting water from the Chirukhistsqali and Skhalta Rivers into a reservoir on the Adjaristsqali River which will provide mainly diurnal storage and from which a head race tunnel on the right bank will take water to a powerhouse downstream from the Shuakhevi village on the Adjaristsqali River (Figure 2.16: Schematic of the Shuakhevi Scheme). Additional storage will be provided on the Skhalta River at the Chirukhistsqali outfall and before the Skhalta to Adjaristsqali transfer. A small powerhouse will be built at the Chirukhistsqali outfall to generate from the head differential of over 100 m. The key components of the scheme are detailed in Figure 2.15 and Figure 2.16.

Table 2.1: Shuakhevi Scheme Key Components

Node	Description	Key Parameters
Chi 1	Weir, sediment trap and run-of-river intake on Chirukhistsqali to transfer / headrace to Skhalta River	Level: 912 m
Chi 1 to Skh 1	Transfer / headrace tunnel to Skhalta Reservoir / Skhalta Powerhouse	Lining type: Unlined Length: 5.8km, Diameter: 3.6 m Design capacity: 10.6 m^3/s
Skh 1	Powerhouse	Type: Surface Units: 9.8 MW (2 x 4.9 MW) Pelton
Skh 1	Dam and Skhalta Reservoir	Type: Concrete barrage Height: 22 m Approx. reservoir capacity: 493,000 m^3 Approx. surface area: 194,000 m^2
SKh 1	Intake to Transfer Tunnel	Operating levels: 790 to 800m
Skh 1 to Adj 7	Skhalta to Didachara Transfer Tunnel	Lining type: Unlined Length: 9.1km Diameter: 6.0m Design capacity: 25 m^3/s
Adj 7	Didachara Dam and Storage Reservoir	Type: Concrete dam Height: 39m Approx. reservoir capacity: 623,000 m^3 Approx. surface area: 169,000 m^2
Adj 7	Intake to Headrace Tunnel	Operating levels: 770 to 780m
Adj 7 to Adj 5b	Headrace Tunnel Intake to Surge Shaft	Lining type: Unlined Length: 16.48km Span and Height: 6.2m Design capacity: 48 m^3/s
	Surge Shaft	Lining type: Unlined Height: 154.9m (CL to GL) Diameter: 12.0m
	Headrace Tunnel Surge Shaft to Pressure Shaft	Lining type: Unlined Length: 0.05km Span and Height: 6.2m Design capacity: 48 m^3/s
	Pressure Shaft	Lining type: Unlined Height: 370.7m

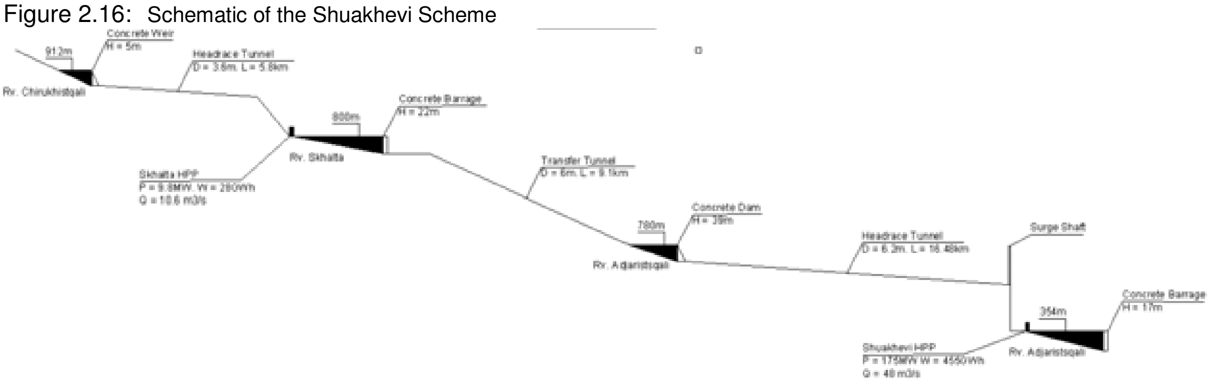
		Diameter: 6.2m
	Pressure Tunnel Unlined	Lining type: Unlined Length: 0.48 km Span and Height: 6.2m Design capacity: 48 m^3/s
	Pressure Tunnel Steel Lined – Single	Lining type: Steel Lining Length: 0.75km Diameter: 4.5m Design capacity: 48 m^3/s
	Pressure Tunnel Steel Lined - Bifurcation (Surface)	Lining type: Steel Lining Length: 17m (Along Chainage) Diameter: 3.2m Design capacity: 48 m^3/s (2 x 24 m^3/s)
Adj 5b	Shuakhevi Powerhouse	Type: Surface Units: 175 MW (2 x 87.5 MW) Francis

Figure 2.15: Shuakhevi Scheme Layout



Source: Mott MacDonald

Figure 2.16: Schematic of the Shuakhevi Scheme



Source: Mott Macdonald

2.4.2.1 Weir on the river Chirukhistsqali, diversion tunnel, and Skhalta HPP

A 5 m high concrete weir will be constructed at an elevation of 912 masl to take water from the river Chirukhistsqali; the water intake and the settling tank will be arranged on the right side of the river bank with trash screens arranged in front of the water intake screens in order to catch any suspended waste and rocks. The water will then be transferred to a three-section settling tank and then into the diversion tunnel. The accumulated sediments will be flushed out and released into the tailrace periodically.

During flood periods, a low-threshold weir will ensure the release of extra water and of solid sediments into the tailrace. In addition, the dam will be equipped with flushing sluices which will provide the release of the accumulated sediments from the headrace into the tailrace during flood periods.

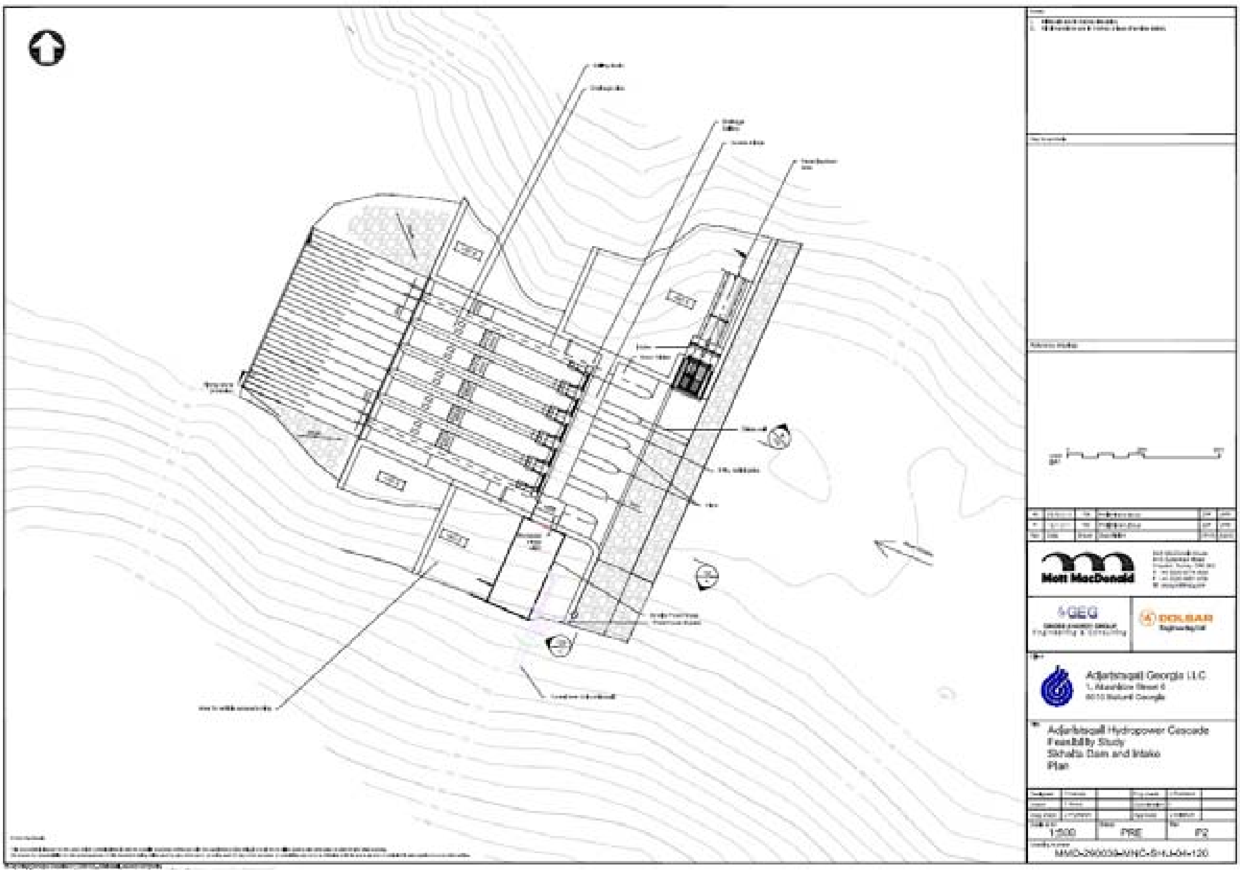
A fish-passage arrangement is planned between the water intake and the dam. The final design of the structure will be defined during detailed design and will aim to allow passage of as many types of fish upstream as well as consider improving downstream migration. Water from the river Chirukhistsqali will be diverted and discharged into the valley of the River Skhalta using a 5.8 km long and 3.6 m diameter diversion tunnel.

There is a 100 m difference in head between the Skhalta River reservoir and the weir on the Chirukhistsqali River. In order to use this difference for generation purposes, a small 9.8 MW capacity HPP (Skhalta HPP) will be built. The water from the diversion tunnel will be transferred into the surge shaft and then directed into the power house. The Skhalta HPP will be a surface power house with two Pelton units hydro-turbines with a capacity of 4.9 MW each. The intake capacity of the transfer tunnel will be 10.6 m^3/s.

2.4.2.2 Skhalta dam, reservoir and diversion tunnel

A 22 m high reinforced-concrete dam will be built at 790 masl on the River Skhalta. At maximum capacity the reservoir will contain 493,000 m^3 of water occupying a surface area of 194,000 m^2. The water intake will be placed on the right bank of the river and then water diverted into the diversion tunnel. The diversion tunnel will be 9.1 km long with a diameter of 6.0 m. The water from this reservoir will create diurnal storage and be transferred to the Adjaristsqali River. The Skhalta headworks drawing is shown in Figure 2.17 below.

Figure 2.17: Designed dam and water intake on the river Skhalta.



Source: Mott Macdonald

2.4.2.3 Didachara dam, reservoir and diversion tunnel

Water supply for the Shuakhevi HPP will come from the Didachara reservoir, which will be formed by a 39 m high reinforced-concrete dam to be built at the confluence of the rivers Adjaristsqali and Ghorjomi creating a reservoir of approximately 623,000 m^3 with a surface area of 169,000 m^2.

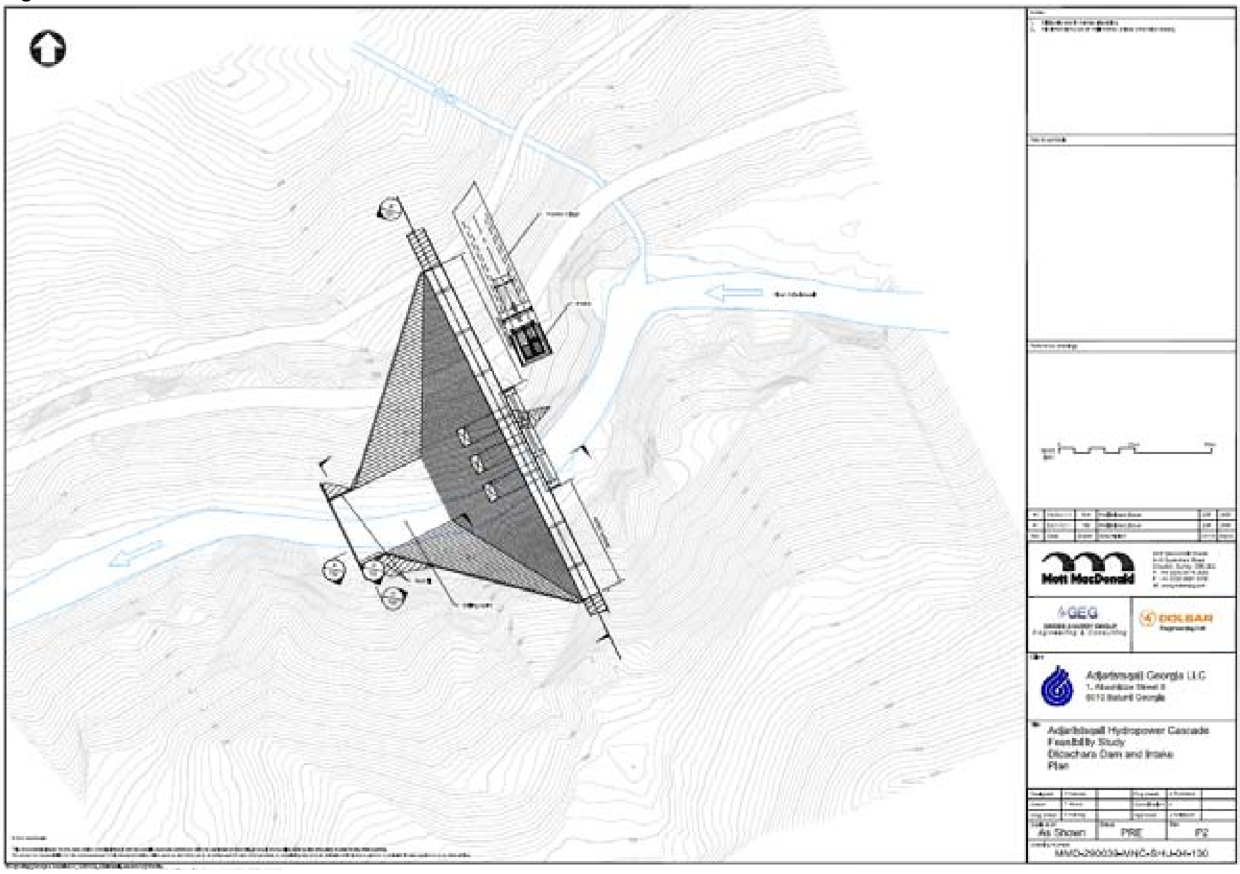
The Didachara reservoir will cover approximately a 2.5 km section of the Batumi-Akhaltsikhe highway, therefore a new bypass road will be constructed.

The water intake that will be arranged on the right side of the dam will be equipped with trash screens. The diversion tunnel that will take water to the Shuakhevi HPP will be 17.8 km long with a 6.2 m diameter and have a design capacity of 48 m^3/s.

An idle spillway arrangement will be located on the left side of the dam, from where the water will be discharged into a reinforced-concrete dissipater tank. The reservoir will be flushed by three sluice gates, which together with the idle spillway will provide release for flood waters.

Accumulated sediments will be flushed several times a year especially during spring and autumn flood periods. During flushing periods the diversion tunnel will be closed, consequently releasing all river flows into the tailrace. Considering the dam height, a fish-passage arrangement has not been considered to be efficient or feasible. A drawing of the Didachara headworks is provided in Figure 2.18 below.

Figure 2.18: Didachara dam and water intake



Source: Mott Macdonald

2.4.2.4 Shuakhevi HPP

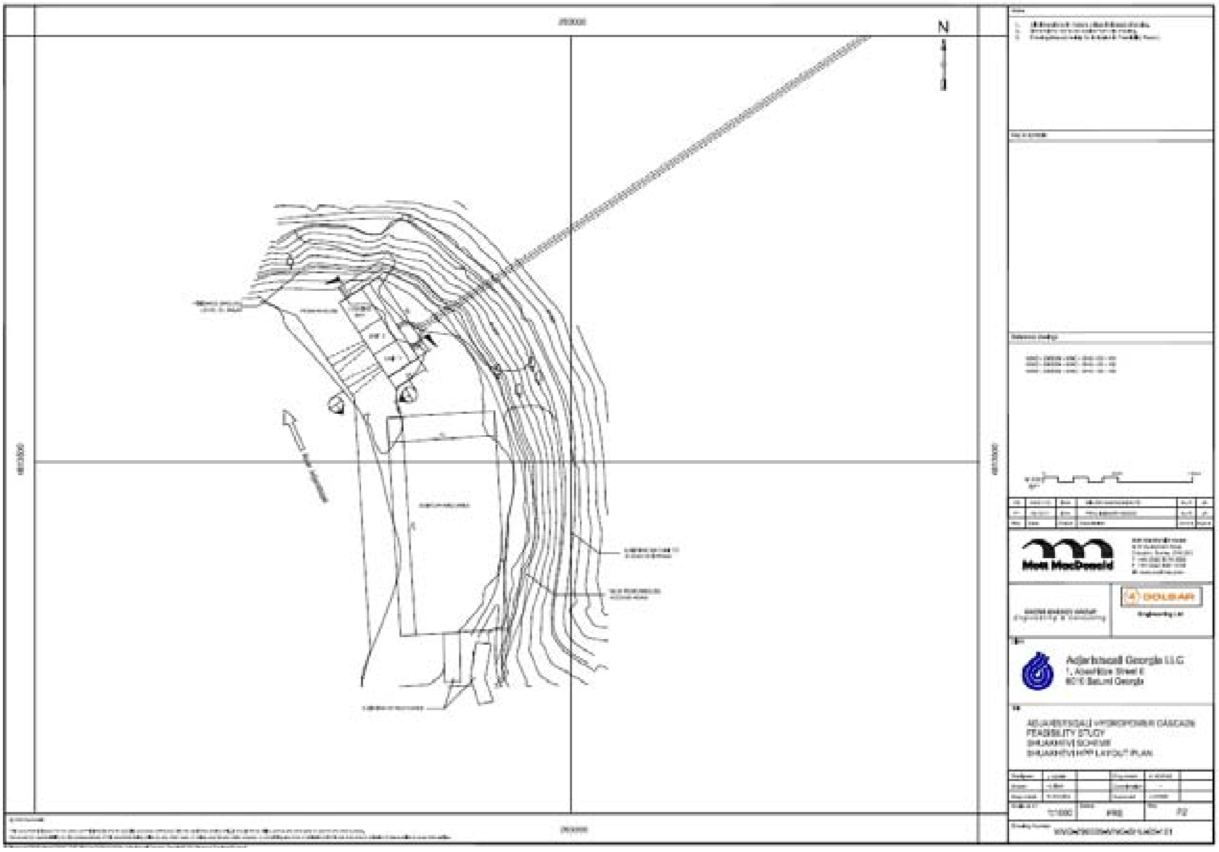
The Shuakhevi HPP will consist of a power house (60 x 24 m) and a 220 kV substation and will be situated upstream from the confluence of the Adjaristsqali and Chvanistsqali Rivers.

The water will go through the headrace tunnel (length 0.05 km, diameter 6.2 m) into the surge shaft (height 154.9 m, diameter 12 m) and then into the pressure shaft (height 370.7 m, diameter 6.2 m) and subsequently to the turbines.

The power house will consist of two Francis turbines each with an 87.5 MW installed capacity. A 220 kV substation will be built on the right side of the power house (with a footprint of 147m by 72 m). The electricity generated from Skhalta HPP will be supplied into the national grid through a 220 kV transmission line. A drawing of the Shuakhevi HPP general arrangement is given in Figure 2.19 below.

.

Figure 2.19: Shuakhevi HPP



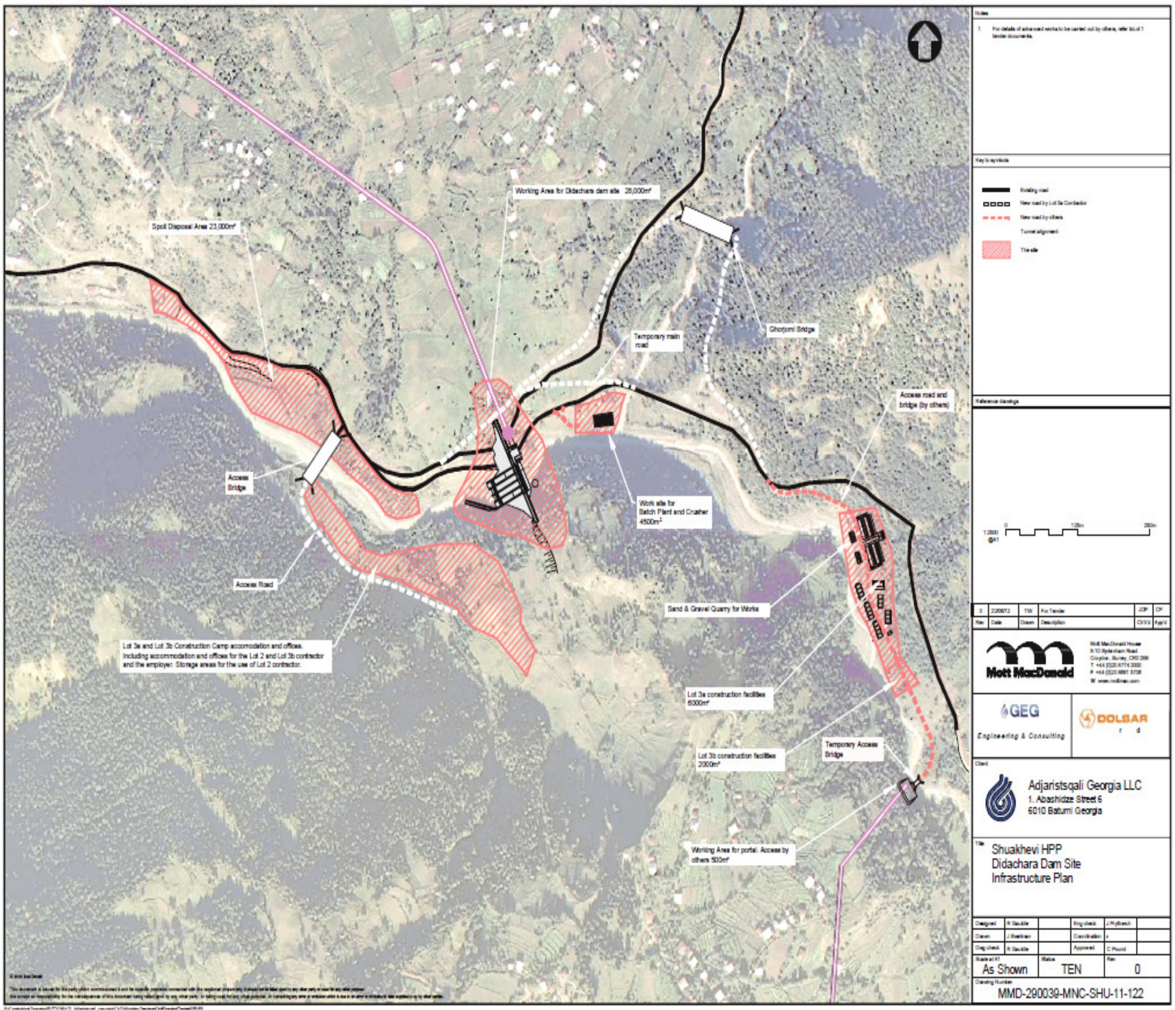
Source: Mott Macdonald

2.4.2.5 Overview of road diversion at Didachara dam

The creation of the Didachara reservoir will cover a 2.5 km section of the Batumi-Akhaltsikhe road and a section of road in Didadjara village, as a result the road will be rebuilt and relocated at a higher elevation around the reservoir.

The new sections of roads are planned to be constructed on slopes and on complex terrain. The first section of the road will go through soft rocks where there could be some risks of landslide, for which appropriate prevention measures have been considered (i.e. groundwater drainage systems, retaining walls). The second section will be on the rocky slopes of the Ghorjomi River where no signs of hazardous geological process were detected. The new roads will consist of two-lanes with 7 m width. In addition a 113.39 m high and 7 m wide concrete reinforced bridge will be built across the Ghorjomi River (Figure 2.20).

Figure 2.20: Road Relocation Design



Source: Mott Macdonald

2.4.3 Koromkheti Scheme

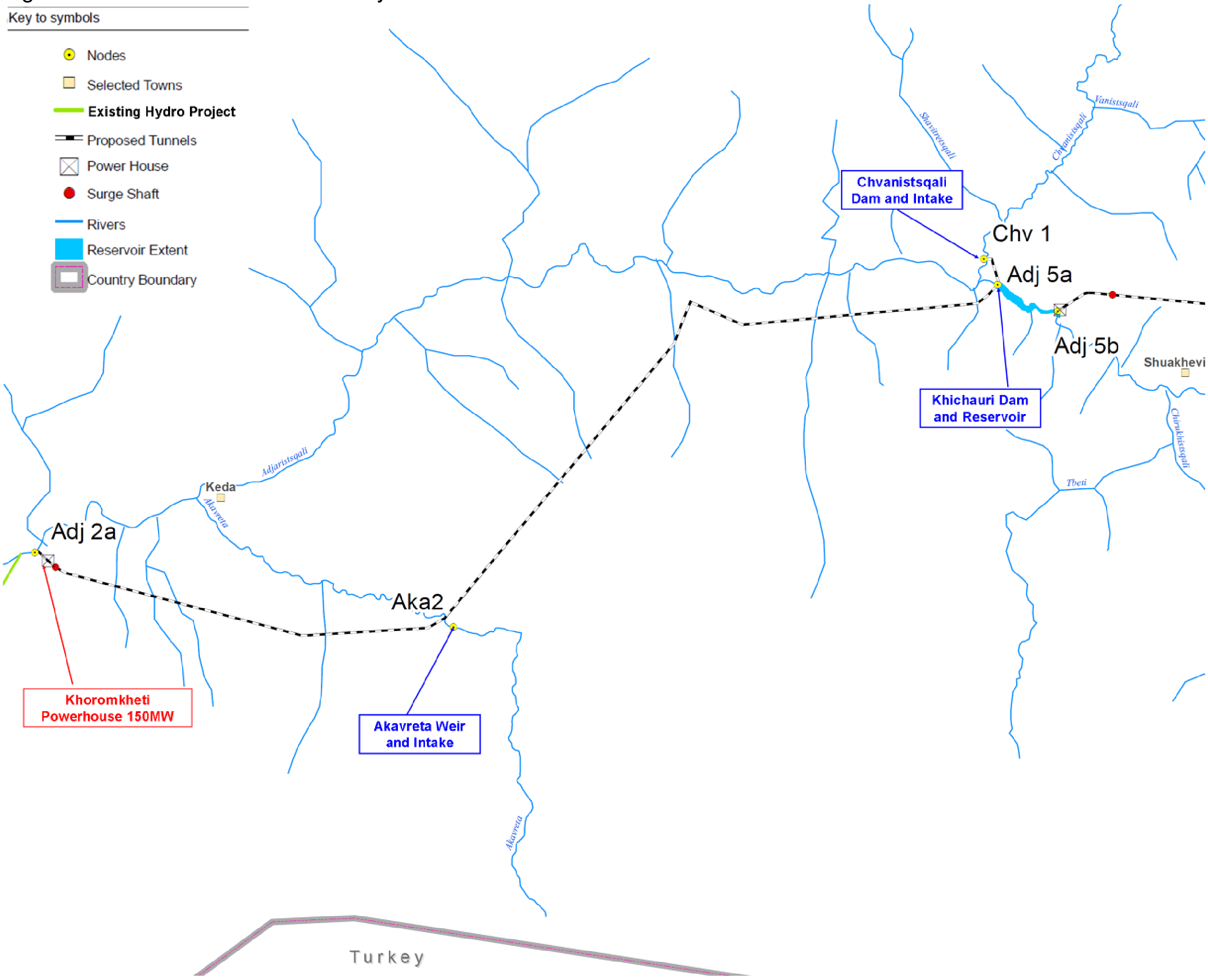
The Koromkheti Scheme will be taking water discharged from the Shuakhevi HPP as well as water flowing into the Adjaristsqali from the Skhalta and Chirukhistsqali Rivers downstream from the Shuakhevi scheme intakes intakes together with flow diverted from the Chvanistsqali River. All waters will be diverted to the Khichauri Reservoir, which will provide some additional diurnal storage into the headrace tunnel which will be located on the left bank. The headrace tunnel travels south west to the Koromkheti powerhouse below the village of Keda on the Adjaristsqali River and just above the existing Atsi hydropower scheme. The key components of the scheme are detailed in Table 2.2, and below in Figure 2.21 and Figure 2.22.

Table 2.2: Khoromkheti Scheme Key Components

Node	Description	Key Parameters
Chv 1	Run-of-river weir and sediment trap on Chvanistsqali River with intake into transfer to	Level: 356m

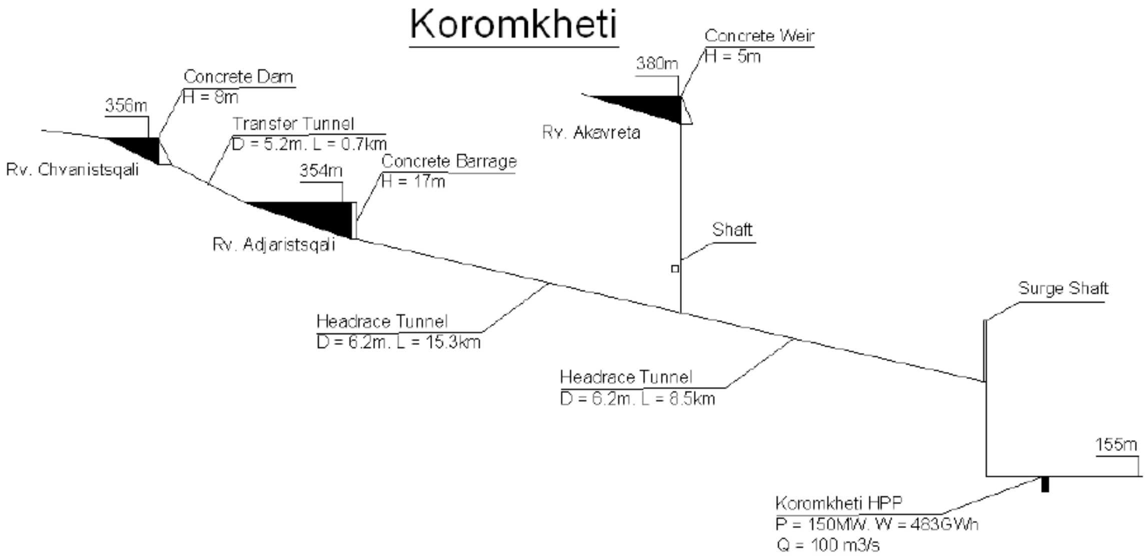
	Khichauri Reservoir	
Chv 1 to Adj 5a	Transfer to Khichauri Reservoir	Lining type: Unlined Length: 0.67 km Diameter: 5.2 m Design capacity: 25 m^3/s
Adj 5a	Khichauri Dam and Storage Reservoir	Type: Concrete barrage Height: 19m Approx. reservoir capacity: 577,000 m^3 Approx. surface area: 187,000 m^2
Adj 5a	Intake to Headrace Tunnel	Operating levels: 349 to 354m
Adj 5a to Aka 2	Headrace Tunnel Intake to Akavreta	Lining type: Concrete lined Length: 15.32 km Diameter: 6.2 m Design capacity: 100 m^3/s
Aka 2	Weir, sediment trap and intake on Akavreta River	Level: 380 m Capacity: 18 m^3/s
	Akavreta Intake Shaft	Lining type: Concrete lined Height: 35.4m Diameter: 4m Capacity: 18 m^3/s
	Akavreta Intake Tunnel	Lining type: Concrete lined Length: 0.29km Diameter: 6.2m Capacity: 18 m^3/s
Aka 2 to Adj 2a	Headrace Tunnel Akavreta to Surge Shaft	Lining type: Concrete lined Length: 8.54 km Diameter: 6.2 m Design capacity: 100 m^3/s
	Surge Shaft	Lining type: Concrete lined Height: 110.8m (CL to GL) Diameter: 20.0m
	Headrace Tunnel Surge Shaft to Pressure Shaft	Lining type: Concrete lined Length: 0.097km Diameter: 6.2m Design capacity: 100 m^3/s
	Pressure Shaft	Lining type: Concrete lined Height: 141.1m Diameter: 6.0m
	Pressure Tunnel Concrete Lined	Lining type: Concrete lined Length: 0.48km Diameter: 6.2m Design capacity: 100 m^3/s
	Pressure Tunnel Steel Lined - single	Lining type: Steel lined Length: 7m Diameter: 5m Design capacity: 100 m^3/s
	Pressure Tunnel Steel Lined - Bifurcation	Lining type: Steel lined Length: 18m (Along Chainage) Diameter: 3.5 m Design capacity: 100 m^3/s (2 x 50 m^3/s)
Adj 2a	Koromkheti Powerhouse	Units: 150 MW (2 x 75 MW) Francis

Figure 2.21: Koromkheti Scheme Layout



Source: Mott MacDonald

Figure 2.22: Design profile of Koromkheti Scheme

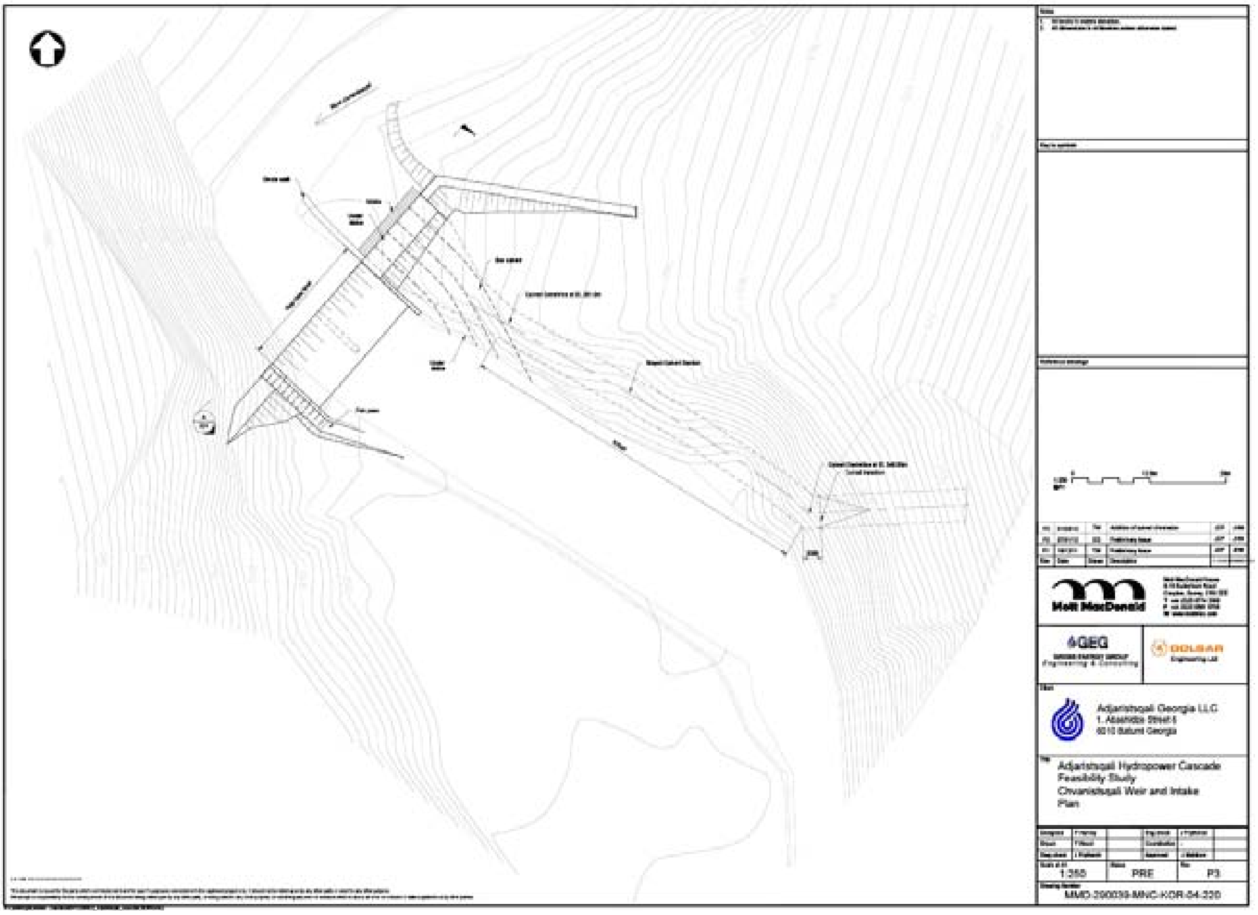


Source: Mott Macdonald

2.4.3.1 Headwork on the river Chvanistskali

An 8 m high concrete dam will be built on the Chvanistsqali River from where water will be transferred into the Khichauri reservoir through a diversion tunnel. The water intake will be located on the left bank and will be equipped with appropriate lock screens and grids. Water from the reservoir will be first transferred to a suspended sediments depositing tank and then into the diversion tunnel. The base of the dam is at 356 masl. The dam will be equipped with 2 sluice gates units which will ensure appropriate water levels in the headrace. Headworks plan is detailed in Figure 2.23 below.

Figure 2.23: Chvanistsqali headworks drawing



Source: Mott Macdonald

2.4.3.2 Khichauri dam and reservoir

The Khichauri reservoir is the main water source for the Koromkheti HPP. The reservoir will be created by a 19 m high concrete dam. The dam will be on the Adjaristsqali River near the confluence with the Chvanistsqali River. The dam will be equipped with 4 units of radial lockers for the release of catastrophic river flow and for periodic reservoir flushing of sediments. The fish-passage arrangement is planned to be situated on the left side of the dam from where the environmental flow will be maintained. For permanent water supply, the fish-passage and water discharge will be arranged on two different levels. The final structure of the fish-passage will be determined during detailed design. The maximum operating level of the reservoir is 354 masl and the minimum operating level is 349 masl. The reservoir's volume will be approximately 577,000 m³ covering a surface are of 187,000 m².

It should be noted, that approximately 1.5-2.0 km of a road section will be permanently inundated as a result of the scheme, and as such will need to be relocated to a higher elevation.

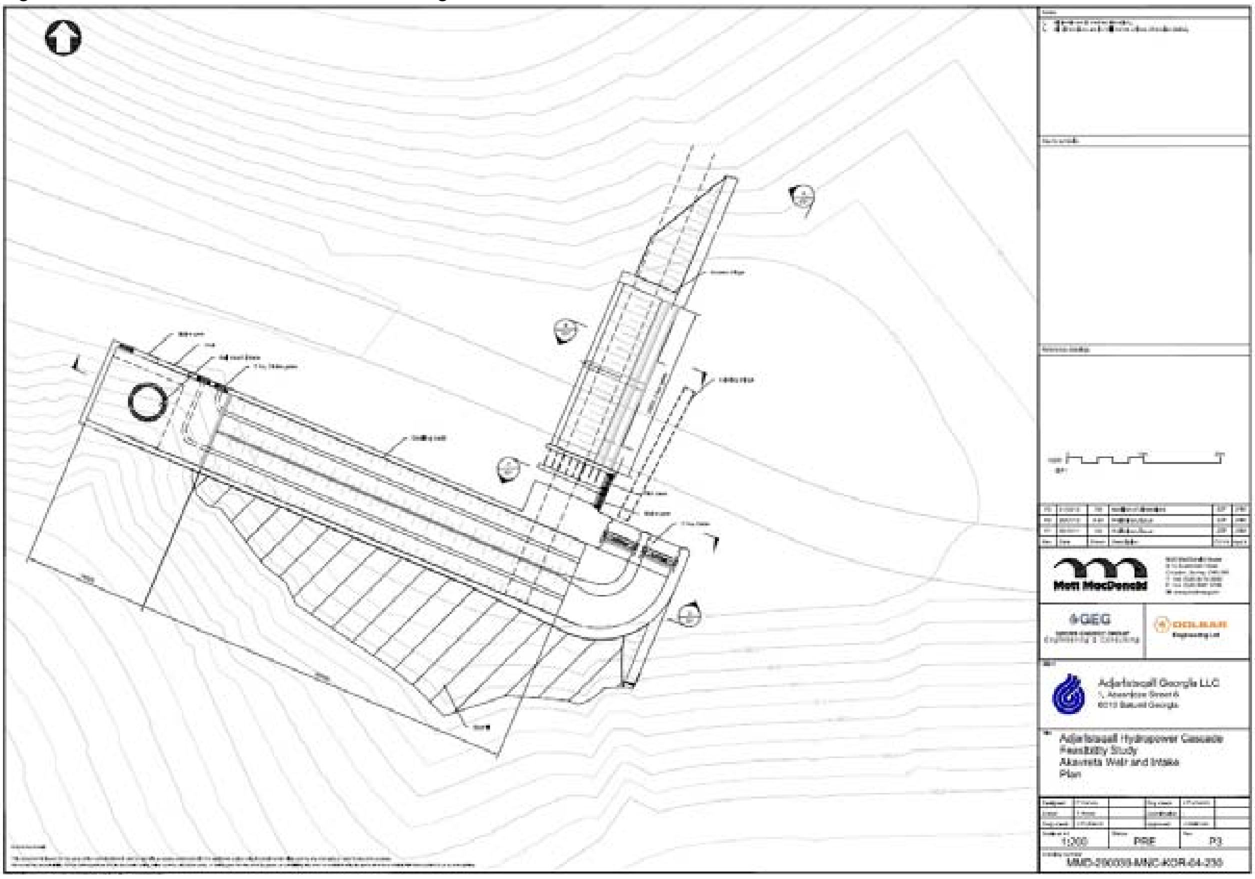
The water intake will be situated on the left bank and will be equipped with two locking screens and trash screens. Water will flow from the intake into the diversion tunnel, which will be constructed on the left bank of the river Adjaristsqali. The diversion tunnel will be 15.3 km long with a diameter of 6.2 m. The Khichauri headworks drawing is given in Figure 2.24 below.

tunnel section from the Akavreta water intake to the surge shaft will be 8.5 km long with 6.2 m as diameter. A fish passage has also been incoproated into th design and will more fully defined as part of the detailed design phase.

Akavreta headworks drawing is given in Figure 2.25 below.

.

Figure 2.25: Akavreta headworks drawing



Source: Mott Macdonald

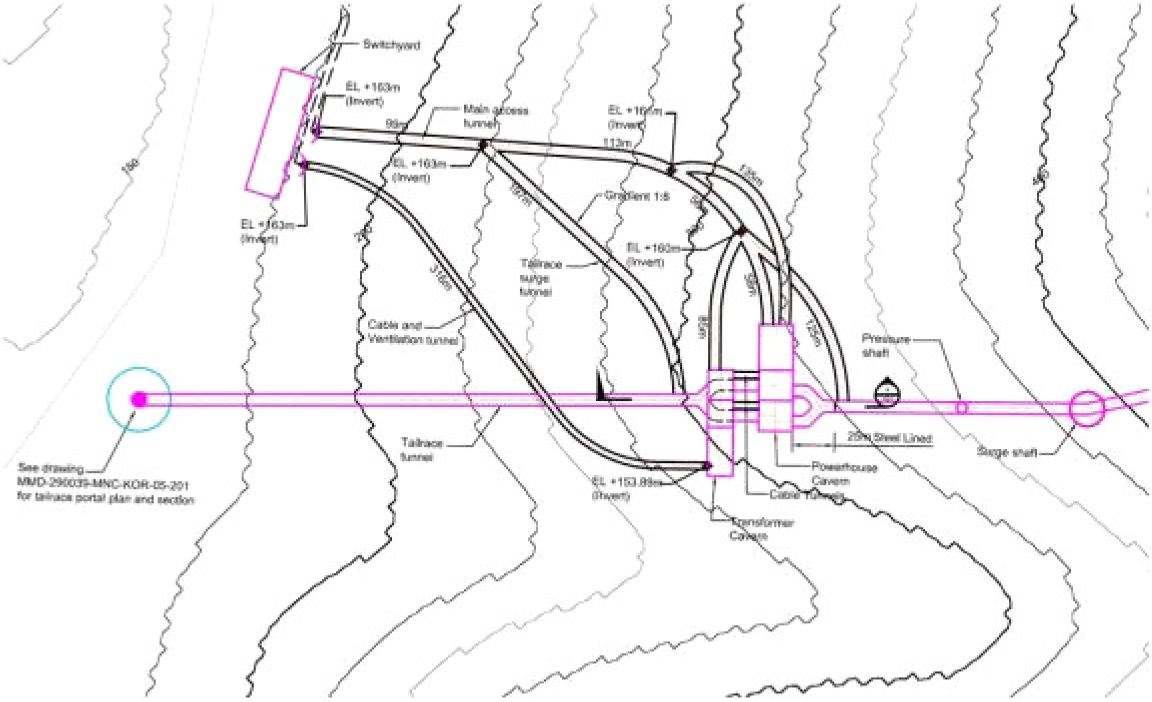
2.4.3.4 Koromkheti HPP

The Koromkheti HPP power unit will be situated on the left bank of the Adjaristsqali River, adjacent to the village of Koromkheti. The power unit will include an underground power house; substation; surge shaft; head-race; pressure tunnels and discharging channel.

The surge shaft will have a height of 110.8 m and a diameter of 20 m, it will be connected to the pressure shaft by a head race tunnel of 97 m in length and a diameter of 6.2 m with a capacity of 100 m^3/s. Pressure shaft height amounts to 141.1 m with a diameter of 6.0 m. The pressure tunnel consists of 2 parts: a concrete lined section and a steel lined section. The first section of the pressure shaft will be 0.48 km long with a diameter of 6.2 m and the second section will be 7 m long with a 5 m diameter. The final section of the pressure tunnel is divided into two (turbine, tunnels), the length will be 18 m with a diameter of 3.5 m with a capacity of 50 m^3/s (2 x 50 m^3/s = 100 m^3/s). Discharge water released from the power house will be released through a discharging channel.

The underground power house will be equipped with two Francis type turbines with a capacity of 75 MW each (water flow 50 m^3/s). The underground power house will be connected to the planned 220 kV substation on the surface. Electricity transfer from the substation to the national grid will be through a 220 kV transmission line. See Figure 2.26 for drawing of the Koromkheti underground HPP.

Figure 2.26: Koromkheti HPP



Source: Mott Macdonald

2.4.4 Khertvisi Scheme

The Khertvisi scheme is located just downstream of the existing Atsi HPP and utilises the remaining head available to the downstream limit of AGL's concession at the confluence of the Adjaristsqali River with the Chorokhi River. A small reservoir providing limited diurnal storage will be located at the beginning of the scheme, the Khertvisi reservoir. The Khertvisi HPP will discharge directly back into Adjaristsqali River.

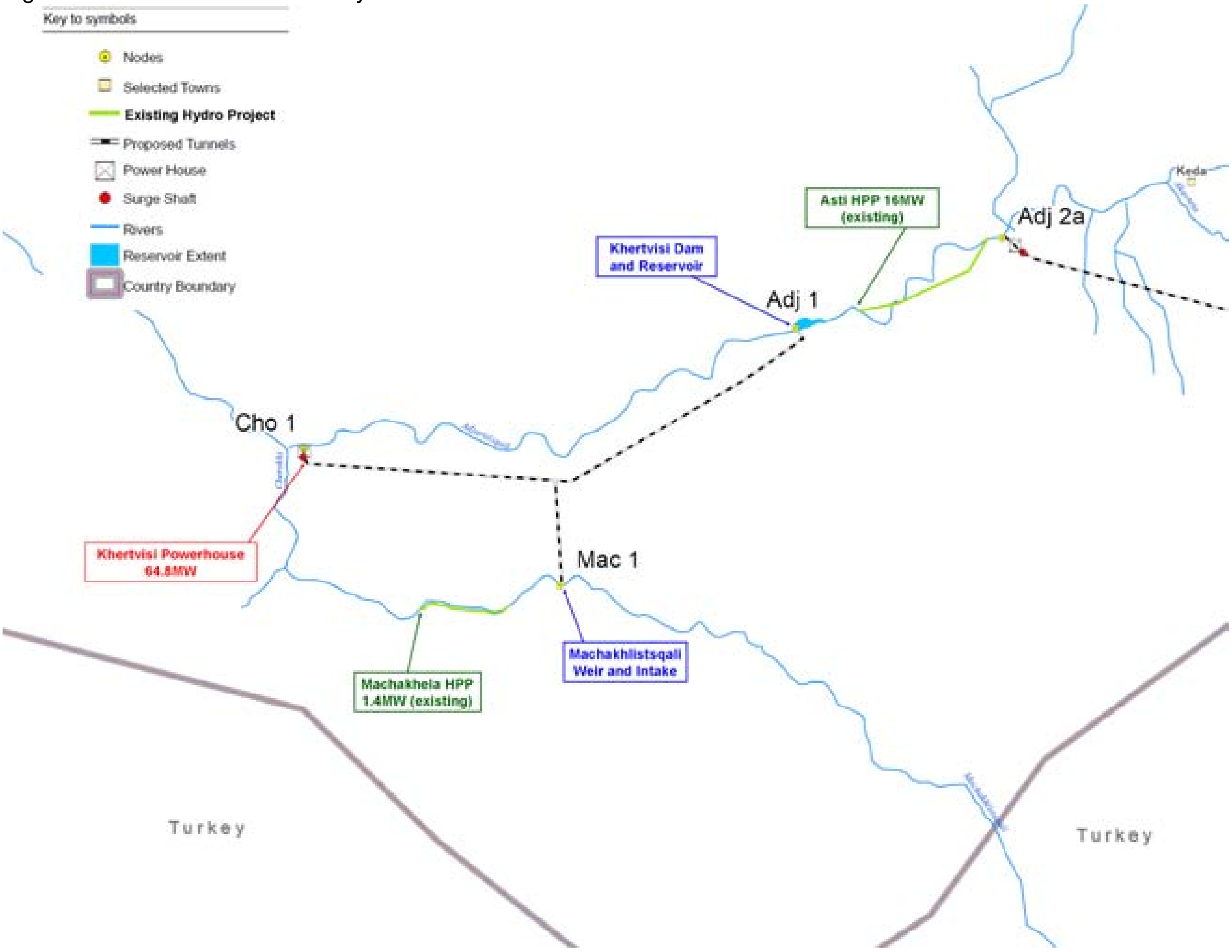
The headrace tunnel will be located on the left bank primarily to enable an intermediate intake into the headrace from the Machakhlistsqali River. The key components of the scheme are detailed in Table 2.3 below and illustrated in Figure 2.27 and Figure 2.28.

Table 2.3: Khertvisi Scheme Key Components

Node	Description	Key Parameter
Adj 1	Barrage with sediment trap Khertvisi Reservoir	Type: Concrete barrage Height: 4.8 m Approx. reservoir capacity: 150,000 m^3 Approx. surface area: 93,000 m^2
Adj 1	Intake to headrace tunnel	Operating levels: 97 to 99 m

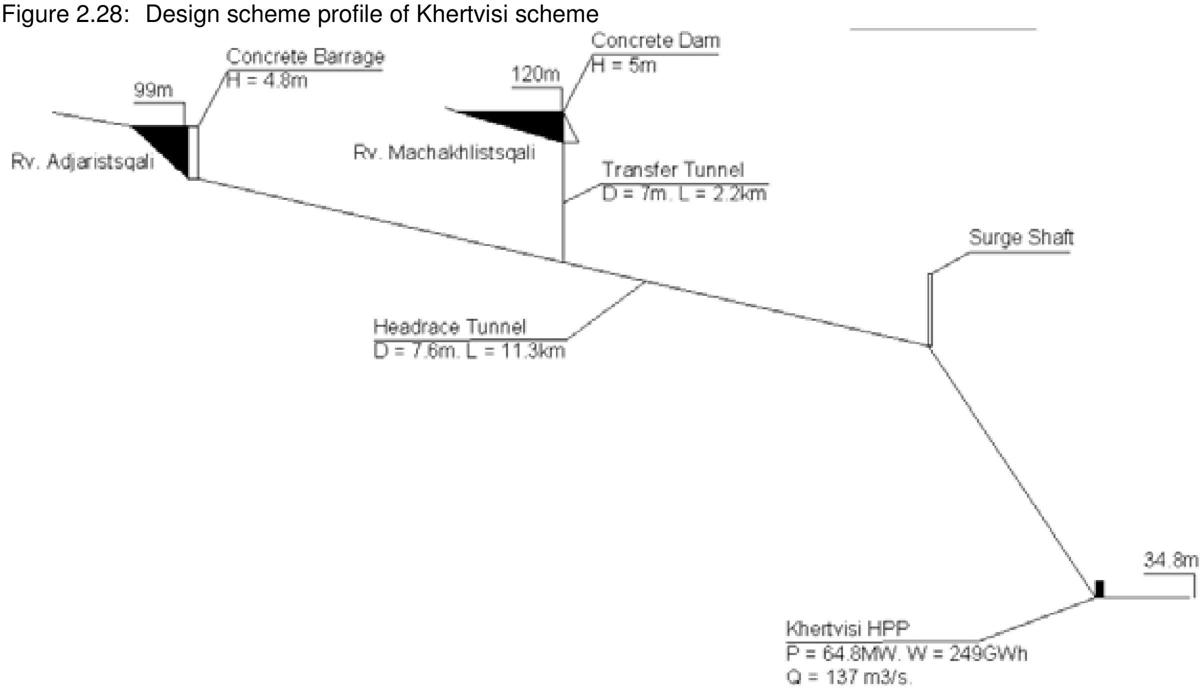
Adj 1 to Cho 1	Headrace Tunnel Intake to Connection at Ch 958	Lining type: Concrete lined Length: 0.96 km Span and height: 7m Design capacity: 137 m^3/s
	Headrace Tunnel Connection at Ch 958 to Connection at Mac	Lining type: Segmental lining Length: 5.20km Diameter: 7.6m Design capacity: 137 m^3/s
Mac 1	Run-of-river weir and sediment trap with intake on Machakhlistsqali River into connecting headrace	Level: 120 m
Mac 1 to Adj 1/Cho 1	Machakhlistsqali Transfer Tunnel	Lining type: Concrete lined Length: 2.16km Diameter: 7m Design capacity: 37 m^3/s
	Headrace Tunnel Connection at Mac to Surge Shaft	Lining type: Segmental lining Length: 5.25km Diameter: 7.6m Design capacity: 137 m^3/s
	Surge Shaft	Lining type: Concrete lined Height: 75.4m (CL to GL) Diameter: 26.0m
	Headrace Tunnel Surge Shaft to Pressure Tunnel	Lining type: Concrete lining Length: 0.03km Diameter: 7.0m Design capacity: 137 m^3/s
	Pressure Tunnel Concrete Lined	Lining type: Concrete lining Length: 0.07km Diameter: 7.0m Design capacity: 137 m^3/s
	Pressure Tunnel Steel Lined - Single	Lining type: Steel lining Length: 0.15km Diameter: 6.5m Design capacity: 137 m^3/s
	Pressure Tunnel Steel Lined – Bifurcation (Surface)	Lining type: Steel lining (Bifurcation) Length: 17m (Along Chainage) Diameter: 3.5m Design capacity: 68.5 m^3/s
Cho 1	Khertvisi Powerhouse	Units: 64.8 MW (2 x 32.4 MW) Francis

Figure 2.27: Khertvisi Scheme Layout



Source: Mott MacDonald Ltd

Figure 2.28: Design scheme profile of Khertvisi scheme



Source: Mott Macdonald

2.4.4.1 Weir and reservoir on the river Adjaristsqali

The Khertvisi scheme will have a concrete dam with a height of 5 m constructed on the river Adjaristsqali, in between the villages Kveda Bzubzu and Makhuntseti. This dam will create a reservoir with a total volume of 150,000 m^3 covering a surface area of approximately 93,000 m^2. The drawing of the dam is provided in Figure 2.29 below. As shown, the fish-passage arrangement has been tentatively located on the right bank of the dam. The fish-passage will be connected to the headrace by a two-leveled entrance, ensuring uninterrupted functioning during the operation of the reservoir providing uninterrupted release of the environmental flow. The Khertvisi dam will be equipped with 12 of radial gates, it will be possible to release the flood waters and flush the reservoir from accumulated sediments, which will take place several times a year especially during the spring and autumn floods

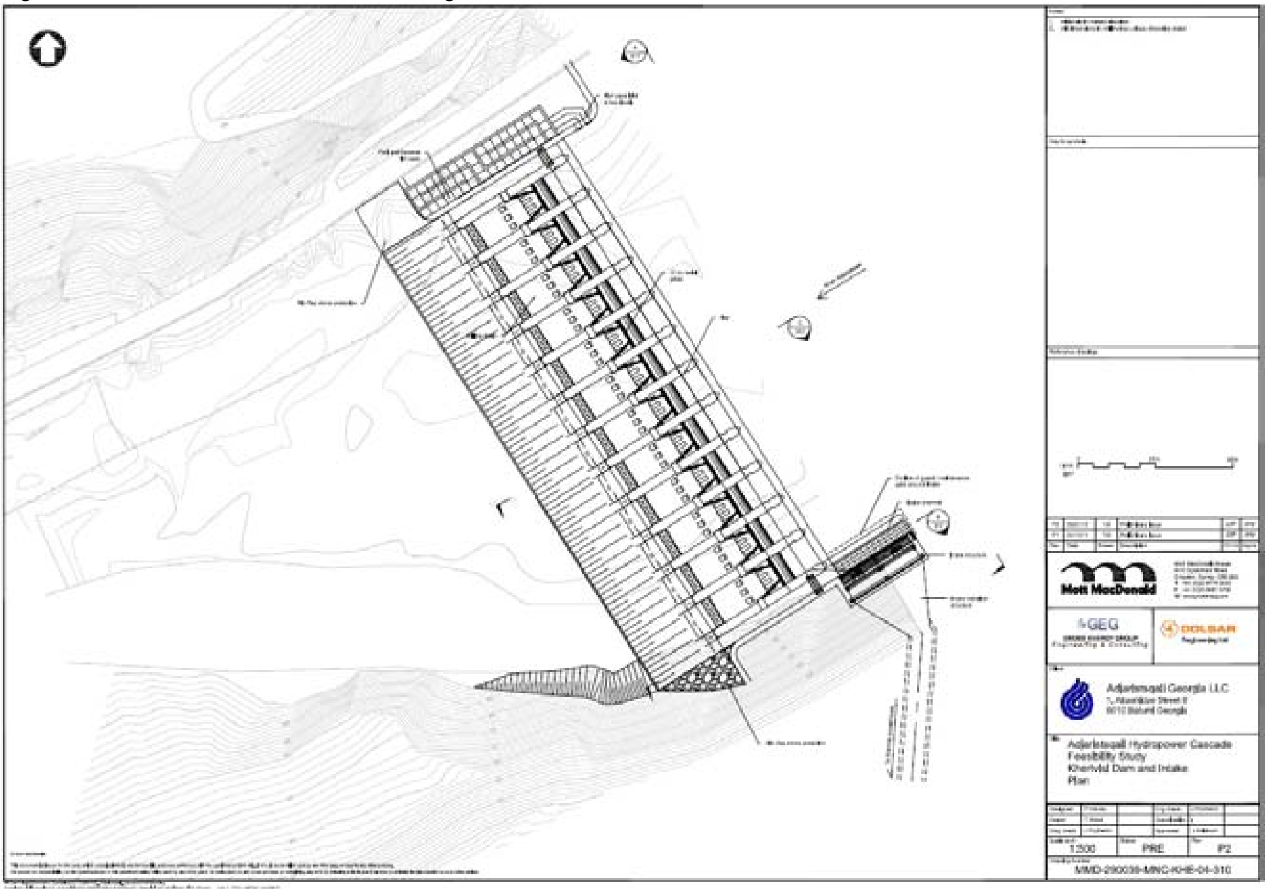
The water intake will be located on the left bank of the river, from where the water will flow into the diversion tunnel. The diversion tunnel will be 10.5 km long.

2.4.4.2 Weir and water intake on river Machakhlistsqali

In order to increase the Khertvisi scheme water flow and consequently its installed capacity, water from the Machakhlistsqali River will be diverted into the scheme. For this purpose, near the village Sindieti at an elevation of 120 masl, a 5 m reinforced-concrete weir will be constructed with 4 units of radial gates. The fish-passage arrangement will be situated on the right side of the weir which will also provide the environmental flow. The final structure of the fish-passage will be determined during the detailed design phase.

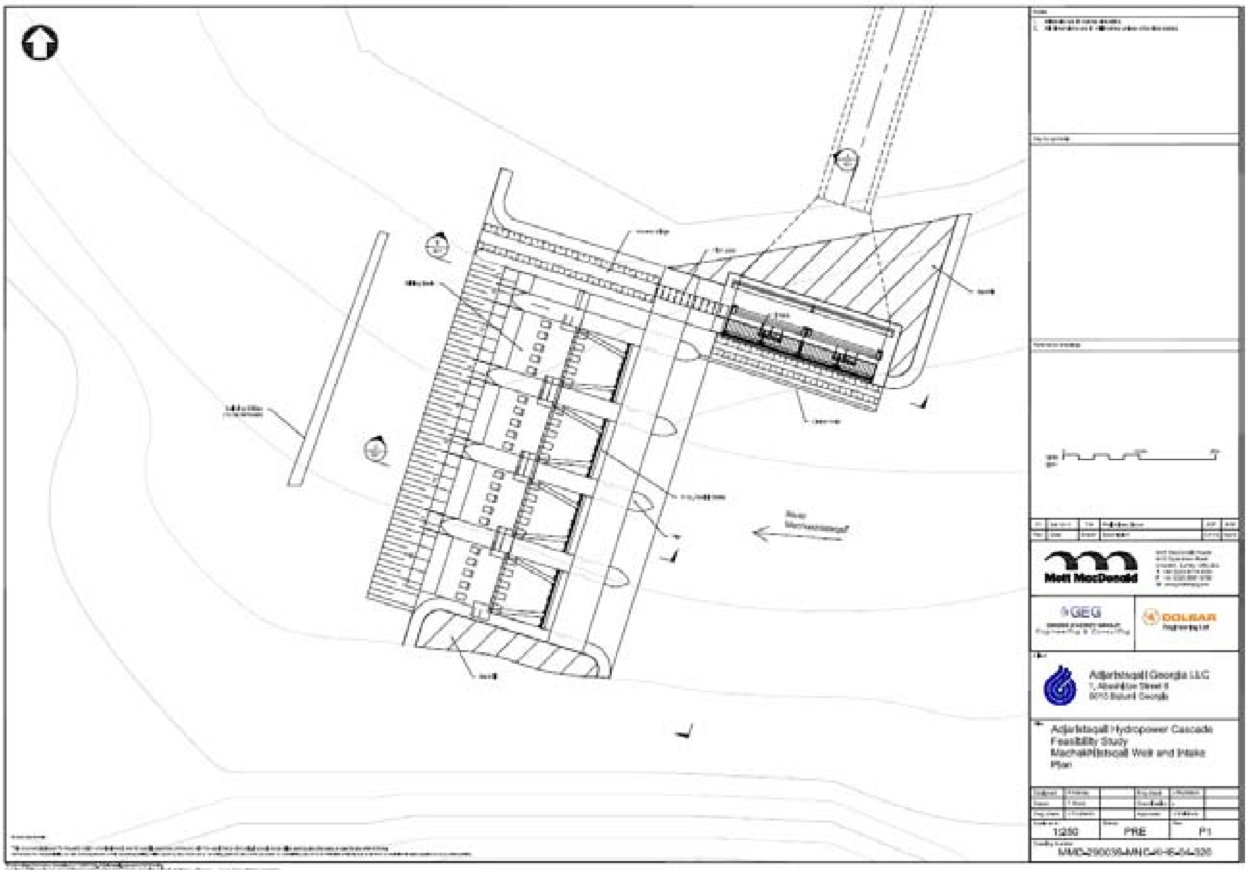
The water intake arrangement will be placed on the right bank, from where the water will be transferred and connected to the main diversion system. The transfer tunnel will be 2.16km long with a diameter of 7m and with a capacity 37 m^3/s. The Machakhlistsqali weir and water intake drawing is given in Figure 2.30 below.

Figure 2.29: Khertvisi Headworks Drawing



Source: Mott Macdonald

Figure 2.30: Machakhela Wier Headworks Drawing



Source: Mott Macdonald

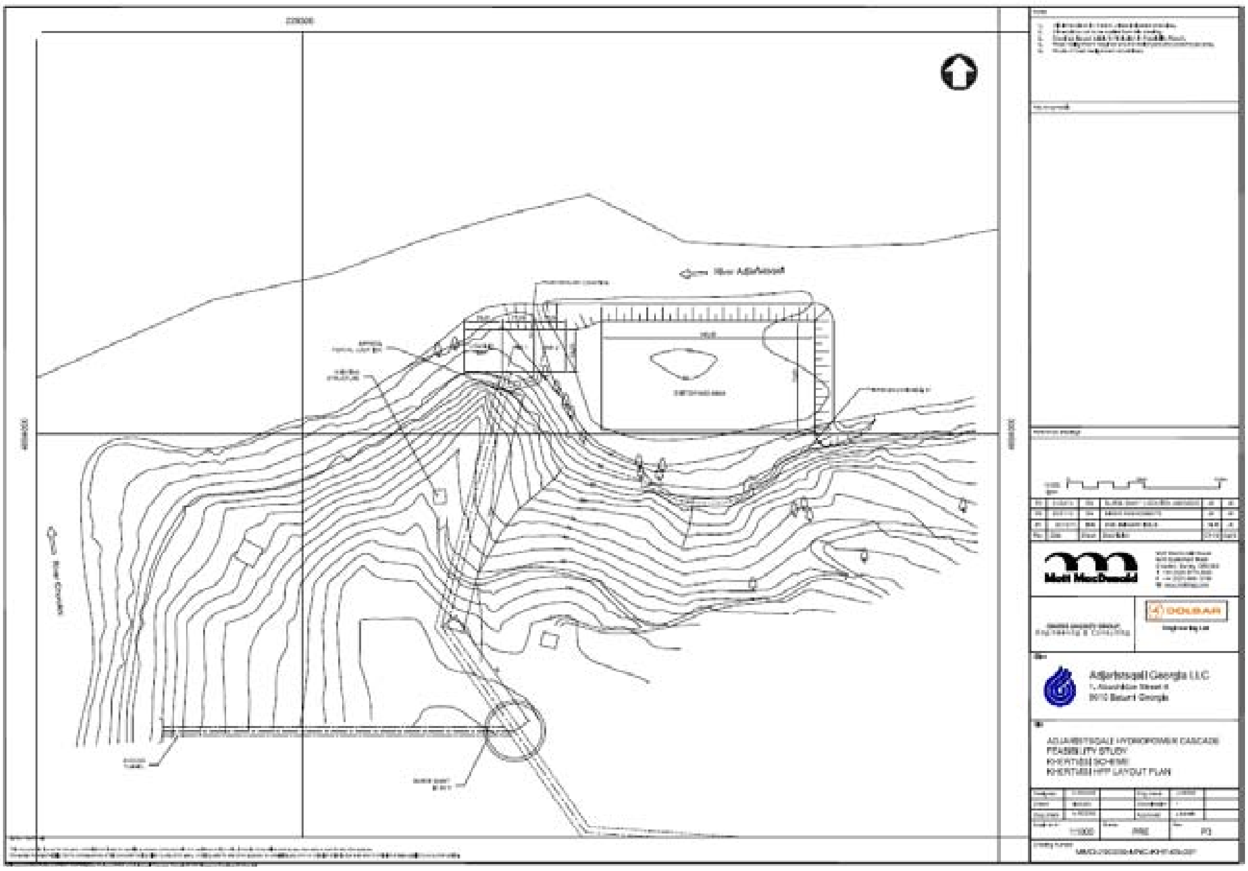
2.4.4.3 Khertvisi HPP

The power house will be located on the left bank of the River Adjaristsqali, adjacent to the confluence with the river Chorokhi. The power house will include a pressure system; power house; discharge tunnel and substation.

The pressure system starts from the surge shaft (height 75.4 m, diameter 26.0 m), which connects the pressure tunnel through the head-race tunnel (length 0.03 km, diameter 7 m), which in turn connects with the turbine tunnels. The discharge water will be discharged into the Adjaristsqali River through a discharge tunnel. The surface power house will consist of two Francis turbines with an installed capacity of 32.8 MW each and flow of 68.5 m^3/s. The Powerhouse drawing is given in below.

A 220kV substation will be constructed on the left bank of the Adjaristsqali River, near the confluence of river Chorokhi. The generated electricity will be transferred to the national grid through a 220 kV transmission line.

Figure 2.31: Khertvisi HPP



Source: Mott Macdonald

2.5 Operational Regime

The Project has been designed to operate as a peaking plant, maximising energy production during periods of high demand to take advantage of higher peak energy prices in Turkey. Hydropower schemes unlike other types of energy are capable of almost instantaneous power generation so long as the water is available. The schemes in the project provide only diurnal storage and are expected to operate at the design discharge so as to achieve peak efficiency for the turbines. At times when inflows into the reservoirs are not sufficient for continuous operation at the design discharge, the reservoirs can be drawn down within the reservoir operating limits. Alternatively the turbines could be turned off in order to fill the reservoirs and ensure that sufficient water is available to operate at rated discharge (and therefore peak efficiency) during hours of peak energy prices in Turkey.

2.6 Construction Infrastructure

2.6.1 Introduction

This section provides an overview of the infrastructure works required prior to execution of the main civil works, activities include:

The infrastructure works include the:
- Rehabilitation of existing bridges and roads
- Construction of temporary / permanent bridges and access roads
- Setting up of camp sites, workshops and stores
- Arrangements for temporary construction power supplies
- Arrangements for reliable telecommunication facilities
- Identification and setting up of quarry sites
- Identification and preparation of spoil disposal areas.

It is estimated that these works will require an overall period of 12 months as part of an advanced work contract with individual items scheduled to suit the start of the principal construction activities.

2.6.2 Roads and Bridges

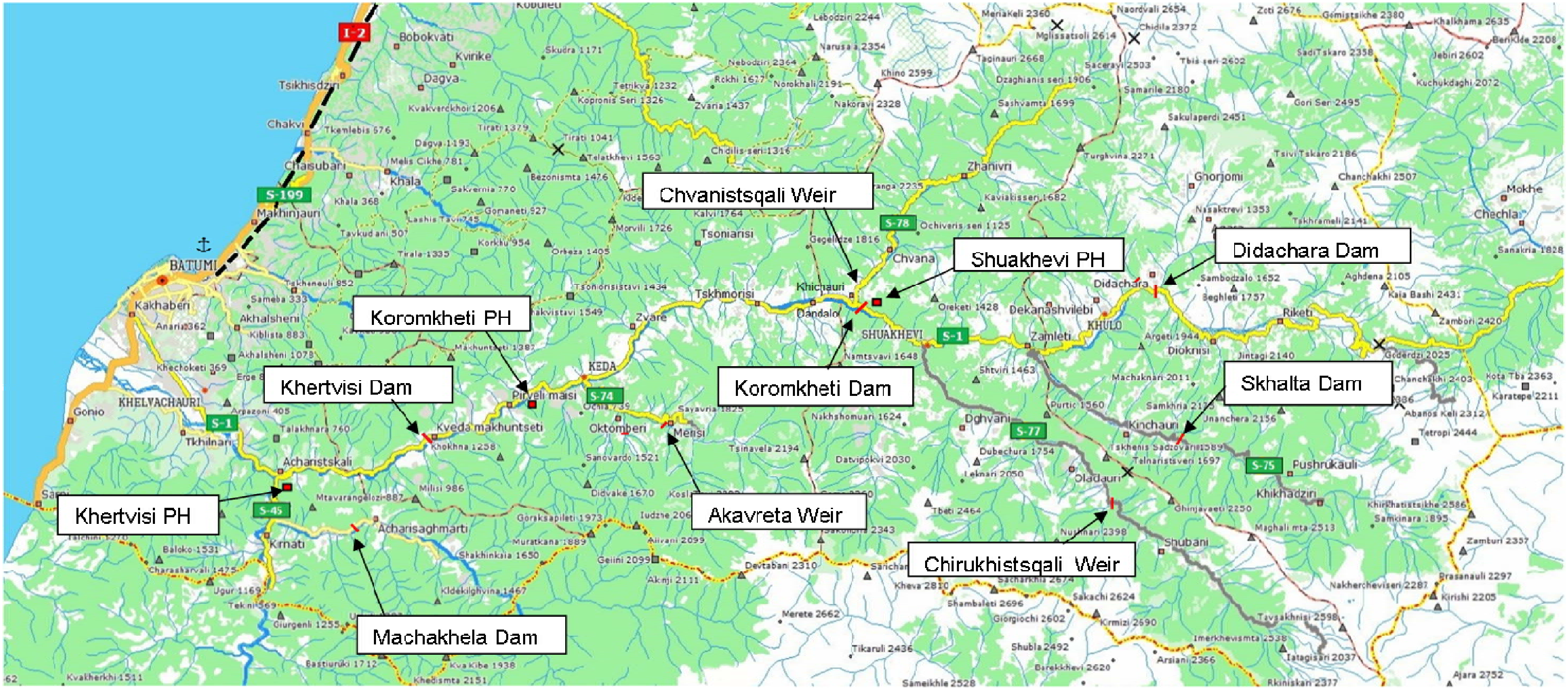
The main Project components are located along the international state highway S-1. Despite the good conditions of the access roads to the majority of the Project sites, a number of bridges and roads will have to be rehabilitated (strengthened and in some cases widened) to allow heavy equipment and abnormal loads to be delivered to the Project sites. The sites of all the major components of each scheme, i.e. dam, intakes, headrace tunnel, surge shaft and tunnel, pressure shaft, powerhouse, tailrace tunnel and associated structures will be connected to the existing road system by new access roads. It is envisaged that these access roads will have a formation width of 5 m with 3 m of metalling.

The following new roads and bridges are envisaged to be constructed:
- Up to eight potential new roads or extensions totalling 5.9 km and four bridges spanning 213 m for the Shuakhevi scheme;
- Up to ten new roads or extensions totalling 7.3 km and three bridges spanning 109 m for the Koromkheti scheme; and
- Up to six new roads or extensions totalling 1.3 km and two bridges spanning 150 m for the Khertvisi scheme.

The actual number of access roads and their final locations will be determined as part of the detailed design and take into consideration the recommendations of this ESIA.

In addition two sections (2.5 km and 1.5 km respectively) of the existing S-1 road will have to be re-aligned during the construction phase because they will be flooded by the proposed Didachara Dam and Khichauri Dam. Figure 2.32 of road network shows the location of the proposed project areas in relation with the highway. Chapter 13 provides additional description of the road access and potential impacts.

Figure 2.32: Project area road network



Source: Mott MacDonald Limited

2.6.3 Construction Laydown and Worker accommodation

Temporary facilities at appropriate locations, including worker accommodation sites, will be required during the construction of the project. The civil contractor will decide the location and number of concrete batching and mixing plants, stores and workshops for each of the schemes. At this moment it is envisaged that each facility will include a concrete batching and mixing plant, main stores (covered and uncovered) and a workshop for maintenance of project equipment. The main camp with offices for the contractor and temporary quarters for project staff will be located near the powerhouse site. Smaller camps will be arranged near the dam sites which will include a site office and temporary quarters. An additional area is available near the adits for the workshops. Facilities will include:

- Parking and general storage areas (covered and uncovered)
- Storage facilities for cement, steel and other materials including chemicals
- Storage and delivery of fuel
- Explosive magazines
- Maintenance workshop for heavy earth moving equipment and transport vehicles
- Workshop for fabrication of, for example, steel linings, tunnel segments
- Testing laboratory
- Accommodation for support staff.

The following sites have been identified for proposed construction facilities for the Shuakhevi scheme:

- Adjacent to Chirukhistsqali Weir
- Adjacent to Skhalta Dam
- Adjacent to Didachara Dam
- Adjacent to the Shuakhevi powerhouse
- Adjacent to one of the construction adits of the headrace tunnel.

The camps at the Didachara and Skhalta dam sites are proposed for 100 to 150 people, with a smaller camp at Chirukhistsqali for around 50 people. The main project camp is proposed to accommodate around 400 people near the powerhouse location. Overall during the peak construction period, approximately 600 to 800 people are expected on site.

The following sites have been identified for proposed construction facilities for the Koromkheti scheme:

- Adjacent to Khichauri Dam
- Adjacent to the Koromkheti powerhouse
- Adjacent to one of the construction adits of the headrace tunnel.

The camp at the Khichauri dam site is proposed for 100 to 150 people, with a smaller camp at Akavreta for around 50 people. The main project camp at the powerhouse is proposed to accommodate around 400 people. Overall during the peak construction period, approximately 600 people are expected on site.

The following sites have been identified for proposed construction facilities for the Khertvisi scheme:

- Adjacent to Khertvisi Dam
- Adjacent to Machakhela Dam
- Adjacent to Khertvisi powerhouse
- Adjacent to construction adits of the headrace tunnel.

The camp at the Khertvisi dam site is proposed for 100 to 150 people, with a smaller camp at Machakhlistsqali for around 50 people. The main project camp at the powerhouse is proposed to accommodate around 300 people. Overall during the peak construction period, approximately 500 people are expected on site.

Table 2.4: Estimated construction phase land requirements for the Project (as of February 2012)

Project Element	Project component		Temporary/ Permanent	Area required (m^2)	Total area required (ha)
Staff buildings (to include water treatment facilities)	Living accommodation	Shuakhevi	Temporary/ Permanent	Unknown at present	Unknown at present
	Living accommodation	Koromkheti	Temporary/ Permanent	Unknown at present	
	Living accommodation	Khertvisi	Temporary/ Permanent	Unknown at present	
	Project headquarters in Kokotauri and Dandalo	All schemes	Permanent	Unknown at present	
Construction lay-down areas (warehouse, workshops, offices etc.)	Powerhouse and dam sites	Shuakhevi	Temporary	50,000-60,000	86
	Construction Portals/Adits		Temporary	180,000 (6 portals)	
	TBM drive site		Temporary	170,000	
Construction lay-down areas (warehouse, workshops, offices etc.)	Powerhouse and dam sites	Koromkheti	Temporary	30,000-50,000	
	Construction Portals/ Adits		Temporary	120,000 (4 portals)	
			Temporary		
Construction lay-down areas (warehouse, workshops, offices etc.)	Powerhouse and dam sites	Khertvisi	Temporary	30,000-50,000	
	Construction Portals/Adits		Temporary	60,000 (2 portals)	
	TBM drive site		Temporary	170,000	
Infrastructure and services for construction	Road widening, new roads, and new bridges.	All Schemes	Permanent	Unknown at present	Unknown at present
Total Temporary land requirements known at present					**86**

2.6.4 Construction Materials

Construction materials such as cement, structural steel, reinforcement steel, rock bolts, bricks, paints, timber will be procured directly by the contractor from sources approved by AGL. However, fine and coarse aggregate to be used in the preparation of concrete is planned to be made available from suitable quarry sites in the vicinity of the various project components and muck from tunnel excavation to optimise the applicable cost of construction materials

As part of the Feasibility Study, initial reconnaissance surveys have been undertaken to identify potential aggregate quarry sites throughout the Project area to supply each of the schemes with locally available materials. There are also a number of existing quarries within the Project area that will also be investigated. Indicative quarry sites identified for each scheme are illustrated in Figure 2.33 to Figure 2.35 (see section 2.6.8). Best practices measures will be employed by all contractors in exploiting quarry sites to minimise their impact on communities and the landscape. Specific reinstatement measures will be implemented at all quarry sites on completion of construction activities.

2.6.5 Spoil Disposal

During construction a significant amount of spoil material from a number of excavation activities (dam foundations, powerhouse caverns, and tunnelling being the most significant) will need to be disposed of and reinstated in a managed way, throughout the construction process. The total estimated spoil quantities for the Project, assuming that no material is re-used as part of the construction process, are 6.6 million m^3.

The Feasibility Study has undertaken an initial desk based assessment of proposed spoil disposal locations which confirm that there are sufficient locations within the Project area where spoil can be permanently disposed of. Chapter 12 provides additional detail on individual spoil sites and the quantities and methods proposed for disposal.

During detailed design further assessment of the proposed spoil disposal sites will be undertaken to confirm their suitability, size and distance from excavation source. The contractor will employ best practice measures when grading and reinstating spoil disposal areas to ensure their stability and avoid erosion. Tunnel excavations will be taking place on a 24hr basis, however it is likely that spoil will temporarily be stored at or near excavation points and subsequently taken to final disposal locations during the day.

2.6.6 Water Supply

The project area is rich with local springs and wells suitable for drinking. The provision of adequate water supplies for both industrial supply and the use of personnel will be available locally from the water supply schemes of Khulo, Shuakhevi and Keda. Suitable drinking water tanks will be provided at higher/remote construction locations.

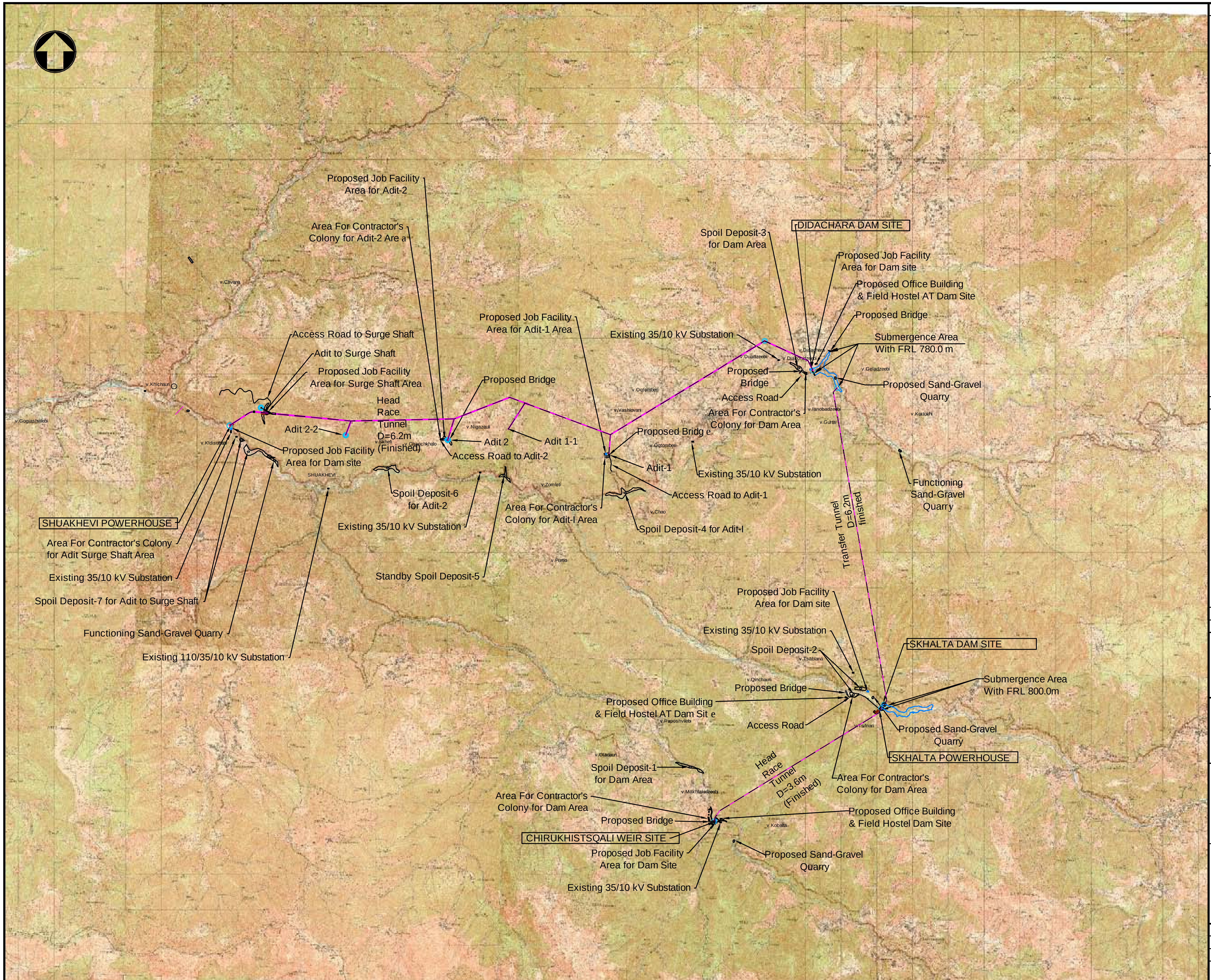
The provision for water treatment plants is also envisaged at suitable locations (ideally near worker accommodation sites) to ensure availability of safe drinking water. During the operation phase, septic tanks will be emptied using special vehicles in line with contracts with the local water supply authorities of Khulo, Shuakhevi and Keda municipalities.

2.6.7 Power requirements

Between 5 and 16 MW of electricity will be needed during construction works. As part of the Feasibility Study a number of substations in proximity to key project construction areas have been identified as potential sources of electricity. However, a full power study will be required during detailed design as well as consultation with the substation operators Energo-Pro Georgia. Should there be insufficient power available to allow direct connection to existing substations, the Project will use a number of diesel generators of varying sizes depending on the location and power requirements. It is likely that diesel generators will be used in any case in more remote project site locations.

2.6.8 Construction infrastructure maps

Figures 2.19 to 2.21 below provide an overview of the proposed locations for construction infrastructure associated with each scheme as described in the sections above.



Notes

Key to symbols

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	10/01/12		Preliminary Issue		

Mott MacDonald

Mott MacDonald House
8-10 Sydenham Road
Croyden, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG
GROSS ENERGY GROUP
Engineering & Consulting

DOLSAR
Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi Georgia

Title

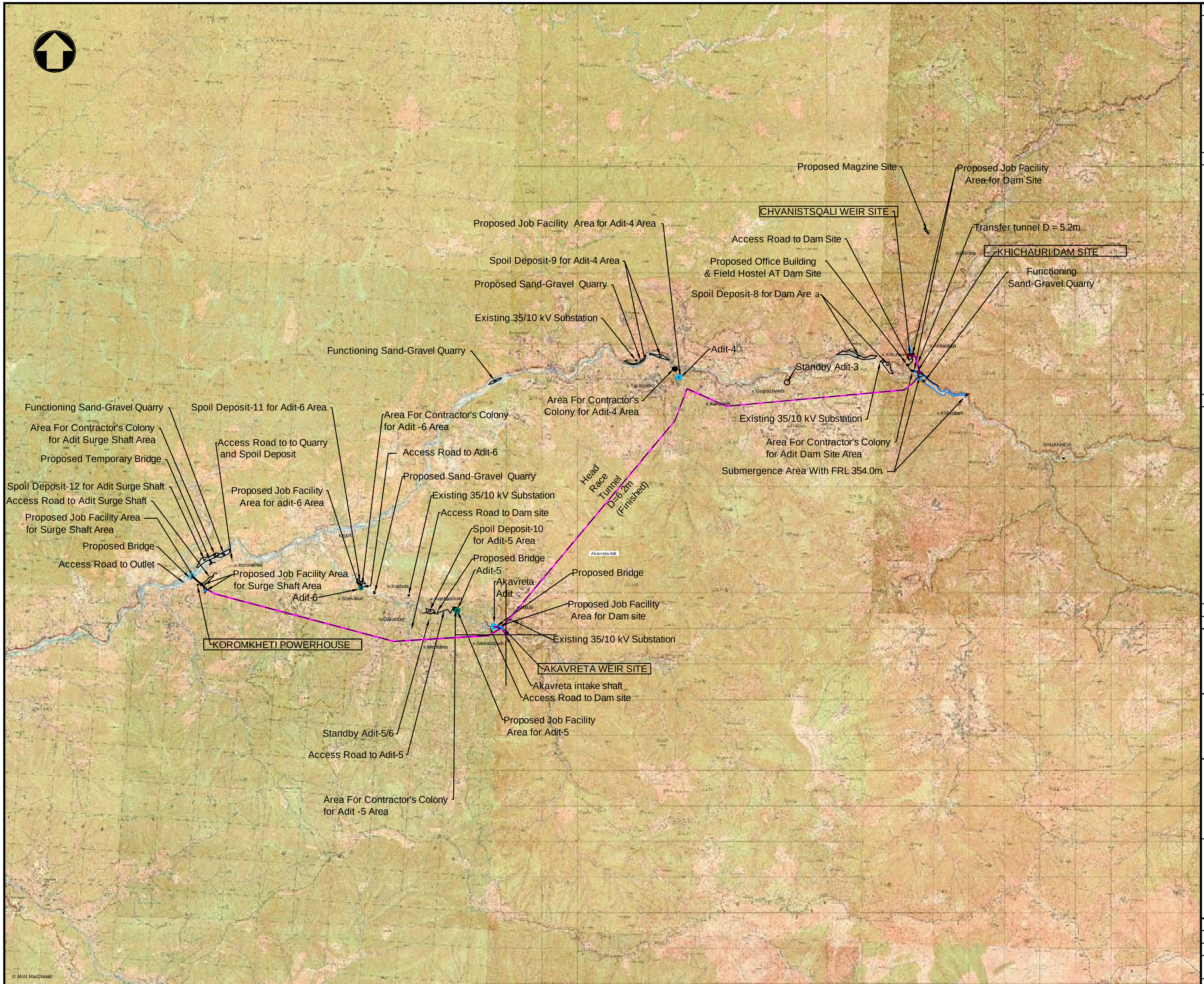
Adjaristsqali Hydropower Cascade
Feasibility Study
Shuakhevi Scheme
Infrastructure Plan

Designed			Eng check		
Drawn			Coordination		
Dwg check			Approved		

Scale at A1	Status	Rev
1:50000	PRE	P1

Drawing Number
MMD-290039-MNC-GEN-08-100

P:\Cambridge\Demeter\EVT2\290422 Adjaristsqali cascade\CAD\Working



© Mott MacDonald

This document is issued for the party which commissioned it and for specific purposes connected with the captioned project only. It should not be relied upon by any other party or used for any other purpose.
We accept no responsibility for the consequences of this document being relied upon by any other party, or being used for any other purpose, or containing any error or omission which is due to an error or omission in data supplied to us by other parties.

Notes

Key to symbols

Reference drawings

1:50000 @A1 — 0 — 2500m — 5000m

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	10/01/12		Preliminary Issue		

Mott MacDonald

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG
GROSS ENERGY GROUP
Engineering & Consulting

DOLSAR
Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi Georgia

Title

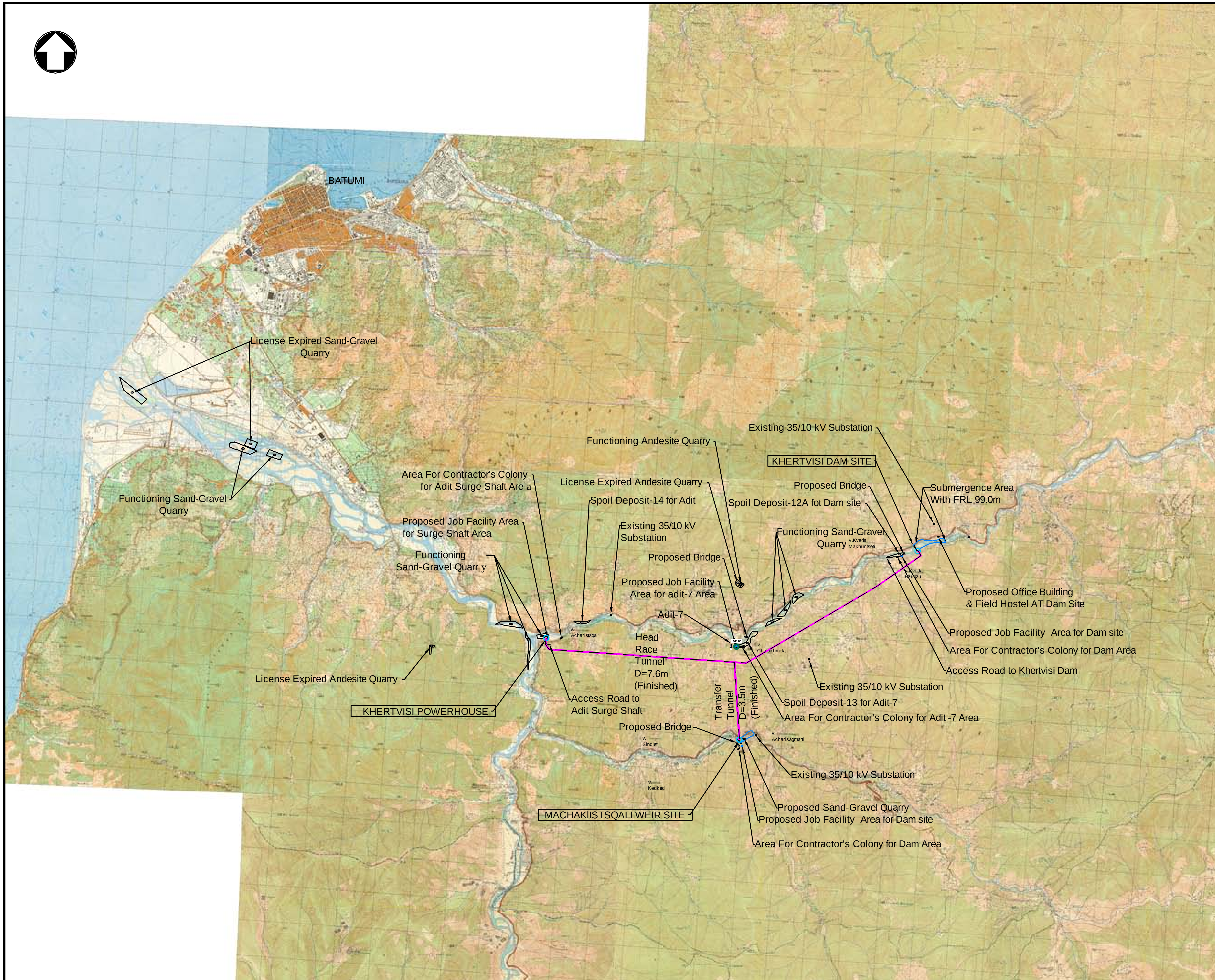
Adjaristsqali Hydropower Cascade Feasibility Study Khoromkheti Scheme Infrastructure Plan

Designed			Eng check		
Drawn			Coordination		
Dwg check			Approved		

Scale at A1	Status	Rev
1:50000	PRE	P1

Drawing Number

MMD-290039-MNC-GEN-08-101



Notes

Key to symbols

Reference drawings

1:50000 @A1 0 2500m 5000m

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	10/01/12		Preliminary Issue		

Mott MacDonald

Mott MacDonald House
8-10 Sydenham Road
Croyden, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

GEG
GROSS ENERGY GROUP
Engineering & Consulting

DOLSAR
Engineering Ltd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi Georgia

Title

Adjaristsqali Hydropower Cascade
Feasibility Study
Khertvisi Scheme
Infrastructure Plan

Designed			Eng check		
Drawn			Coordination		
Dwg check			Approved		

Scale at A1	Status	Rev
1:50000	PRE	P1

Drawing Number
MMD-290039-MNC-GEN-08-102

P:\Cambridge\Demeter\EVT2\290422_Adjaristsqali_cascade\CAD\Working

2.7 Contracting Strategy

An initial contracting strategy has been determined for the Shuakhevi Scheme as this will be the first project to be constructed. Construction work will be carried out under traditional build and design contracts by potentially more than one contractor for the Shuakhevi Scheme as follows:

- Advanced works contract - enabling works such as roads, bridges and site levelling
- Civil works package and and mechanical and electrical (M&E) package for works on the left bank of the Adjaristsqali River
- Civil works pachage and M&E package on the right bank of the River.

Construction activities will take place 24 hours a day, seven days a week and are likely to consist of three shifts of eight hours or two shifts of ten hours.

2.8 Project Programme

Table 2.5 presents the project development timescales that are currently envisaged.

Table 2.5: Project Programme

Activity	Duration	Start/Completion date
Feasibility Study		May 2011 / February 2012
Tender Preparation and Contract Award	12 months	February 2012 / February 2013
Shuakhevi Construction	36 months	January 2013 / January 2016
Koromkheti	54 months	January 2015 / January 2019
Khertvisi	36 months	January 2017/ January 2020
Operation	45 yrs (each scheme)	January 2020 / January 2065

3. Need for the Project and Analysis of Alternatives

3.1 Introduction

This Chapter discusses the needs case and the alternative considerations that have been studied in determining the final Project layout and optimisation, as defined in Chapter 2.

The needs case has been reviewed in the context of economic, socio-economic and market factors in order to evaluate whether there are sufficient drivers to justify development of the Project.

Those significant alternatives considered for the Project are broadly categorised as follows, and discussed in more detail below:
- No project option
- Layout and configuration alternatives for the Project components, including the dam sites, reservoirs and powerhouse locations
- Options and alternatives for key operational requirements of the Project.

3.2 Needs Case

3.2.1 Introduction

This section provides a brief background on the need for the Project in the region as well as an assessment of viable alternatives. The assessment considers alternative sites in the context of environmental impact, existing infrastructure and land use planning constraints. A summary of design decisions made to date in reference to the above stated criteria is also provided.

3.2.2 Existing Economic Focus

Georgian 2010 peak electricity demand is put at 1,620 MW. Electricity sales amounted to 10,040 GWh of which 1,524 GWh were exports (grid connections exist to Russia, Turkey, Armenia and Azerbaijan). While generation supply generally meets the domestic demand in winter months electricity imports are still required. In 2010 nearly 92% of Georgia's electricity was generated by hydropower plants (HPPs). Thermal power plants met 6% of demand while the remaining 2% was satisfied by imports (mainly from Russia and Azerbaijan). In 2011, however, more electricity imports and thermal generation substituted for low hydropower generation. The Georgian power system, characteristic of countries with high hydro penetration, has relatively low consumption and high generation of HPPs in summer, and high consumption and low generation of HPPs in the winter period. HPPs also have been developed with limited reservoir capacity that could store water to balance availability between wet and dry seasons. Furthermore, limited water storage and export capacity does not prevent significant water spillage in summer months of wet years when river flows peak.

Georgia has three largely outdated OCGT power plants, amounting to 730 MW in total, to help meet winter generation needs. Thermal efficiency of the plants is low, estimated at 29-36%. Peak utilization of these plants takes place between January and March. Favourable gas supply agreements with Azerbaijan provide fuel at a price of approximately 100 USD/tonnes per cubic metre, although it is expected that the re-negotiated contract in 2014 will see the price increased. The terms for electricity imports from Russia and Azerbaijan are not known, but they are unlikely to be competitive with the hydro schemes.

Georgia’s official energy policy aims to end dependency on imports and domestic thermal generation using imported fuel and to take advantage of export opportunities through further exploitation of the country’s hydro resources. Georgia’s hydro-power potential is estimated at up to 80 TWh per year, of which up to 50 TWh are economically attractive. At present only 10% of the technical potential is developed, which makes the country’s undeveloped resource the third largest in Europe after Russia and Turkey. Since 2007 the levels of generation are greater than the annual demand, which makes room for a surplus to be available for export, which is increasing each year. Domestic electricity demand has been largely flat in recent years, even during the period of rapid economic growth. Optimistic estimates see it’s growth at a rate of 3% per annum for the next decade. This level of demand, combined with the aforementioned seasonality of hydro generation, make it clear that electricity exports are needed for the hydro resources to be developed in this country.

Considering Georgia’s potential export markets, Turkey appears to be the most attractive of the options. Turkey is struggling to meet strong electricity demand, with growth averaging 8% per annum since 1960, despite a large expansion of hydro power generation and a ramp up of lignite fired power plants. Projected capacity shortfalls and high market prices, among the highest in Europe, make for a promising export market. Furthermore, the absence of suitable transmission infrastructure between Georgia is currently being addressed by a construction of a 1,000 MW interconnector, intended to be used for Georgian hydro schemes exports, due to be completed in 2013. The economic outlook for Turkey is positive with electricity demand growth expected to continue at 6% per annum. It is also recognized that Turkey is seeking a lower exposure to expensive gas imports, the main reason for high electricity prices.

It is clear that from a macroeconomic perspective development of hydro schemes in Georgia is highly desirable. Such developments will reduce power imports and expand power export opportunities contributing to Georgia’s gross domestic product (GDP) growth. Growth of exports will improve Georgia’s negative balance of trade and large external liability position as will reduced imports of energy from Russia and Azerbaijan.

Alternative generation technologies that harness natural resources are also available in this country, but they’re not as abundant and are generally less competitive. Georgia’s wind potential is estimated at 1500 MW, while the total solar energy at 108 MW. Comparatively low temperature of the geothermal waters does not allow electricity generation.

3.2.3 Hydropower in Georgia

Georgia has an operational hydro capacity of around 2,600 MW with generation reaching about 9,000 GWh per annum. The dominant generator is the Enguri HPP with installed capacity of 1,300 MW with the remaining generation coming from a number of medium and small-scale HPPs with variable outputs throughout the year. Out of all operational HPPs approximately 2,000 MW are reservoir schemes and 600 MW are run of river. It is estimated that an additional 1,300 MW of new HPPs will be added to the system by 2017. Since 2007 Georgia has become a net exporter of electricity with surplus coming from the hydro schemes. Low electricity demand that coincides with spring and summer peak river flows result in significant water spillages from the HPP during these periods. This is attributable to the small size of an average reservoir storage capacity of Georgia’s HPP schemes, equal to about 10% of annual generation. The long-term aim of reaching a full reliance on hydro schemes for the country’s electricity generation seems only possible if reservoir capacity is extended.

Generation tariffs for new built HPPs are fully deregulated, although projects of certain size have seasonal supply requirements in place. For schemes with turbine rating from 13 to 99 MW the producer is expected to sell three months in a year onto the domestic market with the months being agreed with the authority.

Technical hydropower resource in Georgia equals 80 TWh per annum, which is third largest in Europe, although at the moment only about ten per cent of this is being realised. Under favourable circumstances it is expected that an additional 40-50 TWh per annum will prove economical to develop.

3.2.4 Socio- Economic / Environmental Context

3.2.4.1 Local municipality tax income benefits

The tax system in Georgia provides a mechanism through which a form of monetary benefits sharing can be realised by local municipalities. The project will be required to pay a yearly property tax to each of the municipalities based on 1% of the value of their assets. An indicative estimate of the income that each municipality affected by the project could receive, compared to their existing budgets is presented in Table 3.1.

Table 3.1: Estimated municipality tax income

	Shuakhevi Scheme	Koromkheti Scheme	Khertvisi Scheme
Total Project Investment Cost GEL million	495	495	330
Commencement of operation	2016	2019	2020
Share of tax income per municipality			
Khulo Municipality	35%		
Shuakhevi Municipality	65%	10%	
Keda Municipality		90%	30%
Khelvachauri Municipality			70%
Estimated property tax GEL m/year**			
Khulo	1.7		
Shuakhevi	3.2	0.5	
Keda		4.5	1.0
Khelvachauri			2.3

Source: AGL

In the case of Shuakhevi and Keda municipalities, the increase could be significant whereas for Khulo and Khelvachauri the increase is less significant but still important when compared to existing budget levels. It is important to bear in mind however that these projects will be realised over 10 year period and therefore it is not possible at this time to compare directly increases in budget compared to existing 2012 budgets.

Table 3.2: Estimated municipality tax benefits

GEL million/year	2012 budgets
Khulo	6.0 million GEL
Shuakhevi	4.6 million GEL
Keda	4.5 million GEL
Khelvachauri	7.9 million GEL

3.2.4.2 Local community skills development and employment

According to statistics and information provided by local municipalities, the unemployment rate in the Project area of influence is higher than that in Batumi and the coastal resort areas. According to information provided by the municipal authority in Shuakhevi the unemployment rate varies from 25% to as high as 75% (these unemployment figures are likely to include those dependent on subsistence farming). Similar situations of high unemployment are observed in Keda and Khulo municipalities, with the majority of the working age population being employed in schools, local administration offices, medical stations or shops.

It is expected that the Project will bring benefits to the local community through skills training and employment opportunities. During the peak of Shuakhevi scheme construction phase, the Civil Contractor will have up to at total of 800 workers both skilled and unskilled on site, where possible the majority of unskilled workers will be drawn from the villages closest to each of the construction sites subject to availability of suitable candidates. It is anticipated that the project may be able to draw a large number of the unskilled workforce from the local area, but this will depend at least in part on the extent to which the contractors appointed bring an greater or lesser external workforce with them.

Table 3.3: Total estimate of workforce for the Shuakhevi Scheme

Sector	Types of Roles	Approx. No
Site Management	Project Manager, Site Manager, accountant, translators, health, safety and environment (EHS) team	55
Civil	Drivers, tunnelling operatives, concrete mixers, engineers, geologist, metal workers, general labourers	600
Mechanical and Electrical	Engineers, riggers/slingers, fitters, welders, crane operators, technicians	60
Secondary Support Staff	Medics, security guards, firemen, emergency response team, caterers, cleaners	70
Total		**785**

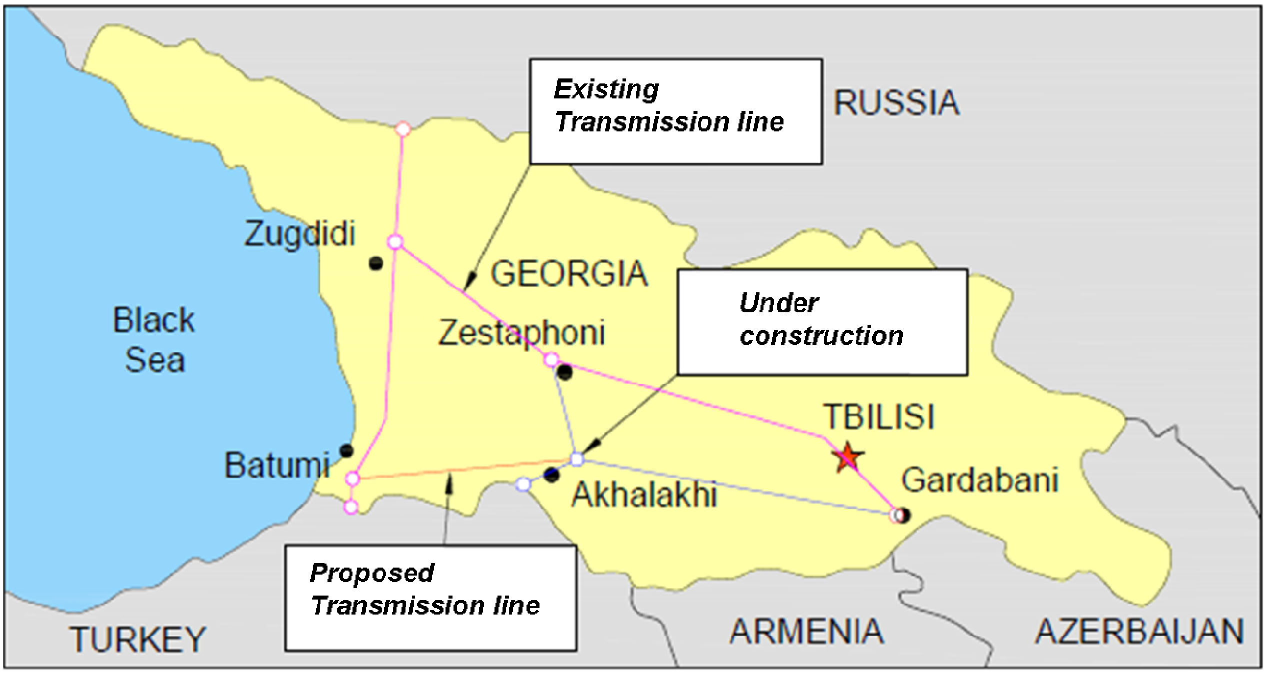
The availability of alternative sources of employment within the project area at present are minimal and the project therefore provides opportunities that are unlikely to have been realised in the short-term, and will enable a number of people to gain skills and experience which will extend beyond the life of the Project.

3.2.5 Improved Grid Connection

The Georgian Government is currently constructing a 500/400 kV high-voltage transmission line (Black Sea Regional Transmission Line, Akahalakhi to Turkey, see Figure 3.1 below) which connects Turkey and Georgia and is being financed by International Financial Institutions (such as KFW, EBRD, and EIB). The Transmission line is planned to be commissioned in May, 2012 and fully operational by January 1, 2013. It should be noted, that the priority for the usage of the new transmission line will be given to newly constructed plants. In addition, there are plans to construct a 500 kV transmission line connecting Azerbaijan and Georgia, and the 400 kV line connecting Georgia and Armenia. Georgia intend to position themselves as a major energy hub for the region. The overall objective is to expand and refurbish its transmission network to increase reliability and improve export and import opportunities.

The construction of a 220kV transmission line from Batumi to Akahalakhi would provide significant benefits to Batumi by improving current connection weaknesses to the national grid and supporting projected increased development and demand. Developing the Adjaristsqali Project in the region provides opportunity and incentive to develop a direct connection from Batumi to the new Akhalakhi substation and thus strengthening of the grid connection.

Figure 3.1: Georgian Transmission System Situation Plan



Source: GEG

3.2.6 Market Context

The Project will sell its output onto the domestic market three months of the year, while in the remaining months it will sell electricity to Turkey. For this reason a brief overview of both markets is provided below.

The electricity sector in Georgia is in some measure deregulated with separate generation, distribution and generation markets. An independent regulator sets most tariffs including: transmission, distribution, import, export, final retail prices and some generation. Nearly half of generation assets are still state owned. Existing generation facilities (HPPs with construction date prior to January 2008) have regulated tariffs, while newly built plants face unconstrained prices. Electricity can be sold at that price either through direct contracts with suppliers (majority of power is sold this way) or to the system operator. The day-ahead tariff fluctuates significantly over the year reflecting the changing share of thermal power in the generation mix.

The Turkish electricity sector is partially deregulated. The wholesale electricity market is not yet fully competitive as state owned generation faces regulated tariffs. The day-ahead market, where independently generated and imported energy is mostly sold, is competitive. The wholesale market is expected to be fully deregulated in the coming years. Import of electricity is undertaken either by TETAS, the state owned wholesale trader, or through private wholesalers. It is assumed, however, that new imports from the Caucasus will be carried through independent wholesale traders. The wholesale prices in Turkey are higher than in neighbouring countries due to high gas prices faced by marginal gas generators. In future the prices might rise yet further if Turkey decides to join the ETS scheme for carbon emissions.

3.2.7 Conclusion

The above sections have set out the economic, socio-economic and market context for development of the Project. It can be safely concluded that the Project will bring significant benefits to the region and electricity consumers in Georgia. The case for it is reinforced if one takes a broader strategic view. Development of hydro potential in the country will not only help it to move closer to the energy independency, but will also allow it to tap into growing markets of Georgia’s southern neighbours improving its export position. It will also benefit Georgia in terms of the development of environmentally clean projects under the Kyoto Protocol.

3.3 Analysis of Alternatives

3.3.1 ‘No Project’ Alternative

Considering the fact that Georgia is a net exporter of electricity the ‘no project’ alternative should only consider the forgone benefits to local communities in terms of employment opportunities, increased budgets from local funding, and increase security of domestic supply sources and infrastructure. Benefits are that the Adjaristsqali would not be impacted by reduced water flows; however there is no existing or known potential for large scale fisheries in the river which would be a forgon opportunity in the event of the project not going ahead.

3.3.2 Alternative Power Project

As previously mentioned Georgia has other natural resources available to the power sector, most prominently wind, but its is largely interment energy source and its economics are not as favourable as that of a hydro project. Another alternative which would provide the same type of benefits as hydropower is biomoass; although biomass does not have quite the same responsiveness (up to 6-12 hours start up) it does offer a non-intermittent energy source. However, biomoass is currently not considered to be an available alternative because there is no exsiting biomass supply network available to provide sufficient biomass fuel for an equivalent 300 MW plant (which would require approxiametly 2.5-3 million tonnes per annum). Although in future Georgia's forested areas may make biomass an option. Fossil fuels plants area alternative option but this would again require reliance on external sources and is not in line with Georgia’s policy to increase their domestic infrstructure. Given the Georgia’s supreme hydrological resource many other hydro projects will undoubtedly be developed, but cross-comparison with them is not considered to be within the scope of this analysis.

3.3.3 Alternative Project Layout

3.3.3.1 Overview

A number of studies have been undertaken in the development of the Project that is assessed within this Report, including pre-feasibility assessment, initial optimisation, and final feasibility study. The development of this ESIA and the Feasibility Study have been undertaken concurrently, as such the Project has been developed with consideration of environmental and social constraints with the aim of mitigating the most significant impacts through an iterative design process. The following sections provide a summary of the specific alternatives that were considered in optimising the Project as a whole and each of the schemes.

3.3.3.2 Overall Project Optimisation

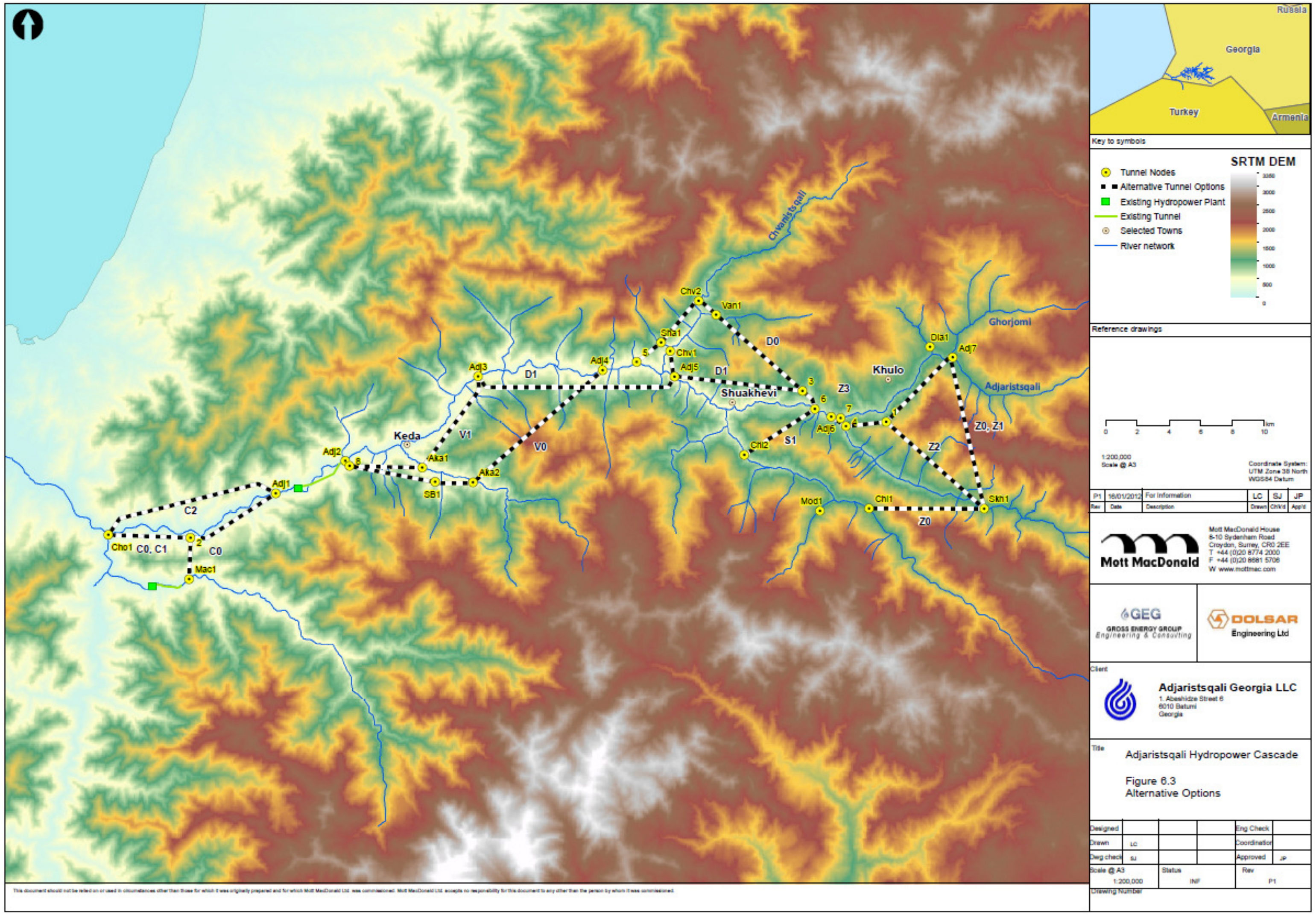
The following considerations and constraints were applicable to all schemes in determining the above options:

- existing hydropower schemes
- avoidance of historic bridges and known cultural heritage features
- avoidance of villages and associated areas used for agriculture
- avoidance of landslides.

In addition to the above the final option chosen was able to reduce the number of intakes and structures on the Adjaristsqali River and its tributaries. A number of intakes were dropped in favour of choosing a combined scheme, which lead to reduction in physical footprint of the project. During the optimisation process, the key factor which drove the design was the geological conditions and avoidance of landslides. As a result the number of options available was significantly reduced, but resulted in benefits such as dropping the intake on the Modulistsqali River and a number of intakes higher up on the Chvanistsqali River and its tributaries. The intakes initially proposed on Diakonidze River and Goderzitsqali River were also dropped to provide additional flow contributions.

Figure 3.2 provides an illustration of all the intial intakes and tunnel layouts considered as part of the feasiblit study.

Figure 3.2: Intial Feasibility Optimisation Options



Source: Mott MacDonald Ltd

4. Policy, Legal and Institutional Framework

4.1 Introduction

This Section presents the national legal framework and regulations for planning and environmental and social protection in Georgia, as well as international standards of potential financiers to the Project, initially understood to comprise the IFC and potentially the European Bank for Reconstruction and Development (EBRD). Where national legal standards are not as stringent as international requirements or vice versa, the Project will be required to defer to the most stringent requirement except in cases where that would contravene national law.

4.2 National Regulatory Framework

4.2.1 Overview

Environmental protection within Georgia is enshrined within the Constitution which guarantees a legal framework for public access to relevant environmental information. Over the past decades, Georgia has created a firm legal and political framework for environmental protection, which attempts to follow international best practices and provides for the application of widespread legal mechanisms and standards, including environmental impact assessment (EIA), economic instruments, inspection/monitoring, and permitting.

Georgian legislation comprises the Constitution, environmental laws, international agreements, subordinate legislation, normative acts, presidential orders and governmental decrees, ministerial orders, instructions and regulations. Along with the national regulations, Georgia is signatory to a number of international conventions, including those related to environmental protection.

4.2.2 Administrative Framework

In Georgia, The Ministry of Environmental Protection (MoE) is responsible for regulating the natural environment. The MoE participates in the development environmental state policy and implements all policies designed for the protection and conservation of the environment and for the sustainable use and management of Georgia's natural resources. This includes controlling activities that have a potential adverse impact on the environment and natural resources and issuing environmental licences and permits.

The MoE functions within six regional units and the responsibilities of each unit comprise of the following:

- To prevent environmental and ecological incidents and to implement remediation activities in the event incidents occur, apply state control to the administration of primary registering of water resources and their usage;
- To organize raising environmental and ecological education of the population;
- To organize interconnection with environmental organizations and environmental community, and;
- To coordinate and undertake activities related to restoration of endemic, rare and endangered species of Georgian flora and fauna and preparation of proposals for creating protected areas and hunting reserves.

4.2.3 Key Legislation

This Section explains the most pertinent environmental laws and regulations in Georgia as they potentially apply to the Project.

4.2.3.1 Law of Georgia on Protection of the Environment 1996

The Law regulates the legal relationship between the State and persons/legal entities in terms of the environmental protection and/or utilisation of natural resources on all Georgian territory including its territorial waters, airspace, continental shelf and special economic zones. The Law covers environmental education, environmental management, economic sanctions, licensing, standards, environmental impact assessment and related issues. The law considers various aspects of ecosystem protection, protected areas, global and regional environmental management, protection of ozone layer, biodiversity and the Black Sea, as well as aspects related to international cooperation. 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.

4.2.3.2 Law of Georgia on Environmental Impact Permit 2007

The Law gives a complete list of activities subject to ecological examination (Article 4, Chapter II) and defines environmental examination through the EIA process as an obligatory step for obtaining authorisation for implementation of the planned development. This includes development of a hydroelectric power station with 2 MW or higher installed capacity. The legislation sets out the legal basis for issuance of environmental permits, including implementation of an ecological examination, public consultations and community involvement in the processes.

According to the Law, the environmental permit is the key procedure for implementation of an activity on the territory of Georgia. The permit takes ecological, social and economic interests of the public and the state into consideration in order to protect human health and natural and cultural assets and heritage. Granting of permission or refusal to issue a permit is based on examination of environmental documents presented to the MoE by the Project proponent. Paragraph 6 of the law requires the Project proponent to organise a public discussion of the ESIA prior to submission of the final version documentation to the Ministry.

The permit application/issuance procedure for the Project is carried out in accordance with the following steps:

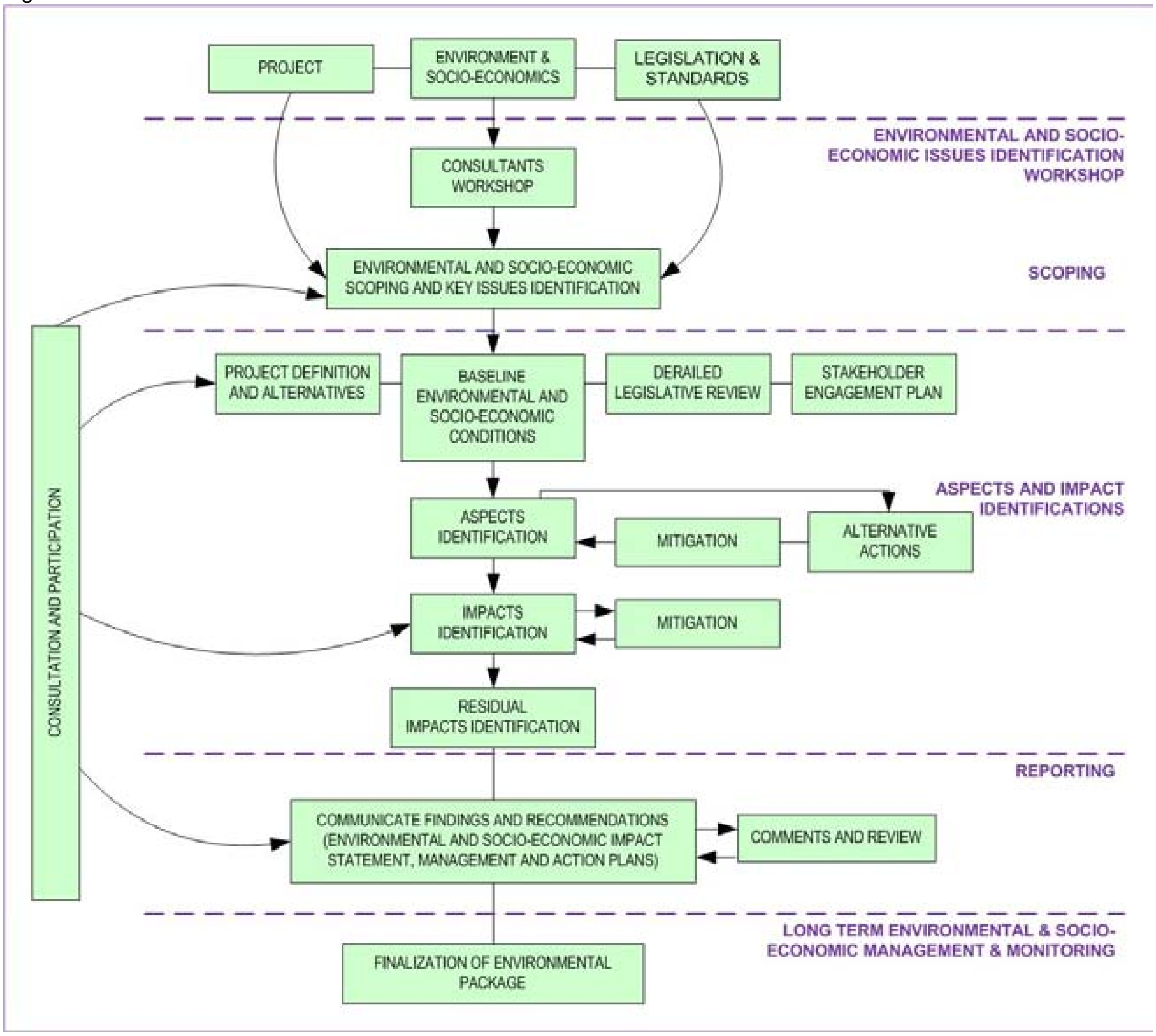
1. The Project proponent publishes information on the Project in central and regional newspapers. The advertisement has to include the project title, location, place and the date, time and venue of public disclosure meeting(s). It will also identify locations where the ESIA can be reviewed and where comments may be submitted.

2. Within one week after publishing the information in the newspapers, the Project proponent will submit the ESIA report (hard copy and electronic version) to the MoE. A period of 45 days is allowed for public comment on the ESIA. Between 50 and 60 days after publication, the Project

proponent will hold a series of meetings to receive comments from stakeholders (which may include government agencies, local authorities, NGOs, community members). Within five days of the meetings, the Project proponent will submit minutes of the meetings (summary of comments and discussions) to the MoE.

3. All comments received from the stakeholders at the meeting or in writing will be reviewed and addressed in the final version of the ESIA. A copy of all written comments, the minutes together with a comment-response section will be included in the final ESIA as Appendix B1. The final ESIA will be submitted to the MoE and made available to the public, along with a project location map, an executive summary, and the any necessary reports on emissions and allowable limits. The permit is to be issued or denied within 20 days from registration of the submission.

Figure 4.1: ESIA Process Schematic



Source: Gamma Consulting Limited

For this Project public disclosure of each of the stand alone documents produced as part of the ESIA process will be carried out according to the requirements in Georgia and published on the AGL's website (www.adjaristsqali.com).

4.2.3.3 Law of Georgia on Ecological Examination 2007

The Law makes an ecological examination obligatory for issuance of development permits. An objective of the Law is to preserve the ecological balance through the incorporation of environmental requirements, sound use of natural resources and sustainable development principles. Demonstration of sustainable ecological outcomes is necessary in order to obtain a development permit. The review of the EIA, and decisions related to, the ecological examinations is regulated by the MoE.

4.2.3.4 Law of Georgia on Licenses and Permits 2005

The Law regulates activities which may result in increased hazard to human life or health, involves interests of importance to the State or public, or connected to consumption of State resources. The Law defines the full list of activities which require licenses and permits, and sets out the rules for granting, amending and abolishing licenses and permits.

The objective and main principles in the regulation of activities via licenses or permits are as follows:
- The security and protection of human health;
- The security and protection of the conditions and cultural environment of humans; and
- Protection of state and public interests.

In compliance with this law, the license or permit issued by a foreign country under an international agreement or law is recognized by Georgia and has the status similar to that granted to the documents issued by Georgia.

4.2.3.5 Environmental laws of Georgia

During the environmental and social impact assessment for the construction-operation of the HPP cascades the following Georgian environmental laws have been considered: (Table 4.1: List of Georgian environmental laws below)

Table 4.1: List of Georgian environmental laws

Adoption year	Law / Regulation
1994	Law of Georgia on Soil Protection (amend.1997, 2002)
1994	Law of Georgia on Plants protection from hazardous organism
1995	Constitution of Georgia (amend. 1999, 2000-2006, 2008)
1996	Law of Georgia on System of Protected Areas (amend.2003, 2004, 2005, 2006, 2007)
1996	Law of Georgia on Protection of Environment (amend 2000, 2003, 2007)
1996	Law of Georgia on ownership of agricultural lands
1996	Law of Georgia on Wildlife
1997	Law of Georgia on Fauna (amend.2001, 2003, 2004)

Adoption year	Law / Regulation
1997	Law of Georgia on Tourism and Recreation
1997	Law of Georgia on Water (amend.2003, 2004, 2005, 2006)
1997	Law of Georgia on Payment of Substitute Land Reclamation Cost and Damages in Allocating Farm Land for Non-Farming Purposes
1998	Law of Georgia on Pesticides and Agrochemicals
1999	Law of Georgia on State Complex Expertise and Approval of Construction Projects
1999	Law of Georgia on Protection of Ambient Air (amend. 2000, 2007)
1999	Forestry Code of Georgia (amend. 2000 2001, 2003, 2005, 2006)
1999	Law of Georgia on Seizure of Property Rights for Necessary Public Needs
2003	Law of Georgia on Red List and Red Book of Georgia (amend.2006)
2005	Law of Georgia on Licenses and Permits
2005	Law of Georgia on Fire Safety
2005	Law of Georgia on Privatization of State-owned Agricultural Land
2005	Law of Georgia on Registration of Rights to Real Estate
2006	Law of Georgia on Regulation and Engineering Protection of Sea and River Coasts of Georgia
2007	on Cultural Heritage
2007	on Status of Protected Areas
2007	on Ecological Examination
2007	on Environmental Impact Permit
2007	on Public Health
2007	on Entitlement of Ownership Rights to Lands Possessed (Employed) by Physical and Legal Persons of Private Law
2009	on Notary

4.2.3.6 Environmental Standards

For the assessment of the quality of environmental objects (soil, water, air) the following standards have been used during preparation of the report:

- Methodological Guides on Assessment of Level of Chemical Pollution of Soil (MG 2.1.7.004-02)
- Technical Regulations for Drinking Water (approved by order №349/n of the Minister of Labour, Health and Social Affairs, 17.12.2007.
- Protection of Georgian Surface Water by the Minister of Environmental Protection and Natural Resources of Georgia
- Order №130 on Protection of Georgian Surface Water by the Minister of Environmental Protection and Natural Resources of Georgia, 17 September 1996
- Sanitary Rules and Standards on Prevention of Surface Water Pollution approved by order №297/n by Minister of Labour, health and Social Affairs, 16 August 2001.
- Hygienic standards on Maximum Permissible Concentrations of Air Born Pollutants for Settlements (HN 2.1.6. 002-01).
- Sanitary Norms 2.2.4/2.1.8 003/004-01 Noise at Work Places, Residential and Public Buildings and Residential Territories.

4.2.4 Land use and Land Acquisition Policies/Legislation

The legal framework relating to land administration in Georgia is wide reaching and complex. In certain cases of public need, the State may take private lands into State ownership or take actions that otherwise affect private land. Laws governing the process are presented in Table 4.2.

Table 4.2: Relevant Georgian Laws

Date	Relevant Georgian Laws
1995	The Constitution of Georgia
1997	Law on Payment of Substitute Land Reclamation Cost and Damages in Allocating Farm Land for Non-Farming Purposes (amended 2007)
2007	The Law of Georgia on Recognition of the Property Ownership Rights Regarding the Land Plots Owned (Used) by Physical Persons or Legal entities
1999	The Law on Procedures for Expropriation of Property for Necessary Public Need
1997	The Law On the Rule for Expropriation of Ownership for Urgent Public Needs
1996	The Law on Ownership Rights to Agricultural Land
2005	The Law on Privatisation of State-owned Agricultural Land
2005	The Law on Registration Ownership Rights to Immovable Property
2007	Cultural Heritage Law
2008	Law on Public Register
2009	The Law of Georgia on Notary Actions

Georgia has in the last 15 years updated a number of its laws which relate to rights to property and expropriation. A key principle is that compensation of physical assets should be provided based on current market prices without depreciation. The laws also provide for compensation for income losses (such as resulting from loss of harvest and/or business closure) which should be compensated to cover net losses. In addition legislation places a strong emphasis on consultation and prior notification of affected peoples so that they may participate in the process. AGL have consulted with the legal department of the Ministry of Energy and Natural Resources who have informed them that they may legally enter into negotiated agreements with affected people to acquire land rights within the framework of the above laws.

These laws and implementing regulations offer the following possibilities to AGL in legally acquiring land rights:

- Obtaining property rights through voluntary negotiated settlements based on payment of fair market prices without depreciation prior to the start of any project enabling/civil works;

Only if and when efforts at negotiated settlement fail is there the possibility of obtaining permanent rights to land and/or other real estate property through expropriation. This would require a presidential order for expropriation, followed by a court ruling to determine the case for public need. If the courts grant expropriation rights they will appoint a third party to assess and determine compensation of all assets based on market values.

4.2.5 Labour Legislation

Labour issues in Georgia are regulated by the Organic Labour Law of Georgia 2010 which governs the rights of the employees in all enterprises, institutions and organisations. This law establishes the requirements regarding human rights and creation of safe and healthy working environment including health and safety conditions, social security and insurance.

4.3 International Standards and Guidelines

4.3.1 Overview

The Project is required to meet the international standards of the IFC, which is part of the World Bank Group, and potentially those of the EBRD. The international environmental and social safeguard policies of these organisations are outlined below, as are the main international conventions that Georgia is a signatory.

4.3.2 Project Categorisation and Standards

4.3.2.1 Performance Standards Review

It should be noted that the IFC has recently completed a review of its 2006 Performance Standards; these revised standards came into effect on the 1st January 2012. The Project has been assessed against these new standards.

4.3.2.2 Project Categorisation

IFC's Policy on Environmental and Social Sustainability, 2012 requires initial screening and categorisation of each proposed Project to determine the appropriate extent and type of environmental assessment needed. The resulting category also specifies IFC's institutional requirements for disclosure in accordance with IFC's Access to Information Policy. Projects can be placed into one of four categories, depending on the type, location, sensitivity, and scale of the Project, as well as the nature and magnitude of its potential environmental impacts. The different categories are listed in Table 4.3.

Table 4.3: IFC Project Categorisation

Category	Description
Category A	Business activities with potential significant adverse environmental or social risks and/or impacts that are diverse, irreversible, or unprecedented.
Category B	Business activities with potential limited adverse environmental or social risks and/or impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures.
Category C	Business activities with minimal or no adverse environmental or social risks and/or impacts.
Category FI	Business activities involving investments in FIs or through delivery mechanisms involving financial intermediation. This category is not applicable to the Project being considered here.

The Project has the potential to cause adverse impacts on the community and on the environment. The Project will permanently alter a considerable section of the Adjaristsqali River and its tributaries and may impact sensitive areas and has the potential to have diverse types of impacts. Therefore this Project is considered to be a Category A project. However, it is considered feasible to mitigate and manage the majority of impacts associated with the Project through appropriate environmental and social management together with the monitoring to be specified in the ESMP and related plans that will be the outcome of this ESIA process.

4.3.3 International Finance Corporation (IFC) Standards and Guidance

As the Project is being implemented with support of the IFC, the requirements of the IFC Performance Standards (PS) will need to be met. The IFC Performance Standards are the key documents through which the IFC manage the quality and level of assessment required for the Projects which they finance. The following Performance Standards are relevant to this Project:

- PS1 Assessment and Management of Environmental and Social Risks and Impacts
- PS2 Labour and Working Conditions
- PS3 Resource Efficiency and Pollution Prevention
- PS4 Community Health, Safety and Security
- PS5 Land Acquisition and Involuntary Resettlement
- PS6 Biodiversity Conservation and Sustainable Management of Living Natural Resources
- PS8 Cultural Heritage

PS 7 addresses indigenous peoples and is excluded because no indigenous peoples will be affected by the Project so it does not apply.

Specific reference will also be made to the following IFC environmental and social standards and guidance:

- IFC General Environmental, Health and Safety (EHS) Guidelines (April 2007)
- IFC Performance Standards on Environment and Social Sustainability, effective Janaury 1, 2012
- IFC EHS Guidelines for Electric Power Transmission and Distribution (April 2007).

Specific legislation and guidelines applicable to particular disciplines that will be considered during the ESIA process will be detailed in the relevant Sections of the ESIA terms of reference.

4.3.4 European Bank for Reconstruction and Development (EBRD) Standards

4.3.4.1 Project Categorisation

Under the EBRD Environmental and Social Policy (ESP) 2008, EBRD categorises projects as either A / B / C / FI based on environmental and social criteria to: (i) reflect the level of potential environmental and social impacts and issues associated with the proposed Project; and (ii) determine the nature and level of environmental and social investigations, information disclosure and stakeholder engagement required for each project, taking into account the nature, location, sensitivity and scale of the Project, and the nature and magnitude of its possible environmental and social impacts and issues.

The categorisation of each project depends on the nature and extent of any actual or potential adverse environmental or social impacts, as determined by the specifics of its design, operation and location. The EBRD Environmental and Social Policy (ESP) 2008 list the criteria by which a project is classified as being a Category A project. This includes projects which involve large dams and other impoundments designed for the holding back or permanent storage of water and the construction of high-voltage overhead electrical power lines, both of which are features of this Project and consequently it is classified as Category A.

4.3.4.2 EBRD Performance Requirements

EBRD has adopted a comprehensive set of specific Performance Requirements ("PRs") that projects are expected to meet. Furthermore, EBRD is committed to promoting EU environmental standards as well as the European Principles for the Environment (EPE). It is noted that the requirements of the EPE are reflected in the PRs. The following PRs are relevant to this Project:

- PR1 Environmental and Social Appraisal and Management
- PR2 Labour and Working Conditions
- PR3 Pollution Prevention and Abatement
- PR4 Community Health Safety and Security
- PR5 Land Acquisition, Involuntary Resettlement and Economic Displacement
- PR6 Biodiversity Conservation and Sustainable Management of Living Natural Resource
- PR8 Cultural Heritage.

PR7 on indigenous peoples is not relevant as there are no indigenous peoples affected by the project.

4.3.5 The European Union (EU)

4.3.5.1 Overview

Georgia is considered a non-EU country (i.e. not a candidate or a potential candidate country), rather its relations with the European Union are shaped via the European Neighbourhood Policy (ENP) and the expectations for implementing EU law as set down in the ENP.

4.3.5.2 The Environmental Acquis

The Environmental acquis comprises of approximately 300 legal instruments, mostly in the form of Directives. The acquis covers environmental protection, polluting and other activities, production processes, procedures and procedural rights as well as products. The key EU environmental directives making up the acquis that are considered to be applicable to the Project are shown in Table 4.4 and are shown alongside the directly equivalent transposed Georgian legislation.

Table 4.4: EU Legislation Applicable to the Project

<table>
<tr><th>EU Legislation</th><th>Georgian Legislation</th></tr>
<tr><td>Council Directive 85/337/EEC (amended by 97/11/EC) on Environmental Impact Assessment (EIA)</td><td>Regulation on Environmental Impact Assessment was approved by the Order No. 59 of the Minister of Environment
Law on Ecological Examination 2007
Law on Service of Environmental Protection 2007
Law on Environmental Impact Permit 2007
other laws, by-laws, statutory acts and regulations</td></tr>
<tr><td>Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna (Natura 2000) – The Habitats Directive</td><td rowspan="3">Law on Protection of Environment (1996, amend 2000, 2003, 2007)
Law on Wildlife (1997, amend. 2001, 2003, 2004)
Law on System of Protected Areas (1996, amend.2003, 2004, 2005, 2006, 2007)
Law on Red List and Red Book of Georgia 2006
Law on Status of Protected Areas, 2007
Biodiversity Protection Strategy and Action Plan, 2005</td></tr>
<tr><td>Council Directive 78/659/EEC on the quality of fresh waters needing protection or improvement in order to support fish life</td></tr>
<tr><td>Council Directive 79/409/EEC on conservation of wild birds</td></tr>
</table>

EU Legislation	Georgian Legislation
	Red List, 2005 other laws, by-laws, statutory acts and regulations Georgia is a party to Convention on International Trade in Endangered Species (CITES), Ramsar and CBD.
Council Directive 2008/98/EC on waste (Waste Framework Directive) Council Directive 1999/31/EC (as updated by 2003/33/EC) on the Landfill of Waste 91/689/EEC (amended by 94/31/EEC) controlled management of hazardous wastes Council Directive 75/439/EEC (amended by 91/692/EEC) waste oil disposal	No special regulations regarding incineration of waste available, waste management/disposal issues are regulated under: Law on Protection of Environment 2007 Law on Licences and Permits, 2006 Law on Transit and Importation of Waste in Georgia 1995 Law on Hazardous Substances 1998 Solid Municipal Waste Landfills arrangement and operation rules and norms 2003 By-laws Georgia is a party to Basel Convention
96/62/EC Framework Directive on Ambient Air Quality Assessment and Management (and Daughter Directives 99/30/EC (NOx, SO2, Pb and PM10), 00/69/EC (benzene, CO), 02/3/EC:Ozone, 2008/50/EC on ambient air quality and cleaner air for Europe	Law on Protection of Environment 2007 Law on Licences and Permits 2006 Law on Protection of Ambient Air 2007
94/55/EC ADR Framework Directive regarding the transport of dangerous goods by road, as amended	Law on Protection of Environment (1996, amend 2000, 2003, 2007) Law on Licences and Permits, 2006 Law on Transit and Importation of Waste in Georgia Law on Hazardous Substances By-laws Georgia is a party to Basel Convention
Council Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy" or, in short, the EU Water Framework Directive	Law on Water 1997 Law on Environment Protection 1996 Law on Public Health 2007 Standard acts of the Ministry of Environment Protection and Natural Resources

4.3.5.3 EU EIA Directive (85/337/EEC)

The installation of hydroelectric energy production is defined as an Annex II project within the EU EIA Directive (85/337/EEC, as amended). All projects listed in Annex II are subject to Environmental Impact Assessment where Member States consider that the Project characteristics warrant such an assessment based on thresholds or criteria set by the Member State. It is assumed an EIA would be required for these works due to the overall scale of the Project and the position of Georgia as a priority neighbour of the EU and if seeking financing from the EBRD.

4.3.6 International Laws and Conventions

The following international laws and conventions have been ratified by Georgia and are of relevance to this Project:

- Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973)
- Convention on Wetlands of International Importance Especially as Waterfowl Habitat (1971)
- United Nations Framework Convention on Climate Change

- Convention on Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters (1998)
- Convention on the Conservation of Migratory Species of Wild Animals (1979)
- Agreement on the Conservation of Bats in Europe (EUROBATS) (2001)
- Agreement on the Conservation of African-Eurasian Migratory Waterbirds (2001)
- UN (Rio) Convention on Biological Diversity (1992)
- Paris Convention on the Protection of the World Cultural and Natural Heritage (1972)
- European Convention on the Protection of the Archaeological Heritage (1992)
- The Black Sea Biodiversity and Landscape Conservation Protocol to the Convention on the Protection of the Black Sea against Pollution
- Convention on the Protection of the Black Sea Against Pollution (1992)
- International Plant Protection Convention
- Convention for the Protection of the Architectural Heritage of Europe (1985).

The Project should also meet the following International Labour Organisation (ILO) core labour standards, all of which have been ratified by Georgia:

- Forced labour (C105);
- Child Labour (C182);
- Discrimination (C111);
- Freedom of Association and the Right to Organise (C 87);
- Equal Remuneration (C100); and
- Minimum Age (C138).

Specific legislation and guidelines applicable to particular disciplines that will be considered during the ESIA process will be detailed in the relevant Section of the ESIA terms of reference.

5. Assessment Scope and ESIA Process

5.1 Introduction

In accordance with international lending requirements for environmental and social assessment, the scope of works for the ESIA includes:

- Environmental, social, labour, gender, health, safety, risks and impacts;
- Primary Project and related facilities. This includes reviewing potential cumulative impacts and planned or unplanned but predictable developments caused by the Project that may occur later or at a different location to the extent possible;
- Risks and impacts that may arise for each key stage of the Project cycle, including pre-construction, construction, operations and decommissioning or closure;
- Role and capacity of the relevant parties including government, contractors and suppliers; and
- Potential third party impacts including supply chain considerations.

The ESIA has identified negative and positive, direct and indirect, and cumulative impacts of the Project related to the bio-physical and the socio-economic environment**.**

The definition of the Project includes all infrastructure and facilities that are directly part of the proposed development or are associated development that exists specifically for or as a result of the Project. Consideration of associated infrastructure is carried out to the extent possible given its level of definition or development at the time of assessment of the primary project facilities.

This Section presents the key findings of the scoping stage and the general methodology followed to produce the present ESIA to international standards.

5.2 Scoping Stage

In order to decide which aspects of the scheme are likely to give rise to environmental impacts, and to determine the work required for the preparation of the ESIA, a Scoping Report was prepared in July 2011. This report set out the perceived likely environmental effects that could be anticipated as a result of the development of the Project and the assessment process by which these effects would be evaluated.

There is no requirement in Georgian legislation to undertake a scoping stage as part of the EIA process so the Scoping Report was used in this case as the basis for early consultation with non-governmental organisation and with the public. It was also posted on the project website. Summary leaflets were also prepared using information from the scoping report and posted in the local municipalities and at public meetings. Further details of the consultation is provided in Chapter 6.

5.3 Impact Assessment Methodology

5.3.1 Introduction

Following scoping and identification of likely environmental impacts, specialist assessments were carried out in order to predict potential impacts associated with the development and propose measures to mitigate the impacts as appropriate. Each assessment chapter (Chapters 7 to 19) follows a systematic approach, with the principle steps being:

- Description of assessment methodology used

- Identification of the spatial and temporal scope of potential impacts (area of influence)
- Description of baseline conditions
- Impact assessment
- Identification of appropriate mitigation measures as required
- Assessment of residual environmental impacts.

5.3.2 Area of Influence

The area of influence (AoI) indicates where proposed works, including related facilities and infrastructure will have a direct or indirect impact on the physical and social environment. This can result from aspects such as the physical land-take or as a result of the extent of the potential impact that extend beyond the development physical boundary such as noise emissions or emissions to air. The area of influence can also vary according to the stage of the Project being assessed such that construction impacts may have a greater area of impact than for operation.

For each impact assessment chapter the spatial and temporal area of influence will be defined.

5.3.3 Baseline

Baseline information has been collated from a range of sources including publicly available information, primary data collection and through consultation. Relevant baseline information used to support the assessment process is referenced / summarised in the relevant impact assessment chapters. Supporting baseline reports are provided where relevant in supporting appendices.

5.3.4 Assessment of Impacts

5.3.4.1 Overview

The assessment of the significance of impacts and identification of residual impacts has taken account of any incorporated mitigation measures adopted by the Project, and is largely dependent on the extent and duration of change, the number of people or size of the resource affected and their sensitivity to the change. The criteria for determining significance are specific for each environmental and social aspect but generally for each impact the magnitude is defined (quantitatively where possible) and the sensitivity of the receptor is defined. Generic criteria for defining magnitude and sensitivity are summarised below.

5.3.4.2 Magnitude

The assessment of magnitude will be undertaken in two steps. Firstly, the key issues associated with the Project have been categorised as beneficial or adverse. Secondly, the magnitude of potential impacts have been categorised as major, moderate, minor or negligible based on consideration of the parameters such as:

- Duration of the impact - ranging from beyond decommissioning to temporary with no detectable impact;
- Spatial extent of the impact – for instance, within the site, boundary to regional, national, and international;
- Reversibility - ranging from permanent requiring significant intervention to return to baseline to no change;
- Likelihood – ranging from occurring regularly under typical conditions to unlikely to occur; and

- Compliance with legal standards and established professional criteria - ranging from substantially exceeds national standards and limits / international guidance to meets or exceeds minimum standards or international guidance.

Table 5.1 outlines generic criteria for determining magnitude.

Table 5.1: Criteria for Determining Magnitude

Magnitude (Beneficial or Adverse)	Description
Major	Fundamental change to the specific conditions assessed resulting in long term or permanent change, typically widespread in nature, and requiring significant intervention to return to baseline; exceeds national standards and limits.
Moderate	Detectable change to the specific conditions assessed resulting in non-fundamental temporary or permanent change.
Minor	Detectable but minor change to the specific condition assessed.
Negligible	No perceptible change to the specific condition assessed.

Source: Mott MacDonald

5.3.4.3 Sensitivity

Sensitivity is generally site specific and criteria have been developed from baseline information gathered. The sensitivity of a receptor will be determined based on review of the population (including proximity / numbers / vulnerability) and presence of features on the site or the surrounding area. Generic criteria for determining sensitivity of receptors are outlined in Table 5.2. Each detailed assessment will define sensitivity in relation to their topic.

Table 5.2: Criteria for Determining Sensitivity

Magnitude (positive or negative)	Definition (considers duration of the impact, spatial extent, reversibility and ability of comply with legislation)
High	Vulnerable receptor (human or ecological) with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.
Medium	Vulnerable receptor (human or ecological) with limited capacity to absorb proposed changes or limited opportunities for mitigation.
Low	Vulnerable receptor (human or ecological) with some capacity to absorb proposed changes or moderate opportunities for mitigation
Negligible	Vulnerable receptor (human or ecological) with good capacity to absorb proposed changes or and good opportunities for mitigation

Source: Mott MacDonald

5.3.4.4 Impact Evaluation and Determination of Significance

Impacts will be identified and significance will be attributed taking into account the interaction between magnitude criteria and sensitivity criteria as presented in the significance matrix in Table 5.3.

Table 5.3: Impact Significance Matrix

Magnitude of Impact	Sensitivity of Receptors			
	Negligible	Low	Medium	High
Negligible	Insignificant	Insignificant	Insignificant	Insignificant
Minor	Insignificant	Minor	Minor	Moderate
Moderate	Insignificant	Minor	Moderate	Major
Major	Insignificant	Moderate	Major	Critical

Source: Mott MacDonald

For each aspect, the significance of impacts will be discussed before and after mitigation (i.e. residual impact). Impacts identified as having major or moderate significance based on the above approach are classified as significant impacts.

Where feasible the following hierarchy of mitigation measures will be applied to reduce, where possible, the significance of impacts to acceptable levels:

- Mitigation / elimination through design;
- Site / technology choice; and
- Application of best practice.

5.3.4.5 Uncertainty

Any uncertainties associated with impact prediction or the sensitivity of receptors due to the absence of data or other limitation will be explicitly stated. Where applicable, the ESIA will make commitments concerning measures that should be put in place with monitoring and /or environmental or social management plans to deal with the uncertainty. This will be summarised in the Project environmental and social management and monitoring plan (ESMP) that will form part of the ESIA and implemented through the Project ESAP.

5.3.5 Assessment of Cumulative Impacts

Cumulative impacts are those impacts that may result from the combination of past, present or future actions of existing or planned activities in a project's area of influence. While a single activity may itself result in an insignificant impact, it may, when combined with other impacts (significant or insignificant) in the same geographical area and occurring at the same time, result in a cumulative impact that is significant.

Each specialist Chapter within this ESIA has included, where relevant, an assessment of the cumulative impact of the Adjaristsqali Project, taking into account the scheme as a whole as well as with any other known present and planned developments in the area of influence.

The list of planned developments which have been included in considering cumulative impacts is provided in Table 5.4.

Table 5.4: Existing and proposed developments in project area of influence

Existing Projects or Planned Development	Socio-economics	Ecology and Biodiversity	Water Resources and Water Quality	Materials and Waste Management	Ground Conditions	Noise and Vibration	Traffic and Transportation	Landscape and Visual Amenity	Air Quality	Carbon
Existing Asti Hydropower plant (HPP)	✓	✓	✓							
Existing Machakhlistsqali Hydropower plant (HPP)	✓		✓							
Chirukhistsqali HPP under construction	✓							✓		
Proposed Chorokhi hydropower cascade project		✓	✓				✓	✓	✓	
Local tree felling				✓	✓					
Ski Resort on the Chvanistsqali Valley	✓							✓		
Goderdzi Pass Ski Resort (Khulo Municipality)							✓		✓	
Gomarduli Ski Resort (Shuakhevi Municipality, Gomarduli Village)							✓		✓	
Goma Mountain Ski Resort (Shuakhevi and Keda Municipalities)							✓		✓	

5.3.6 Consideration of Climate Change

The potential consequences of climate change for the Adjaristsqali river basin have been considered in the feasibility study (Section 4.5.4) using trend analysis to assess potential increases or decreases in operational yield over the lifetime of the Project (baseline data taken from the Second National Communication (2009) under the Kyoto Protoco). The trend analysis was based on (i) the agreed reserved flows for ecological and anthropogenic water use ‘environmental flow rules’; (ii) inter-annual variation in runoff; and (iii) characteristics of drought periods and potential impacts on runoff associated with projected climate change. Specifically, the feasibility study included design parameters to accommodate the worst probable maximum flood (PMF) event. Therefore, the Project design has considered the possible effects of future climate change and the infrastructure has been designed to function should these effects and conditions be realised.

At the operational level, this assessment describes the methodology for setting the 'environmental flow' (see Chapter 10 of this ESIA). The methodology considers historical hydrological data (which incorporates seasonal flow variability going back nearly 50 years) and the system inflows and outflows are actively monitored to identify variations in flows. This mechanism enables the operation of the Project to be altered to adapt to changes in flows, either as a result of seasonal variations or wider variations associated with future climate change.

5.3.7 Proposals for Monitoring

Where appropriate, proposals for future monitoring have been put forward within the assessment chapters. These proposals for monitoring have been designed to evaluate the accuracy of the impact prediction and the success of the implemented mitigation measures. All future monitoring has been committed within the ESMP constituting Volume IV of this ESIA documentation.

6. Information Disclosure, Consultation and Participation

6.1 Introduction

This Chapter outlines the information disclosure, consultation and participation activities that have been undertaken as part of the ESIA process (in accordance with the Stakeholder Engagement Plan (SEP), July 2011, this document can be found at www.adjaristsqali.com). This Chapter reports the outcomes of these activities, as well as those activities planned for future phases in the lifecycle of the Project.

The Chapter consists of the following subsections:
- 6.2 Principles of Consultation
- 6.3 Consultation Requirements
- 6.4 Stakeholder Identification
- 6.5 Project Consultation Activities and Outcomes
- 6.6 Project Grievance Redress Mechanism.

6.2 Principles of Consultation

Early and ongoing consultation, disclosure and meaningful stakeholder engagement is a key requirement for projects financed by IFC and EBRD. The ESIA will be informed by the outcomes of consultation activities that will be guided by the SEP initially produced for the Project at the outset of the ESIA process (July 2011).

The Project SEP has been designed to guide public consultation and disclosure activities up to the completion of the ESIA Report and through the construction and operational phases of the Project. It is a strategic document for planning meaningful and appropriate consultation with stakeholders that will be periodically updated as the Project progresses. Stakeholders are defined as persons and entities who are interested in, are affected by, or can affect the outcome of the Project. Specific objectives of the SEP are to provide a consultation strategy for the Project to:
- Ensure all legal and international finance requirements related to consultation are addressed
- Involve a full range of stakeholders in the planning of the Project to improve the acceptability of the Project design, implementation and monitoring
- Encourage an open dialogue with local communities and especially Project Affected Peoples (PAPs) where the Project is located
- Keep all interested and affected stakeholders informed of project progress
- Provide a grievance mechanism for PAPs to raise complaints that are appropriately addressed by the Project.

The SEP is underpinned by the principles that community engagement should be free of external manipulation, interference, coercion and intimidation and conducted on the basis of timely, relevant, understandable and accessible information. Consultation activities should always be well planned and based on principles of respectful and meaningful dialogue.

6.3 Consultation Requirements

6.3.1 Overview

This sub-section provides an overview of the international consultation, disclosure and stakeholder engagement requirements of the IFC, EBRD, and the national requirements contained within the Georgian ESIA procedures.

6.3.2 National Consultation Requirements

The environmental permitting system is governed by the Law of Georgia on Environmental Impact Permit (2007); Law of Georgia on Protection of Environment (enacted 1996, amended 2000, 2003, 2007); Law of Georgia on Licenses and Permits (2005); and Law of Georgia on Ecological Assessment (adopted in 2007).

The Constitution of Georgia guarantees public access to information and states the right of an individual to obtain full, unbiased and timely information regarding his/her working and living environment. Public participation in project development is regulated under the Law on Environmental Impact Permit (2007). The Law also provides a list of activities subject to environmental and social impact assessment (ESIA). According to paragraphs 6 and 7 of the Law, the project developer is required to prepare an ESIA and is responsible for public engagement, which includes announcing public disclosure of the document in both central and local media. The law states that public participation and provision of access to information are obligatory procedures of the environmental permitting process. This is conducted in the form of a public discussion of the proposed activity with participation by the investor, the Ministry of Environment Protection and local administrative authorities.

Public consultation is only required by law on completion of the draft Final ESIA. Scoping workshops or on-going consultation during the construction and operational phases are not required by law. Projects which do require an ESIA are mandated to conduct public hearings within 60 days of publishing the draft ESIA[4]. There are no additional requirements for disseminating information, either by means of leaflets, posters and/or other visual displays, or radio/television, nor are there any requirements to identify possible stakeholders (including vulnerable groups) and ensuring their participation.

6.3.3 International Consultation Requirements

6.3.3.1 IFC Consultation Requirements

Public consultation, disclosure and stakeholder engagement are key requirements of the IFC's Policy and Performance Standards on Social and Environmental Sustainability (January 1, 2012).

The eight IFC Performance Standards (PS) are applicable to private sector projects in emerging markets. Each PS has specific consultation requirements and these are embedded in the general requirements specified in *Performance Standard 1: Social and Environmental Assessment and Management Systems.* These requirements specifically refer to the need for and means of achieving community engagement,

[4] This provision relates to Decree No. 154 "On the Procedure and Terms for Issuance of an Environmental Permit"

disclosure of relevant project information, appropriate consultation processes and grievance mechanisms throughout the Project lifecycle. The requirements for stakeholder engagement in projects are:
- Start as early as possible in the project cycle
- Continue throughout the life of the project
- Be free of external manipulation, interference, coercion, or intimidation
- Where applicable enable meaningful community participation
- Be conducted on the basis of timely, relevant, understandable, and accessible information in a culturally appropriate format.

The IFC seeks to provide accurate and timely information regarding its investment and advisory activities as well as more general institutional information in accordance with its Access to Information Policy (January 1, 2012). IFC's Access to Information Policy states that for all Category A and B projects proposed for financing, a summary of its review findings and recommendations will be disclosed and include as a minimum, the following information:
- Reference to the performance standards and any applicable grievance mechanisms, including the compliance advisor/ombudsman;
- The rationale for IFC's categorisation of the Project;
- A description of the main social and environmental risks and impacts of the Project; and
- Key measures identified to mitigate those risks and impacts, specifying any supplemental measures and actions that will need to be implemented to undertake the Project in a manner consistent with the PS.
- Electronic copies or weblinks to any relevant environmental and social impact assessment (ESIA) documentation prepared by the developer
- Any additional documents such as Action Plans (APs), Stakeholder Engagement Plans (SEP), Resettlement Action Plans (RAPs) etc.

In addition to the above, general financial and investment information will also be provide by the IFC. Project or investment information, once published by the IFC, will be disclosed through its Disclosure Portal at http://www.ifc.org/disclosure. Relevant environmental and social information must be made publicly available for at least 60 days prior to consideration of investment approval by the IFC's Board of Directors (or other relevant authority).

6.3.3.2 EBRD Consultation Requirements

The EBRD's Environmental and Social Policy (2008) and Public Information Policy (2008) documents outline the EBRD's key policies with regards to information disclosure and stakeholder engagement. Similarly to the IFC, EBRD requires the project sponsor to provide the public, including NGOs, with information about the project during scoping stage and to prepare an SEP.

The 2008 EBRD policy requires project sponsors to engage with stakeholders from the earliest stages of the Project throughout the life of the project. Stakeholder engagement must be open, meaningful, and in an appropriate manner acceptable to the potentially affected communities. The engagement program must actively address the needs of vulnerable populations who may be affected by the project. The ESIA documents must remain in the public domain for the life of the project, and if changes to project plans are necessary, these have to be made public as well.

EBRD's Public Information Disclosure Policy requires ESIA documents to be available through their Business Information Centre in London and resident offices as well as their website (under the specific project name, which can be found at http://www.ebrd.com/saf/search.html?type=eia) at least 60 days prior to consideration of the Project by the Board of Directors for private sector projects.

6.3.3.3 Public Consultation Requirements under the EU

The European Union's EIA Directive 85/337/EEC (as amended by 97/11/EC, 2003/35/EC, and 2009/31/EC) describes the impact assessment process that their member states must follow. The EIA Directive requires public consultation throughout project development, impact assessment, and project implementation. The Directive requires that public participation for projects which may have environmental and/or social impacts takes place early in the decision making process and alternatives are presented. As the project develops, the public is to be provided with relevant information. Public comments must be taken into account and any rejection or disregard of the comments needs to be clearly justified.

The public is to be notified of decisions made and the reasons for the decisions. The Directive provides members of the public with the right to challenge decisions or actions based on substantive or procedural legality.

It also includes the tenets for public participation that are incorporated in the Aarhus Convention on Access to Information, Public Participation in Decision- Making and Access to Justice in Environmental Matters. The Aarhus Convention grants the public rights regarding access to information, public participation and access to justice in governmental decision-making processes on matters concerning the local, national and transboundary environment. The Company must have a procedure or policy in place that allows right of access to environmental information to any person. Relevant project information related to environmental and social issues must be made available free of charge.

EU Directive 2003/4/EC (repeals Directive 90/313) on Public Access to Environmental Information also grants right to the public to access information either held by public authorities or for public authorities and incorporates the provisions and requirements of the Aarhus Convention on public access to environmental information, with a wider remit than that applicable under the EIA directive.

6.3.3.4 International Conventions on Public Consultation

Similar requirements for access to information and public involvement in decision making are also specified within the following international conventions:

- Agenda 21. (UN, 1992b) Article27 (9) states that the UN system should "provide access for nongovernmental organizations to accurate and timely data and information to promote the effectiveness of their programs and activities and their roles in support of sustainable development".
- Rio Declaration on Environment and Development (1992). Annex 1 Principle 10 - "Each individual shall have appropriate access to information on hazardous materials and activities in their communities […] States shall facilitate and encourage public awareness and participation by making information widely available".

UN General Assembly Resolution A/RES/S-19/2 (1997). Paragraph 108 - "Access to information and broad public participation in decision-making are fundamental to sustainable development".

6.4 Stakeholder Identification

6.4.1 Area of Influence and Selection of Districts for Consultation

Within the Project area of influence there are four main settlements (Keda, Shuakhevi, Khulo and Khelvarchauri), located within four municipalities. The consultation has been targeted towards these four settlements, with a number of smaller villages also selected in order to cover the entire Project area. Such an approach captures all of the members of the public and stakeholders who could potentially be directly or indirectly affected by the Project and associated infrastructure. The consultation process also included a range of local government bodies such as representatives from the local communities and local NGOs, as these bodies hold information that is very important to the Project.

6.4.2 Direct Stakeholders

Direct stakeholders can be defined as those stakeholders who are likely to be directly impacted by the Project and have livelihood restoration measures targeted towards them. Direct stakeholders include:

- Physically and economically displaced people
- People living in communities close to the Project area
- Local labour pools for job seekers
- Local women's groups
- Local business owners, such as fish farmers
- Local social and community service providers (e.g. health and education)
- Local governmental bodies related to public welfare, environmental protection and permitting for the Project
- Neighbouring and supply chain industries and businesses including livestock owners.

All of these stakeholders are considered to be 'impact-based'. The role of each stakeholder in the consultation process for the Project is summarised in Table 6.1.

Table 6.1: Direct Stakeholder Groups

Stakeholder Group	Reasons for Inclusion within the Consultation Process
Local Project Affected Communities – Khulo, Shuakhevi, Keda, and Khelvarchauri Municipality	**Impact-based**: local communities may be adversely affected by construction and operational impacts but also may benefit from employment and indirect economic opportunities.
Physically and economically displaced Project Affected People (PAPs)	**Impact-based**: Will need to be compensated, and /or resettled in accordance with the resettlement plans to be developed as part of the ESIA process.
Employees and labour	**Impact-based**: Can benefit from employment opportunities but also face potential health and safety risks
Industry and Business	**Impact-based:** Possible impact on the operating regime of existing HPP and other businesses during construction and operation of the proposed Adjaristsqali HPP.
Government of Georgia	**Impact-based:** They will be interested to know what benefits the Project will be contributing to Adjaristsqali, such as the production of local jobs and the opportunity to bring economic wealth to the area etc.

6.4.3 Indirect Stakeholders

Indirect stakeholders can be defined as those persons or organisations that may, be interested in or able to influence the outcome of the Project, either because they can contribute knowledge or improve Project design or mitigate social and/or environmental impacts, or because they have political influence in the Project that needs to be considered. All of these stakeholders are considered to be 'interest-based'. Indirect stakeholders relevant to the Project are identified in Table 6.2.

Table 6.2: Indirect Stakeholder Groups

Stakeholder Group	Reasons for Inclusion within the Consultation Process
International Bodies (e.g. EU) / Financial Institutions (e.g. IFC/EBRD)	**Interest-based**: They influence government policy which affects the Project, and in the case of IFIs, provides finance.
National Government Departments including Ministries of Energy; Environmental Protection and Natural Resources; Culture and Monument Protection; Internal Affairs; Regional Development and Infrastructure; Economy and Sustainable Development; Agriculture; and Health, Labour and Social Affairs.	**Interest-based:** Meeting the requirements of country's energy policies during the implementation of the planned activities, setting national policies, providing project approvals.
Provincial/Local Government Departments such as the Adjaran Government and the Municipalities of Khulo, Shuakhevi, Keda and Khlevachauri.	**Impact-based and Interest-based:** Managing local impacts, facilitating project implementation and consultation.
Local Community Women's Groups	**Interest-based:** These groups promote the interests of women in pursuit of gender equality. They will be interested in employment and other opportunities for women.
Civil Society, NGOs, Research Bodies	**Interest-based**: Protection of rights of residents of the local communities during the project implementation, should be involved in external monitoring and identification of environmental and social issues.
Press and Media	**Interest-based**: Informing residents living in the Adjara region and the Project affected area about the planned activities, reporting Project activities.

6.5 Project Consultation Activities and Outcomes

6.5.1 Overview

This sub-section presents the activities undertaken during the ESIA process and their outcomes, and summarises those activities planned throughout the remainder of the Project's lifecycle in accordance with the SEP, available from the Project website (www.adjaristsqali.com), and the requirements outlined in Section 6.3. These activities are presented in chronological order in Table 6.3 below.

Table 6.3: ESIA Consultation and Disclosure Chronology

Project Phase	Activity	Date	Objectives
ESIA Phase Engagement	Disclosure of Scoping Report	Final scoping report version completed on 26 August 2011.	•
	Disclosure of Stakeholder Engagement Plan	Final Stakeholder Engagement Plan issued 28 July 2011.	•

Project Phase	Activity	Date	Objectives
	ESIA Scoping Consultation and Disclosure Activities (4 municipality consultation meetings and 6 community and village consultation meetings)	19-20 July 2011	• Disclose information about the Project and the consultation process • Enable the site visit team to respond to any queries / concerns that stakeholders had about the Project • Obtain where possible baseline environmental and social information relevant to the Project.
	Draft ESIA Disclosure on AGL website	April 2012	• Disclose the findings of the Draft ESIA.
	Draft ESIA public consultation meetings	June 2012 (no later than 60 days after disclosure of the draft ESIA on the website)	• Disclose the findings of the Draft ESIA • Receive comments on the Draft ESIA findings • Finalize the ESIA with assistance of local people and local authorities and NGOs.
	Private meetings and workshops	September 2011 and further meetings as necessary over the duration of the ESIA process.	• Disclose information about the Project and the consultation process • Collect data and register /concerns opinions. In particular NGO's, decision makers, local authorities, residents of settlements within the Project impact zone • Respond to stakeholder concerns or queries and ensure they are addressed in the ESIA • Invite comments before finalisation of the ESIA ToR.
	Focus groups discussions with vulnerable groups	At least one meeting with: • Village representatives and wider municipality heads • Effected landowners • Women's group	• Disclose information to vulnerable groups • Determine the need for extra attention or assistance for vulnerable groups • Obtain information about the number of possible vulnerable people/households in the Project area.
	Media communications	As requested or when press releases deemed relevant	• Disclose information about upcoming public consultation meetings • Newspaper (regional and national coverage) notice for two successive weeks prior to public consultation meetings • Radio (with nationwide coverage) announcement once a week for at least two weeks prior to public consultation meetings.
Construction Phase Engagement	Ongoing community liaisons and grievance logging	Ongoing during construction phase	• Appointment of the CLO • Providing day-to-day interface with the community • Visiting local communities for informal consultation once a week at minimum • Reporting grievances weekly.

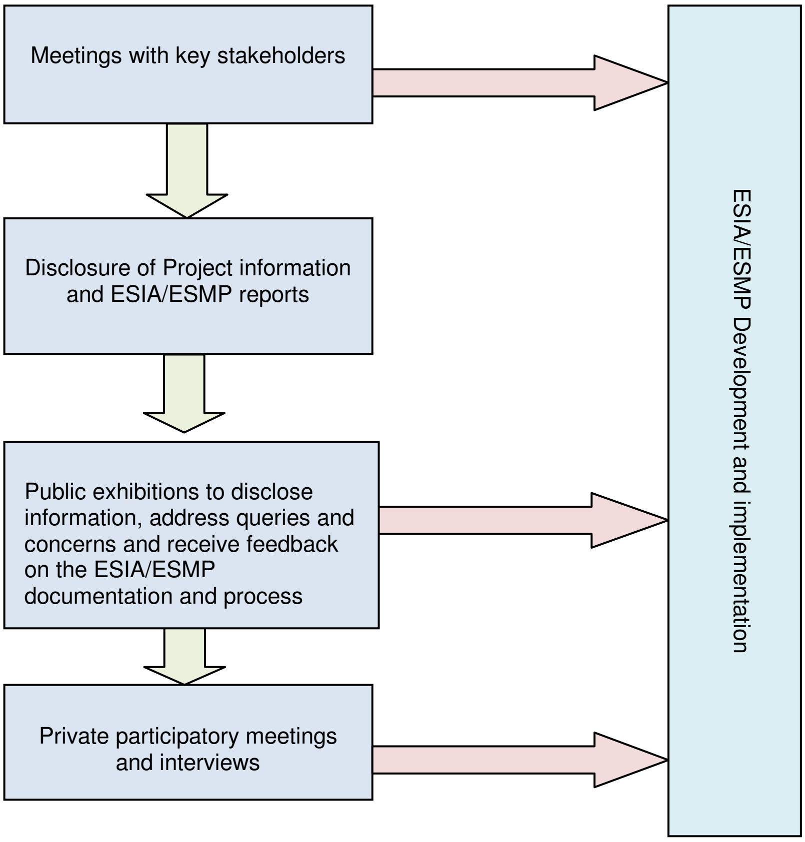
Project Phase	Activity	Date	Objectives
	Community consultation events	• Prior to start of construction • Prior to the completion of construction • Regularly updated on website	• Disclose any information relevant to the Project construction • Respond to stakeholder concerns or queries and ensure they are addressed • Invite comments or grievances to be presented.
	Media notifications of Project progress	• At least two weeks prior to the community consultation meetings. • Regularly updated on website	• Disclose information about upcoming public consultation meetings • Newspaper (regional and national coverage) notice for two successive weeks prior to public consultation meetings • Radio (with nationwide coverage) announcement once a week for at least two weeks prior to public consultation meetings.
	Updating SEP	• Following each of the community consultation events	• Assessing whether all stakeholder engagement presented in the SEP is still valid • Assessing whether more stakeholder engagement is necessary.
Operation and Decommissioning Phase Engagement	Open Days	Annually	• Allow local residents to gain a better understanding of the Project.
	Grievance logging, resolution and reporting.	• Ongoing logging and resolution • Bi-annual reporting	• Log and provide answers to all grievances and prepare reports on grievances and their resolutions.
	Decommissioning consultation event with affected staff and communities	• With staff prior to retrenchment proceedings • With communities prior to ceasing operations	• Disclose information about decommissioning the plant • Respond to stakeholder concerns or queries about decommissioning • Invite comments or grievances to be presented.
	Updating SEP	Annually	• Assessing whether all stakeholder engagement presented in the SEP is still valid • Assessing whether more stakeholder engagement is necessary.

6.5.2 International ESIA Consultation

6.5.2.1 Overview

The remainder of this Chapter will cover the ESIA consultation, disclosure and participation activities and the outcomes that were reported for each activity. This Section summarises the consultation activies undertaken during the ESIA phase prior to construction commencing (in accordance with the SEP, which is available from the Project website – www.adjaristsqali.com). The Project consultation, disclosure and participation activities can be broadly categorised into the components identified in Figure 6.1.

Figure 6.1: ESIA Consultation, Disclosure and Participation Components



These activities have occurred throughout the ESIA scoping phase as outlined below and consulation activities will continue to take place throughout the life of the project. ESIA monitoring is planned throughout the lifecycle of the Project as summarised in the ESMP (Volume IV to this ESIA).

6.5.2.2 ESIA Inception (Scoping) Site Visit Consultation (July 2011)

During the preparation of the Inception (Scoping) Report, four stakeholder consultation meetings were carried out in the four main centres of Keda, Shuakhevi, Khulo and Khelvarchauri as well as six other smaller villages in the assessment area as part of the Inception (scoping) site visit. The ten consultation meetings were arranged so that they spanned the length of the assessment area and so that all affected stakeholders would have the chance to attend a meeting.

Municipality Scoping Consultation Meetings

The four municipality level scooping consultation meetings were held over the period 19th and 20th of July 2011 at the following locations:

- Khulo Municipality, 19th July, 2011
- Shuakhevi Municipality, 19 July, 2011
- Keda Municipality, 20th July 2011

- Khelvarchauri Municipality, 20th July 2011.

During the meetings, the site visit team (consisting of AGL and international and local ESIA team environmental and social specialists) introduced themselves, explained the Project and the ESIA process and then invited comments and questions. Any comments or questions raised by stakeholders were responded to by AGL and Gamma and recorded. A number of key themes were brought up regularly during the municipality consultation meetings, these included the prevalence of landslides, erosion and seismic activity in the area, there were also issues regarding environmental flow, in regards to biodiversity and fish as well as those people worried there would not be enough water for irrigation, farming and recreational purposes. A number of people were concerned about existing roads and the possibility of the construction of new roads, or rehabilitation of existing roads. Employment opportunities in jobs associated with the Project was another theme brought up in the meetings as well as the possibility of relocation, or resettlement of households or parcels of farmland. Many respondents were also concerned that the consultation process be ongoing and wished to know when the next round of consultations would commence. The information gathered from these meetings, along with a review of Project documentation and site visit observations was used to produce the Scoping Report in August 2011.

The municipality consultation meeting comments and queries and how they were responded to at the consultations are summarised in Table 6.4 below. This table also shows where these issues have been addressed in the ESIA report.

Table 6.4: Summary of Municipality Consultation Meetings

Location	Summary of Key Issues Raised	Responses and ESIA Report References
Khulo Municipality 19th July, 2011	Potential opportunities for future public discussions.	International Financial Organizations (in this case the IFC), ESIA policy as well as per Georgian Environmental legislation state that there should be a second round of stakeholder meetings after preparation of the preliminary ESIA. Future stakeholder meetings will be at the publication of the draft ESIA in March – April 2012.
	Concerns about a lack of irrigation, if there will be water left in the river after the cascade construction.	According to Environmental legislation and International Ecological Standards ecological flow issues must be considered as a priority for each dam. Calculations will assess aquatic ecology and water resource user (irrigation, fish farms) requirements. Chapter 10 of the ESIA discusses environmental flows
	Queries about whether there are going to be improvements made to existing local roads.	The planned dam at the confluence of the river Acharistskali and Ghorjomi will be high and will cause water to cover the existing road. Before commencement of the Project works plans will be made for the construction of new roads as well as reconstruction-rehabilitation of the existing roads. Chapter 13 discusses Transport and Traffic issues, and Section 7.4.1.3 – 7.4.1.5 include social impacts of reconstructing and rehabilitating local roads
	Queries as to whether local electricity tariffs will be offered to local communities.	Power supply tariffs are defined by the State Regulation Committee. The hydro power operation company is not empowered to give discounts to local consumers. However, AGL will consider other opportunities to support municipality programmes.
Shuakhevi Municipality 19th July, 2011	Queries about the impact of the dams on Black Seas Salmon	During the ESIA process measures will be prepared that will consider: insertion of fish ways on dams and

Location	Summary of Key Issues Raised	Responses and ESIA Report References
	migration.	fish protection facility construction on water intakes. Information on Black Sea Salmon and other fish can be found in Chapter 8 which discusses ecology and biodiversity and Chapter 10 discusses environmental flows.
	Concerns on the impact of the Project on the village's historical bridges.	According to current preliminary design decisions no historical buildings or bridges existing within the frame of the present Project will be subjected to flooding. Chapter 17 discusses places of cultural heritage and whether they will be affected or not by the Project.
	Queries on the environmental flow and the volume of water which would pass through the Shuakhevi Municipality after the Project is implemented.	According to Environmental legislation and International Ecological Standards ecological flow issues must be considered as a priority for each dam. Calculations will assess aquatic ecology and water resource user (irrigation, fish farms) requirements. Chapter 10 of the ESIA discusses environmental flows
Keda Municipality 20th July 2011	Queries about potential electricity tariffs for local populations.	Tariffs are determined by the State, i.e. the National Energy Regulatory Commission and therefore the investor can not decide such matters. The investment company will take an active part in local social programs. Similar programs are planned in coordination with the local municipality. Section (7.5.3.1) covers recommendations on community investments.
	Concerns over ownership of land parcels, and the potential for land parcels to be flooded and how affected people would be compensated.	The number of parcels to be flooded will be identified after the detailed engineering design has been completed and the information will be provided at future consultations. "Geographic"; will hold individual negotiations with each family and land parcels or other real estate will be acquired on the basis of mutual agreements. Chapter 7 the social impact assessment includes information on population resettlement.
	Concerns about the Project leading to landslides.	AGL is currently carrying out detailed engineering - geological and topographic - geodetic studies and the future dam site locations will be selected on the basis of obtained conclusions. AGL will select the best landslide and erosion prevention methods specific to each area based on the above studies. Chapter 11 of the ESIA discusses geology, landslides and seismic risks and also includes information on erosion
Khelvarchauri Municipality 20th July 2011	Many concerns were raised about the river potentially running dry within the local area, and also concerns about the potential rise in river height within the region.	According to the Georgian environmental law and international environmental standards, mandatory ecological flow should be considered for every specific dam. Along with the water volume, needed for existence of the biological environment also the water volume, needed for water consumers downstream of the dam will be considered during the ecological flow calculation. Although the river water level will reduce significantly, the environmental flow will be maintained. The river level will not rise on the Adjaristsqali River. The project construction project on Chorokhi River is planned by another company and AGL has nothing to

Location	Summary of Key Issues Raised	Responses and ESIA Report References
		do with this Project. Chapter 10 discusses environmental flows.
	Concerns about the threat of landslides, damage to local buildings/facilities.	Construction works within the Adjaristsqali community area will not damage buildings/facilities or create landslides. The tunnel design criteria for each section of the Project can be found in Section 2.6 and the powerhouse design can be found in Section 2.7.
	Queries about how close the reservoir would be to local populated areas.	Within Adjaristsqali community area, the power house will be installed underground, so no protective zone will be required. The power substation will be located above ground, and its right of way will not exceed 50-100 m. The distance between the Project site and a populated area, means there will be practically no risk of negative impacts on residents' health and safety. It should be noted that indicative layouts presented at scoping have changed. Latest layouts are described in Section 2.5.

Source: GAMMA

Figure 6.2: Khulo Municipality Consultation

Source: GAMMA

Figure 6.3: Keda Municipality Consultation

Source: GAMMA

Community and Village Consultation Meetings

The five community and village level consultation meetings were held over the period 19th and 20th of July 2011 at the following locations:

- Didachara Village, 19th July 2011 (Khulo Municipality)
- Chvana Community, 19th July 2011 (Shuakhevi Municipality)
- Zamleti Community, 19th July 2011 (Shuakhevi Municipality)
- Oladauri Community, 19th July 2011 (Shuakhevi Municipality)
- Merisi Community, 20th July 2011 (Keda Municipality)

A further community and village level consultation meetings was held in Kvatia Village on the 2nd September 2011.

These meetings followed very similar structure to the municipality level meetings, but were addressed to smaller groups of people. Many of the questions and comments brought up in the community and village meetings were similar to those asked in the municipality level meetings.

The community and village consultation meeting comments and queries and how they were responded to at the consultations are summarised in Table 6.5 below, and a complete version included comments from the Khelvarchauri Munuicipality is provided in Appendix B1. This table also shows where these issues have been addressed in the ESIA report. A full review of the questions and comments can be found in Appendix B1 as well as a table calculating the prevalence of responses to highlight the most frequently raised comments across the different villages.

Table 6.5: Summary of Community and Village Consultation Meetings

Location	Summary of Key Issues Raised	Responses and ESIA Report References
Didachara Village – Khulo Municipality 19th July 2011	Concerns were raised over potential environmental hazards induced by the Project such as landslides and erosion and who would be held responsible if such an event was to take place.	AGL is currently carrying out detailed geological-engineering surveys of the Project territory. The survey results will evaluate existing geological risks in the area of Didachara village. Decisions about the implementation of Project activities, in regards to possible environmental hazards, will be made in relation to the findings of the geological-engineering surveys. A second meeting will be held with stakeholders to disclose the findings of the ESIA prior to submission of the report. If erosion or landslides occur that are directly connected to implementation of the planned activity, the Company responsible for this activity shall be liable. Chapter 11 discusses geology, landslides and seismic risks and also includes information on erosion.
	Queries about whether there are going to be improvements made to existing local roads.	The dam at the Acharistskali and Ghorjomi rivers will cause water to cover the existing road. Therefore before commencement of the Project works, a new road will be constructed as well as reconstruction and/or rehabilitation of the existing roads. Chapter 13 discusses Transport and Traffic issues, and Section 7.4.1.3 – 7.4.1.5 include social impacts of reconstructing and rehabilitating local roads
	Concerns over the Projects impact on local historical and cultural heritage.	The preliminary design shows that no monuments of cultural heritage face any direct negative impact. The indirect impact assessment issues shall be studied during a process of the ESIA. Chapter 17 discusses places of cultural heritage.
	Queries about local employment opportunities.	As per AGL social policy the majority of nonqualified manpower shall be employed from the local population; qualified manpower will be selected as well and further training shall be given to local employees. Section 7.4 discusses the possible employment opportunities for local people in the construction phase (Section 7.4.1.1) and in the operational phase (Section 7.4.2.1).
Chvana Community – Shuakhevi Municipality 19th July 2011	Concerns on vibrations and risk of landslides caused by the Project.	Detailed engineering-geological and geodetic survey works are ongoing in the design area. Based on the survey results basic design solutions and preventive measures against development of dangerous geological

Location	Summary of Key Issues Raised	Responses and ESIA Report References
		processes will be determined. Chapter 11 discusses geology, landslides and seismic risks and also includes information on erosion
	Many concerns were raised about the risk of resettlement, especially for land poor communities located in their Municipality. Also concerns about the registering of land.	These residents are not likely to be in the direct impact zone of the Project. More precise information about this will be able after elaboration of the detailed engineering. Chapter 7 the social impact assessment includes information on resettlement.
	Query about what tunnelling methods were going to be used	Tunnelling will be done by means of a tunnelling machine. Section 2.6 covers the criteria set up for tunnel design.
	Query of potential electricity tariffs for local populations.	The electricity tariffs are determined by the State, i.e. the National Energy Regulatory Commission and therefore AGL cannot decide such matters. AGL will take an active part in implementation of social programs in the villages, located in the Project impacted zone. Section (7.5.3.1) covers recommendations on community investments.
Zamleti Community–Shuakhevi Municipality 19th July 2011	Several stakeholders raised concerns over the potential link the Project could have to future landslide hazard events.	Prevention measures for landslides and erosion shall be adopted; including: strengthening the slopes of water reservoirs, providing concrete screens on the slopes etc. Chapter 11 discusses geology, landslides and seismic risks and also includes information on erosion
	Query about future consultation opportunities.	A second stakeholder meeting will take place after the preparation of the ESIA and following publication of information in a newspaper about the public discussion. Stakeholder Engagement Plan (SEP), which can be accessed at the Project website (www.adjaristsqali.com), discusses future public consultations.
	Concerns about the Projects impact on local drinking water quality.	Considering that the tunnels will be mainly located at a great depth, the possibility of impacts on natural springs is lessened. Chapter 9 includes information on water resources and water quality.
Oladauri Community – Shuakhevi Municipality 19th July 2011	Several stakeholders raised concerns over what changes the Project was going to bring to local road networks.	The tunnel construction will require transportation services and therefore, rehabilitation of existing roads will certainly be provided, where necessary. Chapter 13 discusses Transport and Traffic issues, and Section 7.4.1.3 – 7.4.1.5 include social impacts of reconstructing and rehabilitating local roads.
	Issue of potential local employment opportunities.	According to the social policy of AGL company, they will employ the maximum number of local residents as possible for the Project construction and operation phases. Only highly qualified specialists, that can not be found locally, will be invited from outside. Section 7.4 discusses the employment opportunities for local people in the construction phase (Section 7.4.1.1) and in the operational phase (Section 7.4.2.1)
	Whether local electricity tariffs will be offered to local communities.	Electricity Tariffs are determined by the State, i.e. the National Energy Regulatory Commission and therefore the investor cannot decide such matters. AGL will take an active part in local community social programs; priority issues for these programs will be determined in coordination with the local municipality council. Section (7.5.3.1) covers recommendations on community investments.

Location	Summary of Key Issues Raised	Responses and ESIA Report References
	Concerns about the river running dry.	According to the Georgian environmental law and international environmental standards, mandatory ecological flow should be considered during water intakes from a river. Ecological flow is calculated under consideration of the water volume, necessary for existence of the biological environment and the water volume, needed for unhindered functioning of water consumption in the dam downstream. Chapter 10 discusses environmental flows.
Merisi Community – Keda Municipality 20th July 2011	Concerns about increased water shortages within the local area.	Along with the water volume, needed for the existence of the biological environment also the water volume, needed for functioning of water consumers downstream from the dam will be considered during the ecological flow calculation. Chapter 10 - discusses environmental flow.
	Queries about how the environmental flow will be calculated.	The ecological flow volume to be maintained downstream of the dam will be determined in the ESIA process. The Project operator shall ensure that the ecological flow is permanently maintained. Chapter 10 discusses the environmental flow
	Whether local labour resources will be used during construction and operation phases of the Project.	According to the social policy of AGL, they will employ the maximum number of local residents as possible during the Project construction and operation phases. A special program has been developed to select appropriate specialist among the local residents. Section 7.4 discusses the employment opportunities for local people in the construction phase (Section 7.4.1.1) and in the operational phase (Section 7.4.2.1).
	Concerns over the impact of the Project on local industries such as the fish farm at Goderdzistskali River.	The Project operator is obliged to permanently maintain the ecological flow downstream from the dam. The ecological flow must provide the water volume, needed to operate the fish farm. Hence, the fish farm should not be closed. Chapter 10 discusses the environmental flow
Kvatia Village, Khulo Municipality – 2nd September 2011	Questions on how close the reservoir water will get to their village and will it affect the village?	The indirect impact assessment issues sill being studied during the ESIA process and if it is necessary any mitigation measures will be prepared during the ESIA. A layout of the headworks for each section of the Project can be found in Section 2.5. Chapter 7 the social impact assessment includes information on population resettlement and mitigation measures.
	Queries about whether there will still be enough water in the river once the dam is built.	According to the Georgian environmental law and international environmental standards, mandatory ecological flow should be considered during water intakes from a river. Ecological flow is calculated under consideration of the water volume, necessary for existence of the biological environment and the water volume, needed for unhindered functioning of water consumption in the dam downstream. Chapter 10 discusses environmental flows.
	Queries about the possibility of employment	As per AGL social policy the majority of nonqualified manpower shall be employed from the local population; qualified manpower will be selected as well and further training shall be given to local employees. Section 7.4 discusses the possible employment opportunities for local people in the construction phase (Section 7.4.1.1) and in the operational phase (Section 7.4.2.1).

Source: GAMMA

Figure 6.4: Zamleti Community Consultation

Source: GAMMA

Figure 6.5: Oladauri Community Consultation

Source: GAMMA

6.5.2.3 Focus meetings and Workshops

Private workshops and meetings are more targeted ways in which to engage with stakeholders. They allow more in-depth discussions about Project plans and allow the opportunity to go into more detail about technical aspects of the Project or addressed specific concerns raised by one or a group of stakeholders. These meetings or workshops are likely to involve interest-based stakeholders who have most influence over the Project such as government regulatory bodies and non government organizations (NGOs).

A preliminary focus group meeting was conducted in September 2011 in Batumi Municipality with a number of the Project's identified direct stakeholders, consisting of environmental and social NGOs with local expertise in the Project area. The general purpose of these meetings was for the site visit team to:

- Disclose information about the Project and the consultation process
- Enable the site visit team to respond to any queries/concerns that stakeholders had about the Project
- Obtain where relevant environmental and social information to inform the ESIA preparation by gathering baseline information and identification of likely significant impacts.

During the meetings, the site visit team introduced themselves, explained the Project and the ESIA process and then invited comments and questions. Any comments or questions raised by stakeholders were discussed until the stakeholders were satisfied with the level of information provided. Key issues discussed in the workshop were similar to those already voiced during the Municipality and Community and Village Consultation Meetings. Environmental flow was an issue that was frequently raised, both in terms of water levels and the security of river biodiversity. Risk of landslide, erosion and seismic activity was another issue that was discussed as well as population resettlement and the impacts of the Project on eco-tourism.

An additional focus group meeting was held in May 2012 in Batumi on the draft ESIA as part of wider public disclosure and engagement. The project design, ESIA baseline, assessment and mitigation measures were summarised at the meeting. A stakeholder workshop on the Biodiversity Action Plan (BAP) inviting key stakholders interested in Biodviersity issues was held on September 14th 2012. The aim of the workshop was to identify key priority conservation aims of the BAP, baseline information gathered, and potential actions.

The main issues of concern as brought up in these meetings are provided below in Table 6.6. Further information on questions asked, the response given during the consultation meetings and how these queries have been addressed in the ESIA are summarised in Appendix B1. A table that highlights the most frequently raised comments across the different villages is also located in Appendix B1

Table 6.6: Summary of NGO Consultation Responses – Batumi Municipality

Location	Summary of Key Issues Raised	Responses and ESIA Report References
Butami Municipality 1st September 2011	Queries over how the ecological flow was going to be calculated.	The ecological flow will be calculated using international standard methods and will take into account local specifics, in particular: the ecological flow will be calculated under consideration of water volumes, necessary for existence of the biological environment and the functioning of water consumers downstream of the dam. Chapter 10 discusses ecological flow
	Concerns about population resettlement and the number of residential areas that are going to be flooded.	Identification of the Project impacted land parcels is finished. After verifying the final designs it will be possible to determine the number of affected land parcels more accurately and detect the number of residents, who will be subject to physical or economic resettlement. Resettlement will take place and several households and individuals will be subject to resettlement. Chapter 7 the social impact assessment includes information on population resettlement. Section 2.5 has a description of the headworks for all three Schemes
	Queries about additional consultation opportunities.	Stakeholder meetings will be held after scoping report disclosure, as well as after disclosure of the preliminary ESIA; after disclosure meetings with NGOs will take place. This Chapter (Chapter 6) discusses future consultations. The Stakeholder Engagement Plan (SEP), which can be accessed at the Project website (www.adjaristsqali.com), discusses future consultations in greater detail.
	Concerns over possible links between the Project and landslides / earthquakes etc.	Engineering-geological, topographic-geodetic and seismic surveys of the Project area are being carried out; all landslide zones will be explored the design solutions will be adopted based on results of these studies. Chapter 11 presents information on geology, seismology and landslides.
	Concerns over the effect the Project will have on local fish populations, especially Black Sea Salmon.	Gamma Consulting's ichthyologist, provided with guidance from Mott MacDonald specialists, is studying the ichthyofauna baseline conditions. For the ichthyofauna in general, as well as for the Black Sea Salmon appropriate mitigation measures will be elaborated. Information on fish species can be found in Chapter 8 and possible impacts can also be found in Chapter 10 which discusses environmental flows.

Source: GAMMA

Figure 6.6: Private meetings and Workshops (Batumi)

Source: GAMMA

Figure 6.7: Private meetings and Workshops (Batumi)

Source: GAMMA

6.5.2.4 Focus Groups Discussions

In-depth engagement with vulnerable or marginalised community groups will require less formal methods of engagement to disclose information, gather ESIA data and register community concerns. Project plans and timescales will be explained in non-technical language and in Georgian; communication should also be verbal to overcome any issues with illiteracy. During the ESIA process AGL have been consulting with stakeholders, including NGOs, local government agencies and the Ministry of Energy and Natural Resources, Ministry of Environment Protection and the operators of the existing Asti HPP. These discussions are ongoing.

6.5.2.5 Final ESIA Public Disclosure and Consultation

The Draft ESIA (including the Non-Technical Summary) were translated and submitted in Georgian in March 2012 for consultation. Hard copies were disclosed in the local communities to enable local stakeholders to raise comments and concerns before finalisation. The Draft ESIA was also available in Georgian and English on the AGL website: www.adjaristsqali.com and the following disclosure activities were undertaken:

- Notification of project and ESIA disclosure meeting dates and venues in relevant regional and national newspapers on submission of the Draft ESIA to the ministry in March as well as television advertisements broadcast on Adjara TV one week prior to public meetings.
- Submission of draft ESIA, Technical Summary, and Report on “maximum permissible levels of pollutants discharged into the surface water bodies together with effluents” to relevant administrative bodies as required by Georgian law
- Publication of draft ESIA Non Technical Summary in Georgian distributed to all municipalities and on the AGL website for a minimum of 40 days
- Four public consultation workshops in administrative centres in the municipalities of Khulo, Keda, Shuakhevi and Acharistskali were held to discuss the Project and the Draft ESIA report, providing an opportunity for stakeholders to comment on the report before it was finalised.

ESIA consultation activities have been fed back to the ESIA technical specialists and reported in the final ESIA report. MML and Gamma have produced these documents in Georgian and English for distribution to stakeholders in hard copy and published in full on the Projects website. The final ESIA will be disclosed in the local communities and on the AGL website.

A full table containing all questions raised during the public consultations with their corresponding answers is given in Appendix B. Below is a summary of the key issues and concerns raises during these public consultations.

6.5.2.6 Public Consultation summary

Main concerns raised during public consultation in Khulo, Keda, Shuakhevi and Adjaristsqali related to concerns on the Projects effect on the local climate; land acquisition and compensation; landslide risks; employment opportunities and whether the communities were to benefit from low electricity prices.

Concerns were raised as to whether the project would have an effect on the local climate by increasing humidity, but as no large reservoirs are part of the scheme design the effect on local climate is considered to be minimal.

There was also a general concern on the possibility of erosion and the likelihood of landslide activation and whether the AGL would take responsibility for any repercussions these effects may cause. It was stated that during the project design great care has been taken to assess the potential landslide risk areas and the scheme has been developed and modified to limit risks on any sensitive areas (see Chapter 11 for further details on risk assessment undertaken), as such only low risks sites were chosen to position the dams/weirs, reducing the likelihood of landslides to a minimum, however, in case such an unlikely event may occur, the AGL would take responsibility if as result of the scheme.

The Project was perceived to have a negative effect on water levels particularly in the Adjaristsqali River affecting the communities' water supply and sewage systems. Although the project will affect overall existing water levels, the greatest impacts reaches of rivers are close to the dam sites and a minimum ecological flow rate of 10% of the annual average will continue to be released at each dam, this will be contributed by additional inflows from side streams and tributaries along the Adjaristsqali reducing impacts along the river.

Questions in relation to land acquisition and compensation measures were raised in three of the four public consultation meetings. Each municipality was informed of AGL's intention to treat all land owners and users equally and offer compensation to all whether or not they had legal entitlement to the land. Land prices were to be determined based on market valuation to be undertaken on each land plot by a local real estate valuation company. Further details were provided in a leaflet distributed during the meeting and contact details of AGL's Community Grievance Officer included. AGL informed that those affected by land acquisition would be approached and have further consultation meetings and updates throughout the project.

All municipalities raised the question of whether they would benefit from either free or low electricity prices. They were informed that electricity prices are set by the authorities at national level and that AGL has no power over the matter.

The opportunity of employment and re-training of local population was brought up during the consultation and they were informed that AGL has been carrying out professional skills surveys in the municipalities and is planning to open a professional re-training centre in the Khulo region in cooperation with a Kobuleti public college.

The municipality of Khulo raised the question whether a resettlement action plan will be developed. It was clarified that at present the project had not identified any physical displacement requirements, only economic displacement. A Land Acquisition and Livelihood Restoration Framework (LALRF) has been developed for the project as whole and separate Livelihood Restoration Plans will be developed for each scheme detailing all land acquisition requirements. A copy of the LALRF is available on the project website as well as a summary document in Georgian.

6.5.3 Consultation Planned throughout the Lifetime of the Project

As part of the ESIA, an Environmental and Social Management and Monitoring Plan (ESMP) will detail specific monitoring and reporting requirements for environmental and social project performance. This will include ongoing stakeholder engagement and implementation of the grievance mechanism throughout the construction, operation and decommissioning stages.

6.5.3.1 Ongoing Community Liaisons and Grievance Logging

AGL has designated a Community Liaison Officer (CLO) who will be responsible for day to day community engagement during the initial Project development phase. This individual will be suitably qualified and tasked to:

- Act as main point of contact for the local community e.g. local group leaders (for instance there are women's groups, youth groups, village elders, religious leaders) and the elected and appointed local authorities;
- Disclosure of Project employment opportunities and key project news and impact information, such as the commencement/completion of construction activities;
- Community consultation and disclosure events at key stages in the Project, for example at the beginning of construction;
- Organise local community meetings to provide a regular opportunity to discuss any issues or concerns.
- Receive and record written and oral comments;
- Receive and log stakeholder grievances according to the grievance mechanism detailed below (see Section 6.6);
- Dissemination of comments/meeting minutes to appropriate stakeholders; and
- Produce annual summaries that provide details related to community investment activities and the use of the grievance mechanism.

AGL will also include clauses in the construction contracts to ensure that construction contractors and other sub-contractors appoint their own CLO's, who will report to AGL's CLO.

6.5.3.2 Community Consultation Events

Regular workshops will be a constructive way in which to involve key stakeholders throughout the duration of the operation phase, so that issues and any grievances can be raised and addressed as they emerge. Private meetings with individual stakeholders will also be organized as the need arises to discuss specific Project elements or concerns. These workshops will be held as a minimum prior to the start of construction; prior to the completion of construction; and prior to ceasing operations.

6.5.3.3 Media Notification of Project Progress

The Project will be advertised in regional newspapers and national newspaper one week prior to publication of the draft ESIA as well as television advertisements. The advertisement will contain information related to the title, location, place, and timescales of the proposed Project activities. Copies of the draft ESIA report (both in printed and electronic format) will be provided to the relevant administrative bodies, including municipalities of Khulo, Shuakhevi, Keda, and Khelvachauri, Non Technical Summaries will be made available in Georgian. The Final ESIA Report will also be disclosed on AGL's Project specific website www.adjaristsqali.com, as well as IFC's website for a period of 60 days to enable stakeholders to submit comments before the report is finalised.

AGL will regularly update the Project website, highlighting progress, minutes of meetings, the latest grievances and other issues as appropriate. This site will be functional throughout the duration of the construction period and for at least the first years of operation. Press releases will also be issued as and when necessary. For example at key stages of the Project such as at issuance of permits, the completion of construction and just before the Scheme is about to become operational.

6.5.3.4 Stakeholder Engagement Implementation

In order to comply with international finance standards, the Project will require public consultation and disclosure activities and mechanisms to continue beyond the ESIA process throughout the lifecycle of the Project. IFC PS 1 states that "The client will provide periodic reports to the Affected Communities that describe progress with implementation of the project Action Plans on issues that involve ongoing risks to or impacts on Affected Communities and on issues that the consultation process or grievance mechanism have identified as a concern to those Communities. The frequency of these reports will be proportionate to the concerns of affected communities but not less than annually". All of the project stakeholder engagement activities are guided by the SEP, which is available from the Project website (www.adjaristsquali.com).The key activities are summarised in Table 6.7 below.

Table 6.7: Stakeholder Engagement Implementation Timescales and Responsibilities

Activity	Timing	Responsibility
Construction Phase Engagement		
Ongoing Community liaison and grievance logging	• Community Liaison Officer (CLO) Appointment immediately in time for consultation and disclosure activities concerning the final ESIA report • Day to day interactions • Visiting local communities for informal consultation once a week at minimum • Weekly grievance reporting • Discussing progress of implementation of project action plans and issues that involve ongoing risks or impacts (as needed, but at least annually).	AGL Community Liaison Officer and EPC Contractors' CLOs, Project Manager
Community consultation events	• Prior to the start of construction • Prior to the completion of construction • Project website to be regularly updated	AGL CLO and EPC Contractors' Community Liaison Officers
Media notifications of project progress	• At least two weeks prior to the community consultation meetings.	AGL CLO

Activity	Timing	Responsibility
	• Regularly updated on website	
Updating SEP	• Following each of the community consultation events	AGL CLO
Operation and Decommissioning Phase Engagement		
Open days	• Annually	CLO and Project Manager
Grievance logging, resolution and reporting	• Ongoing logging and resolution • Bi-annual reporting	CLO, Project Manager
Decommissioning consultation event with affected staff and communities	• With staff prior to retrenchment proceedings • With communities prior to ceasing operations	CLO, Project Manager
Updating SEP	• Annually	CLO, Project Manager

6.6 Project Grievance Redress Mechanism

6.6.1 Overview

A grievance can be defined as an actual or perceived problem that might give grounds for complaint. As a general policy, AGL will work proactively towards preventing grievances through the implementation of impact mitigation measures and community liaison. A project performance grievance mechanism has been established prior to the commencement of construction activities and an ongoing grievance register will be maintained through construction and operation by the CLO. The sections below consider types of grievances, confidentiality and anonymity, and the Project's grievance resolution process.

6.6.2 Types of Grievances

Anyone will be able to submit a grievance to the Project if they believe a practice is having a detrimental impact on the community, the environment, or on their quality of life. They may also submit comments and suggestions. Grievances could include:
- Negative impacts on a person or a community (e.g. financial loss, physical harm, nuisance)
- Dangers to health and safety or the environment
- Failure of AGL, its Contractors and sub-contractors and their workers or drivers to comply with standards or legal obligations
- Harassment of any nature
- Criminal activity
- Improper conduct or unethical behaviour
- Financial malpractice or impropriety or fraud
- Attempts to conceal any of the above.

Grievances during construction will be investigated by AGL and their CLO to review the validity and responsibility of each grievance. There will be a separate grievance mechanism prepared for land acquisition and resettlement issues; this can be found in the LALRF, which can be accessed at the Project website (www.adjaristsqali.com). There will also be separate grievance mechanisms prepared for workers; this is discussed in Section 7.5.2.

6.6.3 Community Liaison Officer

AGL has appointed Nino Diasamidze as the CLO for the planning phase of the Project, who will be a main point of contact for enquiries or complaints related to the Project's performance. AGL may nominate additional CLOs to act as points of contact within relevant municipalities. The CLO's contact details are as follows:

Name: Nino Diasamidze
Address: 6, Irakli Abashidze Street
Batumi 6010
Georgia
Tel: +995 (8) 99715125
E-mail: info@adjaristsqali.com

Anyone will be able to submit a grievance to the Project if they believe a practice is having a detrimental impact on the community, the environment, or on their quality of life. They may also submit comments and suggestions. A format for logging grievances will be established.

The CLO's contact details have been disclosed at municipality and community and village level consultation meetings and will be available at all future group meetings, on the Project website and in any written information given to stakeholders. The CLO will organise and manage the Project performance grievance mechanism and processes related to localised disturbances. The CLO will also be responsible for disseminating appropriate information on the construction programme on a timely basis to those who are likely to be directly affected or if specific impacts are potentially a nuisance.

6.6.4 Adjaristsqali Project Website

AGL have established a Project specific website with the following address: www.adjaristsqali.com. The grievance mechanism and contact details will be posted here and stakeholders will be able to submit grievances via the website.

The website also has links to all publicly available information (in both English and Georgian), and includes a regularly updated section that provides up-to-date information on project activities and any other relevant Project news.

6.6.5 Grievance Reporting and Resolution

A Grievance and Information Request Form has been produced and can be found in Appendix B of the Stakeholder Engagement Plan (which can be accessed at the Project website (www.adjaristsqali.com)), for those wanting to make a complaint or comment. Provision will be made to do this directly to AGL or the contractor; through the CLO or through a community representative (e.g. through the community leaders). The procedure for lodging grievance and their resolution will be included in appropriate project communication materials such as the non-technical summaries.

A formal logging system will be developed and the CLO will be responsible for logging all grievances. Two tabulated standard forms will be prepared, one for recording any environmental grievances or comments and one recording community grievances or comments that are received from the public or government organisations by whatever medium i.e. visits to the site, telephone calls or correspondence. The form will concisely list the following information:

- Date of the grievance or comment
- Name and contact address of the complainant
- Brief description of the complaint, with a file reference to any correspondence from the complainant
- Brief description of the action taken by the Project Plant Management to investigate the cause of the complaint and bring about corrective action, if justified
- Date of reply to the complainant, with a file reference to any correspondence.

In the first instance, grievances will be directed to the CLO who will classify grievance according to Table 6.8.

Table 6.8: Grievance Classification Criteria

Grievance Classification	Risk Level	Validity	Response
Low	Negligible to low	Unsubstantiated	CLO will conduct investigation, document findings and provide a response.
Medium	Possible risk and likely one off event	Possible substantiation	CLO and an appropriate investigation team will conduct investigation. The Site Manager or OHS Manager may decide to stop work during the investigation to allow the corrective preventative actions to be determined. The CLO will provide a response.
High	Probable risk and could re-occur	Probable substantiation	CLO will get the contractor to organise a Major Investigation Team including the AGL for prompt investigation and resolution. Work will be stopped in the affected area. The CLO will provide a response.

The Project will aim to protect a person's confidentiality when requested and will guarantee anonymity in annual reporting. Individuals will be asked permission to disclose their identity. Investigations will be undertaken in a manner that is respectful towards the aggrieved party and the principle of confidentiality. The aggrieved party will need to recognise that there may be situations when disclosure of identity is required and the Project will identify these situations to see whether the aggrieved party wishes to continue with the investigation and resolution activities. There will be no costs or retribution of any kind associated with using the grievance mechanism.

A differentiation will be made on the Grievance and Information Request Form between grievances and comments. The CLO will log the receipt of a grievance, formally acknowledge it, track progress on its investigation and resolution, and respond in writing with feedback to the aggrieved party. They will initiate the investigation and ensure its speedy conclusion aiming to provide a response within **ten working days**, unless there are exceptional circumstances. If the Project receives a large number of unsubstantiated grievances, the process will be reviewed to define instances when no response is needed.

On the receipt of a comment the CLO will log the receipt, formally acknowledge it, and track progress on its investigation and resolution. Some comments may take longer to answer, or not require a formal response. The response of a comment will be provided within **twenty working days**, unless there are exceptional circumstances.

Where investigations are required, Project staff and outside authorities as appropriate, will assist with the process. The CLO will collaborate with AGL to identify an appropriate investigation team with the correct skills to review the issue raised and to decide whether it is Project related or whether it is more appropriately addressed by a relevant authority outside the Project.

The investigation will also aim to identify whether the incident leading to the grievance is a singular occurrence or likely to reoccur. Identifying and implementing activities, procedures, equipment and training to address and prevent reoccurrence will be part of the investigation activities. In some cases it will be appropriate for the CLO to follow up at a later date to see if the person or organisation is satisfied with the resolution or remedial actions.

The CLO will summarise grievances to report on Project performance; weekly during construction and bi-annually during operation removing identification information to protect the confidentiality of the complainant and guaranteeing anonymity. Bi-annually grievance analysis and reporting will be undertaken where logs will be reviewed to identify repeat grievances.

6.6.6 Grievance Mechanism Disclosure

Prior to the start of the main construction activities, the CLO contact details and information material about the grievance redress mechanism will be disclosed in the local communities at group meetings, on the Project website and in any written information given to stakeholders.

7. Social Impact Assessment

7.1 Introduction

7.1.1 Overview

This Chapter of the ESIA presents the Social Impact Assessment (SIA) undertaken for the Project and includes a description of the methodology and assessment criteria, the socioeconomic baseline, assessment of socioeconomic impacts, mitigation and enhancement measures and residual significance. The Chapter concludes with proposed monitoring and reporting and a statement of significance and compliance. The remainder of this sub-section provides an introduction to SIA and an overview of the SIA approach including definition of the spatial and temporal scope of assessment.

7.1.2 General Approach

SIA includes the processes of analysing, monitoring and managing the intended and unintended socio-economic and community consequences, both positive and negative, of planned interventions such as the proposed Project and any social change processes invoked by those interventions.

There is no specific Georgian regulatory guidance on SIA requirements so the approach and methodology used draws on guidance for SIA by the International Association for Impact Assessment (IAIA)[5] and the international standards and requirements discussed in Section 7.2.2. The IAIA conceptualises social impacts as changes to one or more of the following:

- People's way of life – how they live, work, play and interact with one another on a day-to-day basis
- Their community – its cohesion, stability, character, services and facilities
- Their culture – their shared beliefs, customs, values and language use
- Their environment – the quality of the air and water people use, the availability and quality of the food they eat; the level of hazard or risk, dust and noise they are exposed to, the adequacy of sanitation, their physical safety, and their access to and control over resources
- Their health and wellbeing – whereby health is a state of complete physical, mental, social and spiritual wellbeing and not merely the absence of disease or infirmity; perceptions of safety
- Their personal and community property rights – access issues; how people are economically affected and experience personal disadvantage or advantage.

Social, economic and biophysical impacts are inherently and inextricably interconnected. Change in any of these domains will lead to changes in the other domains. The primary purpose of the SIA is to safeguard the well-being of project affected peoples and where possible, bring about a more sustainable and equitable biophysical and human environment as a result of the Project.

7.1.3 Spatial Scope of Assessment

For SIA the practicality of defining the spatial parameters of communities comprising of social receptors and resources is complex because there are different types of communities which often overlap and seamlessly merge into one another. There is a range of characteristics which can be used to define communities including geographical (defined by specific distances measured for example on a metric scale

[5] International Association for Impact Assessment, Social Impact Assessment: International Principles, May 2003.

or by walking distance), administrative (defined by local government boundaries), socio-cultural (defined by shared interests, values or bonds such as religion or class status or family) and economic or business (defined by financial interdependencies and relationships). This SIA has used administrative boundaries to define the wider and local areas of influence.

The wider area of influence consists of the following four municipalities of the the Autonomous Republic of Adjara: Khulo, Shuakhevi, Keda and Khelvachauri Municipalities. Khulo, Keda and Shuakhevi Municipalities are located in the mountainous regions of Adjara where the level of economic development is generally lower than that in Batumi City (the capital of Adjara) and in Khelvachauri Municipality, which are located at lower elevation and nearer the coast.

The immediate area of influence has been determined from consideration of communities likely to be affected and includes villages:

- Near all construction sites, tunnel faces and adits
- Near to workers' accommodation
- Affected by reduced flow of water, flushing of sediment or increased water during overflow periods downstream of dams
- Where water resources may be affected by tunnelling
- Near roads to be used by construction traffic
- Where land will need to be acquired
- Which may be affected by in-migration of people attempting to capitalise on the Project's opportunities.

Approximately 100 different villages have been identified in the immediate area of influence that are likely to be directly affected by the key features of the Project, as listed in Appendix C. The number of villages in each of the four municiaplities is summarised in Table 7.1 and the main villages are shown in Figure 2.15 to 2.17.

Table 7.1: Overview of Spatial scope of social impact assessment

Wider area of influence (municipalities)	Immediate area of influence
Khulo Municipality	31 directly affected villages
Shuakhevi Municipality	17 directly affected villages
Keda Municipality	26 directly affected villages
Khelvachauri Municipality	10 directly affected villages

There will be other villages in the wider area of influence which will not be directly affected by the Project but where indirect impacts will be felt, such as employment and opportunities to provide goods and services.

7.1.4 Temporal Scope of Assessment

The Project has been assessed by comparing the existing social conditions (ascertained with document review and sites visits) with the change expected over time as a result of the Project. The temporal scope of assessment includes the following phases of the Project:

- Site preparation and construction: expected to commence in 2012 lasting a period of up to nine years. Enabling works are likely to commence between June and September 2012 and the main civil and M&E contracts for Shuakhevi are likely to be awarded in January 2013. Mobilisation of the construction phase for the Shuakhevi Scheme is expected by April 2013 and commissioning in March 2016, entailing a three year construction phase. The construction phase for the Koromkheti Scheme is expected to take four years (2015-2019), some of which will overlap with the Shuakhevi Scheme, and the Khertvisi Scheme is anticipated to have a three year construction phase (2017-2020), also overlapping with the Koromkheti Scheme.

- Operation: expected to commence with start-up in 2015 and normal operations in 2016, lasting a period of approximately 45 years; and
- Decommissioning/rehabilitation[6]: expected to commence in 2060 lasting a period of approximately 6 months.

The baseline conditions are those assumed to be prevailing immediately prior to the start of site preparation.

7.2 Methodology and Assessment Criteria

7.2.1 Overview

This sub-section presents the methodology and evaluation criteria used for the SIA and include a description of the national and internation legislation, regulations and standards and the criteria used to identify then significance of effects.

7.2.2 National Legislation and Regulations

7.2.2.1 Overview

The following sub-sections presents the relevant national regulations and requirements that the Project will be required to comply with and that have been considered in the SIA process in relation to: land acquisition, labour and working conditions, community health and safety, women's rights and gender equality and social protection and welfare.

7.2.2.2 Land Acquisition Legislation and Regulations

The legal framework relating to land administration in Georgia is wide reaching and complex. In certain cases of public need, the state may take private lands into state ownership or take actions that otherwise affect private land. Key laws governing the process are summarised in Table 7.2.

Table 7.2: Relevant Georgian Laws

Date	Relevant Georgian Laws
1995	The Constitution of Georgia
1997	The Civil Code of Georgia
1997	The Civil Procedural Code
1997	Law on Payment of Substitute Land Reclamation Cost and Damages in Allocating Farm Land for Non-Farming Purposes (amended 2007)
2007	The Law of Georgia on Recognition of the Property Ownership Rights Regarding

[6] It is not known at this stage whether the Project will be decommissioned or rehabilitatesd after the completion of the operational period, however the latter is thought to be more likely.

Date	Relevant Georgian Laws
	the Land Plots Owned (Used) by Physical Persons or Legal entities
1999	The Law on Procedures for Expropriation of Property for Necessary Public Need
1997	The Law On the Rule for Expropriation of Ownership for Urgent Public Needs
1996	The Law on Ownership Rights to Agricultural Land
2005	The Law on Privatisation of State-owned Agricultural Land
2005	The Law on Registration Ownership Rights to Immovable Property
2007	Cultural Heritage Law
2008	Law on Public Register
2009	The Law of Georgia on Notary Actions

The laws state that properties can either be appropriated using negotiated settlements, or GoG can expropriate any property if the project is crucial for public needs, but properties should be appropriated through negotiated settlements where possible. Compensation is based on current market price without depreciation. The laws define the types of losses and damages that must be compensated and in some cases specify the amount of compensation that must be paid. Besides expropriation, the laws also provide for compensation for lost income that results from Project actions (for example, loss of crops through construction of access roads or through vehicle traffic that damages crops or animals).

7.2.2.3 Labour and Working Conditions

The key law regarding labour legislation is the Labour Code of Georgia, May 25, 2006, hereafter refered to as the Labour Code. The Labour Code regulates labour relations between employer and employee, including characteristics of employment of minors, prohibition of discrimination, grounds for labour relations, issues related to work, recess, rest and vacation, maternity rights and benefits, compensation and arbitration issues. The Labour Code regulates that the minimum age of employment is 16 years of age. It also sets the maximum working period to not exceed 41 hours per week.

Under the Labour Code of Georgia an employee has the right to refuse to perform any work, task and instruction that is against the law, or will jeopardizes his/her, or another person's life, health, or safety and an employer is required to:

- Ensure and provide his/her employees with healthy and safe working conditions
- Communicate to the employees any health and safety risks that may affect the health and life of employees or the environment
- Implement the proper preventive systems with regards to occupational safety and inform all employees of these preventative systems
- Provide his/her employees with all necessary information concerning the utilization of dangerous equipment and provide appropriate protective equipment
- Make efforts to localize and contain any accidents, and provide medical assistance and evacuation to employees if necessary
- Reimburse the medical expenses of employees if injuries were sustained while working.

The Law of Georgia on Professional Labour Unions regulates the creation of such unions. According to this law, a professional labour union is a voluntary union of individuals having the same professional interests. The objective of a union is to represent its members and protect their labour, socio-economic and legal rights. According to the Constitution, everyone has the right to create and unite in a professional union. Law of Georgia on Employment (2001) regulates the employment policy of the country including protection of the unemployed in terms of economic, social and legal issues. The Constitution of Georgia in Article 30 states that labour shall be free and that the protection of labour rights, fair remuneration of labour and safe, healthy working conditions and the working conditions of minors and women shall be determined by law.

Article 30 of the Constitution of Georgia considers labour rights, including the right to healthy working conditions.The Labour Code of Georgia and the various legislative normative acts contain the special technical rules and decrees concerning safety and health of workers and employees at the workplace. One of the standards that may be important to this Project is Georgian law "On safety of Hazardous Industrial Objects", which determines the legal basis for technical safety of industrial objects.

7.2.2.4 Women's Rights and Gender Equality

Article 14 of the Georgian Constitution upholds the principle of equal rights for men and women.

7.2.2.5 Social Service Provision, Protection and Welfare

Article 37 of the Constitution of Georgia states that everyone shall have the right to enjoy health insurance as a means of accessible medical aid. According to the Constitution the state controls all institutions of health protection and the production and trade of medicines. The central government is taking steps to privatize both publicly owned hospitals and health insurance. Reforms were started in January 2007 starting with the replacement of hospital infrastructure and transferring ownership rights of hospitals to the private sector. Other relevant health laws include:
- Law on Public Health (2007)
- Law on HIV Infection/AIDS (2009).

The Law on HIV/AIDS Prevention and Control (2009) ensures equal access to free diagnostic and treatment services, including antiretroviral therapy for everyone living with HIV/AIDS.

Other relevant laws to social protection and welfare include the following:
- Law on Social Aid (2006)
- Law on Mental Aid (2006)
- Law Concerning the Social Protection of Repressed Persons and Acknowledgement of Those as Victims of Political Repressions (1997)
- Law Concerning the Social Protection of Disabled People (1995).

7.2.3 International Standards

7.2.3.1 Overview

The SIA has been undertaken to promote the Project's compliance with the International Finance Corporation (IFC) Policy and Performance Standards (PS) on Social and Environmental Sustainability and Environment, Health and Safety (EHS) guidleines; and, the EBRD Performance Requirements (PRs).

7.2.3.2 IFC Performance Standards and Environment Health and Safety Guidelines

The following IFC Performance Standards (PS) are relevant to this SIA:
- IFC PS1 – Social and Environmental Assessment and Management System
- IFC PS2 – Labour and Working Conditions

- IFC PS4 – Community Health, Safety and Security
- IFC PS5 – Land Acquisition and Involuntary Resettlement.

IFC PS7 addresses indigenous peoples and is excluded because no indigenous peoples will be affected by the Project. The requirements of the relevant PS are summarised below.

PS1 - Social and Environmental Assessment and Management Systems

PS1 establishes the importance of: (i) integrated social and environmental assessment; (ii) effective community engagement through information disclosure and consultation with local communities; and (iii) the client's management of social and environmental performance throughout the life of the project.

PS2 - Labour and Working Conditions

PS2 recognizes that economic development should be balanced with workers rights. PS2 aims to: establish, maintain and improve the worker-management relationship; promote the equal opportunity of workers, and compliance with national labour and employment laws; protect the workforce by addressing child labour and forced labour; and promote safe and healthy working conditions.

PS4 – Community Health, Safety and Security

PS4 aims to: avoid or minimize risks to and impacts on the health and safety of the local community during the project life cycle; and ensure that the safeguarding of personnel and property avoids or minimizes risks to the community's safety and security.

PS5 – Land Acquisition and Involuntary Resettlement

PS5 aims to: avoid or at least minimize involuntary resettlement wherever feasible by exploring alternative project designs; mitigate adverse social and economic impacts from land acquisition by (i) providing compensation for loss of assets and (ii) ensuring that resettlement activities are implemented with appropriate consultation and disclosure; and improve or at least restore the livelihoods, standards of living and living conditions of displaced persons.

IFC Environment Health and Safety (EHS) Guidelines

PS2 and PS4 in relation to occupational and community health and safety respectively requires reference to be made to the relevant Environmental, Health and Safety (EHS) Guidelines. These are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The following IFC EHS Guidelines are considered applicable to the Project:
- Electric Power Transmission and Distribution (April 2007)
- General EHS Guidelines (April 2007).

This SIA outlines mitigation measures aimed to ensure compliance with these guidelines, specifically in relation to the following key areas:
- Occupational health and safety
  - Use of Personal Protective Equipment (PPE)
  - Hazard Operational Studies (HAZOP) to identify hazards and formulate appropriate management plans

  - Use of a formal Permit to Work (PTW) system to ensure that all potentially hazardous work is carried out safely and ensures effective authorization of designated work, effective communication of the work to be carried out including hazards involved, and safe isolation procedures to be followed before commencing work
  - Provision of specialised first aid providers
  - Specific provision of measures to avoid and mitigate impacts related to the following:
    - Fire and explosion
    - Hazardous materials
    - Transportation
    - Landslides and floods
  - Development of an Emergency Preparedness and Response Plan
- Community health and safety
  - An adequate safety zone around the facilities should be established based on a risk assessment
  - A community emergency preparedness and response plan that considers the role of communities and community infrastructure as appropriate should also be developed
  - To prevent public contact with dangerous locations and equipment and hazardous materials, access deterrents such as fences and warning signs should be installed around permanent facilities and temporary structures with controlled access points (guarded gates)
  - Means for detecting intrusion (for example, closed-circuit television) should be considered. To maximize opportunities for surveillance and minimize possibilities for trespassers, the facility should have adequate lighting
  - Where security personnel are used appropriate due diligence must be performed on the company and the individuals
  - Public training to warn of existing hazards, along with clear guidance on access and land use limitations in safety zones should be provided
  - Vehicular traffic signs should clearly designate the separate entrances for trucks / deliveries and visitor / employee vehicles.

7.2.3.3 EBRD Performance Requirements

The EBRD Performance Requirements (PRs) 1, 2, 4 and 5 describe the social policies applicable to this Project. Their full titles are as follows:

- EBRD PR1 – Environmental and Social Appraisal and Management
- EBRD PR2 – Labour and Working Conditions
- EBRD PR4 – Community Health, Safety and Security
- EBRD PR5 – Involuntary Resettlement and Economic Displacement.

The EBRD PRs are very similar in content to the corresponding IFC Performance Requirements. Gaps are identified in Chapter 4. EBRD PR7 on Indigenous Peoples has been scoped out as no indigenous peoples have been identified in the Project area.

7.2.3.4 International Labour Organisation (ILO) Conventions

The International Labour Organisation (ILO) of the United Nations is responsible for overseeing compliance with international labour standards (‘conventions’ that national governments are signatories to). The ILO conventions reflect common values and principles on work-related issues and Member States can choose whether or not to ratify them. The ILO regularly monitors the implementation and the application of the conventions as well as developments in countries generally, whether or not they have chosen to ratify ILO conventions.

Georgia has ratified the ILO's four core labour standards which are comprised of eight conventions:

- Freedom of association and collective bargaining (conventions 87 and 98)
- Elimination of forced and compulsory labour (conventions 29 and 105)
- Elimination of discrimination in respect of employment and occupation (conventions 100 and 111)
- Abolition of child labour (conventions 138 and 182).

7.2.3.5 World Commission on Dams

This Project has given consideration to benefits enhancement measures, as required by the World Commission on Dams report of November 2000.

7.2.4 Desk Study and Field Reconnaissance

Information has been obtained from widely available literature and websites, local self-governance offices and other official sources of information, including:

- National Statistics Office of Georgia
- Statistics Office of Adjara Ministry of Finance and Economy
- UNDP Human Development Report for Georgia (2009, 2010)
- Country Profile – Housing Sector, UNECE (2007)
- World Health Organisation
- Joint United Nations Programme on HIV and AIDS (UNAIDS)
- Government of Autonomous Republic of Adjara Official Website
- Young Lawyers Association of Adjara.

7.2.5 Social Resources and Receptors

Socio-economic resources are business or community assets, facilities, services and opportunities. These include both human and non-human existing and potential resources within the areas of influence, for example:

- Community facilities and services in areas such as such as health, education, retail and recreation
- Commercial and residential properties and accommodation
- Livelihood, employment and training opportunities
- Local business customer bases and growth opportunities
- Natural resources such as water, fish, and forests.

Despite the distinction between socio-economic resources and receptors presented above, it is important to note that in many cases receptors are also resources; for example a local market is a community resource for local residents but as a small business it could also be a receptor in its own right that is directly affected by the Project.

7.2.6 Determining Significance of Impact and Effects

7.2.6.1 Overview

Determining the significance of socio-economic and community impacts and their effects is one of the main purposes of an SIA. It enables the identification of necessary mitigation and benefit enhancement measures as well as an indication of the related financial costs associated with the social impacts of a project. A social impact can be either beneficial or adverse and is assessed by comparing the quality of the baseline conditions with the predicted quality of the social environment once the project is in place.

In order to describe the significance of an impact it is important to distinguish between two concepts, magnitude (of impact) and sensitivity (of receptors). In situations where legal standards and established professional criteria are not available, sensitivity and magnitude is determined according to professional judgement and the classifications ascribed are supported with sound reasoning and factual evidence. The use of these two concepts for this SIA is outlined below.

7.2.6.2 Magnitude

The magnitude of an impact and its effects is the extent to which the impact results in a social receptor gaining or losing access to or control over socio-economic resources resulting in a beneficial or adverse effect on their wellbeing. Wellbeing refers to the financial, physical and emotional conditions.

The assessment of magnitude has been undertaken in two steps. Firstly, the key social impacts associated with the project and their related beneficial and adverse, direct and indirect, and cumulative effects have been identified. Secondly, the magnitude of impacts and effects have been categorised as either major, moderate, minor or negligible based on consideration of the parameters listed below along with professional judgement:

- Duration of the impact
- Spatial extent of the impact
- Number of people or groups affected
- Likelihood.

Table 7.3 below summarises the typical varying degrees of impact magnitude.

Table 7.3: Criteria for determining Magnitude of Impact

Magnitude (positive or negative)	Definition (considers duration of the impact, spatial extent, reversibility and ability of comply with legislation)
Major adverse/beneficial	A probable impact that affects the wellbeing of groups of many people or business entities within a widespread area beyond the project life.
Moderate adverse/beneficial	A possible impact that will likely affect either the wellbeing of a group of people or business entities beyond the local area of influence into the wider area of influence or continue beyond the project life.
Minor adverse/ beneficial	An impact that may affect the wellbeing of a small number of people and/or households or businesses, or occurs exceptionally, mostly within the project area of influence and does not extend beyond the life of the project.
Negligible	An impact that is localised to a specific location within the project's site boundary and is temporary or unlikely to occur with no detectable affect on the wellbeing of people or a business entity so that the socio-economic baseline remains consistent.

7.2.6.3 Sensitivity

The sensitivity of receptors is related to their socio-economic vulnerability, measured by their capacity to cope with social impacts that affect their access to or control over additional or alternative social resources of a similar nature, ultimately affecting their wellbeing. Sensitive or vulnerable receptors generally have less means to absorb adverse changes, or to replicate beneficial changes to their resource base than non-sensitive or non-vulnerable receptors.

When considering sensitivity the type of resources in question varies between receptors. For example, a community's vulnerability might be measured in terms of its resilience to loss of community facilities, whereas an individual's vulnerability can be considered as their resilience to deprivation, loss of livelihood assets or opportunities (their job). Activities that increase impoverishment risks contribute to vulnerability. Impoverishment risks include landlessness, joblessness, homelessness, marginalisation, increased morbidity and mortality, food insecurity, loss of access to common property resources, and social disarticulation. Table 7.4 below presents the guideline criteria used to categorise the sensitivity of receptors.

Table 7.4: Criteria for Determining Sensitivity of Receptors

Sensitivity of Receptors	Definition
High	A highly vulnerable receptor with very little capacity and means to absorb socio-economic shocks and take advantage of opportunities.
Medium	A vulnerable receptor with some capacity and means to absorb socio-economic shocks and take advantage of opportunities.
Low	A non vulnerable receptor with limited capacity and means to absorb socio-economic shocks and take advantage of opportunities.
Negligible	A non vulnerable receptor with plentiful capacity and means to absorb socio-economic shocks and take advantage of opportunities.

7.2.6.4 Assigning Significance

The significance of an impact has been determined by the interaction between the magnitude of impacts and the sensitivity of receptors affected as depicted in the significance matrix shown in Section 5.4.3.3. Professional judgement has been used by appropriately qualified social scientists when assigning significance.

7.2.7 Data Limitations

It has not been possible to obtain village level data for all of the directly affected villages and in some cases, municipality level data is the most local data that was available.

7.3 Baseline Description

7.3.1 Overview

Socio-economic data for Georgia, Adjara and the four municipalities in the Project area is outlined below. Additionally, village level data for directly affected villages is used to provide a detailed social baseline of the Project area in order to inform the impact and significance analysis in later chapters of the report. The following sections within this chapter provide a description of issues such as:

- Demography
- Economic Environment
- Employment and Livelihoods
- Agriculture
- Natural Hazards and Risks to Settlements
- Health
- Education
- Gender Equality
- Ethnicity and Religion
- Governance and Community Organisation
- Tourism and Recreation[7]
- Poverty, Deprivation and Vulnerable Groups.

7.3.2 Demography

Combined with a low birth rate, emigration caused a decline in the national population in the 1990's from a peak of 5.46 million in 1991 to a low of 4.15 million in 2004 when the population began to rise again. The most significant recent period of emigration followed the break-up of the Soviet Union in 1991 when many Russians returned to their home country. The average age of the population has been increasing and the birth rate has been decreasing since 2002. In 2011, 17% of the population was younger than 15 years old, 69.2% was aged between 15 and 64, and 13.8% was older than 64 years old. Georgia has an estimated gender ratio of 0.91 males for every female with women accounting for 52.4% of the overall population and outnumbering men in both the 15-64 and over 65s age groups. The percentage of women in Georgia is higher than the global average of 49.8%. According to the January 2011 census, the total population of Georgia was 4,469,200 people, which is an increase of 0.74% since 2010. Approximately 53% of the population lives in towns and 49% of them, almost a quarter of the whole population, live in the capital city of Tbilisi.

The population of Adjara increased by 1% in 2010 and currently stands at over 400,000, 48% of which lives in urban centres such as Batumi. The approximate population density is 135.32 persons per km² across Adjara which is twice that of the nation as a whole (66 persons/km²) and the mountainous areas are significantly overpopulated. The administrative centre of Adjara is Batumi City which is an important port and commercial centre and has a population of over 120,000 people, making it Georgia's third largest city. Table 7.5 shows the populations of the municipalities wider impact area between 2002 and 2010.

Table 7.5: Population in Georgia, Adjara and Project Affected Municipalities

	Population in 1,000s										
Area	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2002 - 2011**
Georgia	4,371.5	4,342.6	4,315.2	4,321.5	4,401.3	4,394.7	4,382.1	4,385.4	4,436.4	4,469.2	2.23%
Adjara	376	373.3	370.1	373	377.2	380.2	382.4	386.9	390.6	400.0	6.38%
Municipality											
Khulo	33.4	33.2	33	33.2	33.6	34	34.5	35	35.5	36.8	10.18%

[7] National Statistics Office of Georgia, http://www.geostat.ge, retrieved January 2012

Shuakhevi	21.9	21.6	21.2	21.3	21.6	21.8	22	22.3	22.6	22.8	4.11%
Keda	20	19.9	19.5	19.6	19.7	19.8	19.9	20	20.2	20.6	3%
Khelva-chauri	90.8	90.2	89.6	90.5	91.3	91.8	92.2	92.8	94.4	95.8	5.51%

Khulo Municipality is the easternmost municipality to be affected by the Project and has a population of 36,835 people and a population density of 52 people per km²[8]. The town of Khulo is its administrative centre and it has 77 villages, 31 of which are considered to be directly affected and included in the immediate impact area. Khulo Municipality is affected by out-migration due to environmental factors such as floods and avalanches although, despite this, the population is growing.

To the west of Khulo Municipality is the Municipality of Shuakhevi which has a total of 68 villages, 17 of which are considered to be directly affected and included in the immediate impact area. The town of Shuakhevi is the administrative centre the municipality which had a population of 22,800 in 2010 and a population density of 39 people per km²[9].

Keda Municipality lies to the west of Shuakhevi Municipality and has the small town of Keda as its administrative centre. Keda Municipality has 60 villages, 26 of which are considered to be directly affected. In Keda Municipality there are 20,561 people and a population density of 45 people per km²[10].

Khelvachauri Municipality is the closest to Batumi and the furthest downstream of the Project affected areas. There are 75 villages in the Municipality, of which ten are directly affected and included in the immediate area of impact. Khelvachauri Town is the Municipality capital. Khelvachauri Municipality is by far the most densely populated of the Project affected municipalities with 232 people per km^2 and a population of 95,764 people[11].

Whilst there was a general decline in the population of Adjara and within the four Project affected municipalities over the first three years of the period 2002 to 2011 (shown in Table 7.5), the populations began to grow again in 2005 and there has been an overall increase since 2002. Khulo showed the most significant population increase between 2002 and 2010 which is in part due to a higher than average birth rate which is common to all of the mountainous municipalities in Adjara (Khulo, Keda and Shuakhevi). There is a trend of out-migration of people from the mountainous municipalities to urban centres such as Batumi in search of work.

In Adjara women represent 51.8% of the total population which is similar to the national ratio. The tables below show the populations of the directly affected villages for which data was able to be obtained. Didachara, which is one of the villages closest to the Didachara reservoir on the Shuakhevi Scheme, is one of the largest villages, with a population of over 1,500 people.

[8] Government of Autonomous Republic of Adjara Official Website, http://www.adjara.gov.ge/eng/index.php?page=khulo, retrieved January 2012

[9] Government of Autonomous Republic of Adjara Official Website, http://www.adjara.gov.ge/eng/index.php?page=shuakhevi, retrieved January 2012

[10] Government of Autonomous Republic of Adjara Official Website, http://www.adjara.gov.ge/eng/index.php?page=keda, retrieved January 2012

[11] Government of Autonomous Republic of Adjara Official Website, http://www.adjara.gov.ge/eng/index.php?page=khelvachauri, retrieved January 2012

Table 7.6: Populations in Project-affected Villages 2011

Municipality	Key villages in municipality	Population
Shuakhevi Scheme		
Khulo	Ianobadzeebi/Iakobadzeebi	362
	Gelabadzeebi	432
	Didachara	1,508
	Diakonidzeebi	337
	Govgadzeebi	157
	Ghurta	258
	Paksadzeebi	469
	Tsablana	857
	Kinchauri	382
	Kvatia	550
	Duadzeebi	607
	Khulo (town)	1,209
	Okruashvilebi	571
	Elidzeebi	186
	Ganakhleba	623
	Dekanashvilebi	940
	Chao	491
	Tago	381
	Kedlebi	660
	Cheri	311
	Gurdzauli	184
	Dzmagula	294
Koromkheti Scheme		
Keda	Merisi	407
	Sikhalidzeebi	148
	Inasharidzeebi	291
	Gundauri	259
	Silibauri	183
	Koromkheti	226
	Dzentsmani	236
	Pirveli Maisi	653
	Kolotauri	514
	Shevaburi	112
	Ortsva	398
Khertvisi Scheme		
Keda	Kveda Bzubzu	335
	Kveda Makhuntseti	415
	Namlisevi	198
	Uchkhiti	341
	Milisi	176

Municipality	Key villages in municipality	Population
	Kosopeli	83
Khelvachauri	Maghlakoni	228
	Adjaristsaghmarti	566
	Sindieti	175
	Tskhemlara	220
	Khertvisi	197
	Adjaristsqali	280
	Kibe	349
	Kedkedi	678

Source: Municipalities of Khulo, Shuakhevi, Keda and Khelvachauri

7.3.3 Economic Environment

The Georgian economy has experienced significant challenges since independence from the Soviet Union in 1991, suffering economic decline in 2009 in the wake of armed conflict in 2008 and the 2008-9 global economic crisis and recession. Despite this, and due to growth between 2004 and 2008 as well as in 2010, GDP has shown an overall increase the last decade, as detailed in Table 7.7.

Table 7.7: GDP Dynamics in Georgia

GDP	2004	2005	2006	2007	2008	2009	2010
GDP at current prices, mil. US$	5,124.7	6,411.0	7,761.7	10,171.9	12,800.5	10,767.1	11,663.4
GDP real growth, %	5.9	9.6	9.4	12.3	2.3	-3.8	6.4
GDP per capita (at current prices), USD	1,187.6	1,483.5	1,763.5	2,314.6	2,921.1	2,455.2	2623.0

Source: National Statistics Office of Georgia (2012)

Activities important for the national economy include mining of manganese and copper, industrial activity such as the manufacture of beverages, metals, machinery, aircraft and chemicals and the cultivation of citrus fruits, hazelnuts and grapes. Georgia relies on imports for its oil and natural gas needs and generates as much as three-quarters of its electricity through hydropower. The country is taking advantage of its strategic location between Asia and Europe and is developing its role as a transit point for export of oil and gas from Azerbaijan.

Important features of the economy of the Adjaran region include agricultural activity in the form of crop growing, livestock rearing, food processing, tea packing, tobacco processing and canning of fish and fruit. In addition to tourism in the Adjaran capital of Batumi, there are a number of health resorts in the region which attract tourists. Batumi is also the primary port in Georgia, exporting oil from Central Asia and agricultural products from the region by boat. The main industries in the city of Batumi include shipbuilding, oil refining and light manufacturing. Table 7.8 shows the VAT generated by the main sectors operating in Adjara. In line with the national trend, agriculture is of declining importance, whereas healthcare and other services are growth sectors in the region.

Table 7.8: Distribution of VAT by Sector, Adjara, 2006-2009 (%)

Sector	2007	2008	2009	2010
Agriculture, hunting, forestry, fishing	12.1	6.8	6.8	5.5
Industry	7.7	5.6	8.0	6.3
Processing by households	3.8	3.1	4.1	3.6
Construction	9.6	14.6	9.0	10.3
Wholesale/retail trade, maintenance of cars, home appliances	12.9	9.3	12.1	14.2
Transport and communication	11.7	9.1	7.3	7.5
State governance	15.4	23.4	17.4	15.7
Education	6.2	6.0	6.4	6.2
Healthcare and public assistance	6.0	6.4	9.6	8.5
Other services	14.1	15.3	18.8	22.2
Total	**100**	**100**	**100**	**100**
Total VAT (Million GEL)	**966.9**	**1224.3**	**1,185.3**	**1378.9**

Source: Statistical Office of Adjara

The water resources in Adjara present a number of economic opportunities in the form of bottled spring water, milling, fish farming, subsistence fishing, and tourist and recreational use of thermal waters. In addition, hydropower is already exploited at a small scale at two locations, Asti Hydropower Plant (HPP) on the Adjaristsqali River and Machakhlistsqali HPP on the Machakhlistsqali River.

The main source of income in Khulo Municipality is cultivation of potatoes. In Shuakhevi Municipality, agricultural activity accounts for 80% of VAT. In both Khulo and Shuakhevi Municipalities there are fish farms. In Keda Municipality there are economic activities such as agriculture, hydropower at the existing Adjaristsqali plant, a juice making factory, a water bottling facility, a number of water or electric mills for milling corn and fish farms. Agriculture is the dominant economic activity in Khelvachauri Municipality. The main industrial activities in Khelvachauri Municipality are tea processing, construction workshops and materials and hydropower.

7.3.4 Employment and Livelihoods

Whilst agriculture is becoming less important for the national economy, over half (55%) of the workforce remains engaged in the agricultural sector and there there is a high national unemployment rate of 16.3% (2010).

Table 7.9 contains information on the number of working age people in the population and their employment between 2004 and 2009. The unemployment rate went up every year between 2004 and 2009 with the biggest increase between 2007 and 2008 as jobs were lost due to the global financial crisis. There was a fall in unemployment in 2010 in line with economic growth.

Table 7.9: Rates of Employment and Unemployment in Georgia

	2004	2005	2006	2007	2008	2009	2010
Economically active (workforce), thousand persons	2,041.0	2,023.9	2,021.8	1,965.3	1,917.8	1,991.8	1,944.9
Employed,	1,783.3	1,744.6	1,747.3	1,704.3	1,601.9	1,656.1	1,628.1

	2004	2005	2006	2007	2008	2009	2010
thousand persons							
Unemployed, thousand persons	257.6	279.3	274.5	261.0	315.8	335.6	316.9
Unemployment rate, %	12.6	13.8	13.6	13.3	16.5	16.9	16.3

Source: National Statistics Office, 2010

In 2009, 53.4% of the population worked in the agriculture sector, while the GDP share provided by this sector was only 12.8% due to the large number of people engaged in small scale agriculture. Over one third of the population is engaged in the service sector and the share of this field in GDP is 58.8% (see Table 7.10) which reflects a disparity in the urban and rural economies which is transferred to incomes.

Table 7.10: Economy and Employment in Georgia by Sectors

Sector	Share in GDP (%)	Share in Employment (%)
Agriculture	12.8	53.4
Industry	28.4	10.5
Service	58.8	36.1

Source: Ministry of Economy and Sustainable Development, 2009; Central Intelligence Agency of the United States, 2009

According to official statistics unemployment levels in Adjara, at over 22% as shown in Table 7.11, exceeds the country average of 16.3%.

Table 7.11: Rates of Employment and Unemployment in Adjara

	2005	2006	2007	2008	2009	2010	2011
Economically active (workforce), thousand	153.05	153.55	139.6	164.2	190.2	181.1	156
Employed, thousand	114.05	122.0	104.2	122.2	148.2	248.6	131.9
Unemployed, thousand	39.0	28.5	35.4	42.1	42.1	32.5	35.0
Unemployment rate (%)	25.5	18.9	25.4	25.6	22.1	17.9	22.4

Source: The State Department of Statistics, www.statistics.ge

The unemployment rate in the Project wider area of influence is higher than that in Batumi and the coastal resort areas. According to information provided by the municipal authority in Shuakhevi the unemployment rate varies from 25-30% in the Zamleti community around the Adjaristsqali river between Khulo and Shuakhevi towns, to as high as 75% in the village of Oladauri which is downstream of the Chirukhistqali dam site. Zamleti and Oladauri are shown on Figure 2.1.5 depicting the Shuakhevi Scheme. These unemployment figures are likely to include those dependent on subsistence farming. Subsistence farming, which supports livelihoods to a great extent especially in the mountainous areas, is supplemented by fishing for home consumption. Similar situations of high unemployment are observed in Keda and Khulo municipalities. The majority of the working age population is employed in schools, local administration offices, medical stations or shops.

7.3.5 Agriculture

Agricultural production in Georgia declined by approximately 5% between 2003 and 2007 which was matched by an almost 10% drop in its share of GDP over the same period[12]. This was in part due to an embargo placed on Georgian products by Russia in 2006[13]. Agricultural production in Georgia is led by cereals which amount to 372,000 tonnes per year, followed by meat and fish which make up 45,000 and 25,000 tonnes respectively. Wood production for the purposes of fuel and industrial wood is also important[14].

In mountainous Khulo as much as 16,000 ha of the alpine area is used for summer grazing. The total area of Shuakevi is 58,800 ha, of which over 60% is classed as forest and 28% is agricultural. In Keda there are 2,466 ha of agricultural crop land and 2,627 ha of other planted agricultural land. There is a total of 9,911 ha of agricultural land in Khelvachauri, 1,366 ha of which is crops, 6,846 ha is other planted land and 1,670 ha is pasture.

There are about 70,000 small farms in Adjara. The Adjaran land is most suited to growing tea, citrus fruits and tobacco as well as rearing livestock. Other important cash crops include maize, courgettes, beans, fodder, grapes for wine, apples, pears, and persimmon, which are grown in Keda and Khelvachauri as well as other parts of Georgia and exported to Ukraine and Belarus. Due to the harsh climate of the high mountainous regions of Georgia, for example Khulo and Shuakhevi municipalities, sheep breeding, potato growing and tobacco production are the leading activities there. In Khulo potato farming is the main agricultural activity, taking up 1,167 ha and producing in the region of 25,000 tonnes in 2004. Corn and tobacco are also important crops and other agricultural activity includes fruit and vegetable production and beekeeping. In Khulo there are also 49,000 head of cattle and 6,000 other livestock animals including goats and sheep using 16,000 ha of summer pastures. In Shuakhevi, agriculture is the mainstay of the economy. The main products are corn, potato, bean, vegetable and fruit. In Keda, vegetables, fruits including blackberries, tobacco and vineyards are the most important crops while cattle and bees are also kept. In Khelvachauri the main crops are tea and citrus, whilst cattle-breeding is also important.

Overpopulation of the mountainous areas means that land is scarcely available. According to the local officials of Khulo and Shuakhevi Municipalities Adjaran families typically have 0.25-0.75 ha of land. Khulo, Shuakhevi and Keda are often at risk of natural hazards such as landslides and erosion which have been linked to anthropogenic activity such as over-farming, high density of water channels and deforestation. Landslides and erosion result in further loss of agricultural and pasture lands.

Lack of land, problems with erosion and access, as well as difficulties posed by the steep slopes of the mountain sides, make farming challenging in the wider Project area. In addition, cultivating small plots and the lack of agricultural inputs, technology, credit and unpredictible markets mean that farming is difficult. A typical family in mountainous Adjara has 4-5 cows and perhaps a few sheep or goats. The amount of land per family is barely sufficient for animal breeding, let alone cultivation of the crops necessary to sustain a household. Since land usually is the only means of income for the rural population in mountainous regions, Adjarans face serious problems of economic hardship, which prompts them to look for new economic opportunities in other regions of the country. At the ESIA scoping meetings in the Project area of impact,

[12] Georgia Human Development, UNDP, 2008.

[13] Rural Poverty Portal, http://www.ruralpovertyportal.org/web/guest/country/home/tags/georgia, retrieved 12 January 2012.

[14] FAO of the UN, http://www.fao.org/countries/55528/en/geo/, retrieved 20 January 2012.

many respondents mentioned that income from agricultural activities is not sufficient and people have to migrate from the region in search of temporary or permanent employment in order to support their families.

Figure 7.1: Photo showing typical conditions for farming in the Adjaristsqali valley

Source: Mott MacDonald

7.3.6 Natural Hazards and Risk to Settlements

In Georgia there are currently 35,204 families registered as being affected by natural disasters and 11,000 families requiring resettlement, have been displaced or are at risk of displacement within disaster affected areas. Government resettlement programmes classify affected persons, many of whom come from the mountainous parts of Adjara, as ‘eco-migrants’. Between 2004 and 2010 there were 763 families resettled from Adjara (including from the Municipalities of Khulo and Shuakhevi) due to the effects of natural disasters such as flooding caused by prolonged heavy rainfall and snowmelt and landslides. According to official data of the Adjara Coordination Group on eco-migration issues, currently 4,144 families affected by natural disasters are registered and awaiting assistance. The resettlement programmes have not been completely successful, with many families returning to their damaged properties amid cultural tensions and other difficulties, such as lack of land and inadequate housing in the host villages.

The population of the Project area is highly susceptable to natural disasters. Table 7.12 shows the number of households in Adjara that have been affected by natural disasters, disaggregated by the following categories of disaster:

- Category I – House or part of the house is destroyed as a result of natural disaster
- Category II – House is not destroyed, but is damaged and unsuitable for habitation. House cannot be restored
- Category III – House is damaged and can be restored
- Category IV – House is usable, but the surrounding area is damaged.

Table 7.12: Number of families affected by natural disasters, by categories in Adjara

Municipality	Category I	Category II	Category III	Category IV	Total
Khulo	5	51	551	1,094	1,701
Shuakhevi	4	33	326	516	879
Keda	2	33	40	402	477
Khelvachauri	5	21	89	307	422
Adjara total	**29**	**166**	**1,274**	**2,675**	**4,144**

The categorisation was prepared using the results of engineering and ecological surveys conducted by the Georgian Geological Department. During the categorisation, damage assessment and social status of the family are determining factors. The term ‘disaster victim’ is used for Categories III and IV and the term ‘eco-migrant’ is used for Categories I and II.

More than 250 settlements (up to 20,000 households) are in high risk and hazard zones. Within the last three decades 1,900 houses and about 350 structures were destroyed by landslides. Approximately 6,000 families have been resettled due to damage to their property and ongoing vulnerability to landslides. About 40 bridges and crossings have collapsed, which has left villages cut off. In 1989 a small settlement near the village of Skhalta was buried by a catastrophic landslide and all of the people there were killed.

Adjara can have problems with roads and bridges being affected due to heavy rainfall and landslides. Roads can be blocked and bridges become unstable and unusable, causing temporary isolation for village communities. Villages and towns in the immediate area of the Project which are particularly vulnerable to this problem include Kvatia, Didachara, Khulo Town, Makhalakidzeebi, Shuakhevi Town and Keda Town. At the ESIA scoping consultation event in Didachara the issue of landslides was the major concern of the attendees and a member of the public commented that houses in the village are not built from concrete but from wood as it is less vulnerable in the event of a landslide. Figure 7.2 shows residents at Didachara village expressing concern over the potential for landslides and the planned locations of Project features. There was a significant landslide in 1982 in Didachara which covered the road and caused the temporary isolation of the village, but no fatalities. The issue of landslides was also raised at the ESIA scoping consultation meetings in Keda and Khelvachauri Towns, in Chvana and Zamleti Communities in Shuakhevi Municipality and by NGOs as concerns amongst the local communities and interested parties.

Figure 7.2: Residents at Didachara village expressing concern about landslides

Source: Mott MacDonald/Gamma Consulting

7.3.7 Health

In Georgia, cardio-vascular and respiratory diseases and illnesses are one of the most common health problems for children. Within the over 60s age group common illnesses include cardio-vascular system and endocryne system problems such as diabetes or thyroid illnesses, as well as skin, larynx and lung cancer. The risk of an HIV epidemic in Georgia is considered by UNAIDS to be ‘high’, despite there being a low prevalence of affected persons of 0.1%. This prediction is linked to population movement between Georgia and neighbouring high-prevalence countries such as Ukraine and Russia, and to high levels of injecting drug use in Georgia[15].

According to the World Health Organisation (WHO), there has been a dramatic reduction in cases of malaria in Georgia since 2002, when there were almost 500 cases. The WHO states that the Black Sea

[15] Georgia Country Progress Report 2008-2009, United Nations General Assembly Special Session on HIV/AIDS, Monitoring the Declaration of Commitment on HIV/AIDS, 2009

coastal area is included within the areas where there is the highest risk of malaria cases[16]. There have been no cases of malaria in the Adjaran mountains for five years, with the most recent case in 2007 having been contracted outside of Georgia[17]. Adjara is one of the areas most affected by HIV/AIDS in Georgia and a National AIDS Center has been set up in Batumi[18].

Every municipality in the project area has its own hospital and there is currently a hospital redevelopment programme in Adjara with eight hospitals currently under construction or having been recently completed. The new healthcare centre in Khulo Town provides 40 beds. There are also eight outpatient clinics in Khulo Municipality. Medical stations are available in a total of 41 out of 77 villages in Khulo which are attended to by paramedic staff. In Khulo Municipality healthcare services are provided by 27 doctors and 24 paramedical staff.

In response to severe flooding in Khulo in 2006, a programme to improve water and sanitation provision was launched in the municipality which improved access to adequate quantities of potable water for 7,500 people and doubled the number of households connected to a water supply. Sewerage in Khulo Municipality was also improved which led to a significant reduction in water borne diseases – out of 156 cases in 2005, 150 were prior to the intervention and only six incidences occurred afterwards.

As part of the healthcare redevelopment scheme, a new hospital equipped with contemporary technology was opened in Shuakhevi in 2011 which has 20 beds and employs 75 people. This hospital is able to provide any type of assistance from dental care to surgeries and trauma care. A new hospital was also opened in Keda in 2011 with 25 beds and 80 highly qualified specialists.

[16] World Health Organisation, http://www.euro.who.int/en/what-we-do/health-topics/communicable-diseases/malaria/country-work/georgia, retrieved 13 January 2012

[17] Ministry of Healthcare of Adjara, January 2012, personal communication with AGL staff.

[18] UNAIDS, http://data.unaids.org/pub/Report/2006/2006_country_progress_report_georgia_en.pdf, retrieved 12 January 2012

Figure 7.3: Health centre in Zamleti village

Source: Mott MacDonald

In total there are 128 community medical stations in Adjara in which 176 nurses are employed. In most communities there is a 'family doctor' programme but most healthcare is provided by dispensaries which are medical institutions where patients receive out-patient care, treatment and supervision. There are different types of dispensaries for cancer, tuberculosis, cardiology, etc. The Project wider area of influence is well served by medical facilities, a summary of which is shown in Table 7.13.

Table 7.13: Description of medical institutions network for the municipalities within the project influence zone

Type of Medical Service	Khulo	Shuakhevi	Keda	Khelvachauri
Ambulance units	Khulo Emergency Service 03	Shuakhevi Emergency Service 03	Keda Emergency Service 03	Khelvachauri Emergency Service 03
Stationary units	Khulo Regional Hospital	Shuakhevi Regional Hospital	Keda Regional Hospital	Khelvachauri Regional Hospital, Republican psycho-neurological hospital in the town of Kakhaberi of Adjara

Type of Medical Service	Khulo	Shuakhevi	Keda	Khelvachauri
				Gonio hospital-ambulatory; Kirnati district hospital
Polyclinics	Khulo Ambulatory-Polyclinic Union	Shuakhevi Ambulatory-Polyclinic Union	Keda Ambulatory-Polyclinic Union	Makhinjauri Multi-profile Polyclinic; Khelvachauri Ambulatory-Polyclinic Union
No. of community medical facilities (staffed by doctors).	7	8	9	41
No. of Private medical institutions	7	1	1	7

Source: Official Web page of the Municipalities

7.3.8 Education

As shown in Table 7.14, in 2009-10 there were 259 state schools in Adjara which was higher number than the previous two years but a lower number than 2005-6. There has also been a reduction in the number of privately financed educational establishments in the period between 2005 and 2010. In general there has been an increase in the number of students in the corresponding period which is likely to result in a shortage of places or class overcrowding if this trend continues.

Table 7.14: Number of educational institutions in Adjara 2005-2010

Adjara	2005-06	2006-07	2007-08	2008-09	2009-10
Schools	260	260	257	258	259
Students	61,657	62,549	60,607	63,811	62,300
State secondary vocational educational institutions	8	7	4	3	3
Private secondary vocational educational institutions	6	6	6	1	1
State higher education institutions	4	2	2	2	2
Private higher education institutions	12	13	5	3	5

Source: Georgian Municipal Service Providers' Association (MSPA); Web site of the Ministry of Education of Adjara, http://mspa.ge.

Table 7.15 provides information on the number of schools, teachers and students in each municipality in the Project area. Whilst there are a large number of schools and teachers in the wider area of influence of the Project, there are a number of villages close to Project activities which have no kindergarden or nursery provision, such as Dgvani village near the Chirukhistsqali Dam and Adjaristsqali and Machakhela villages near the parts of the Khertvisi Scheme.

Table 7.15: Number of public educational institutions, teachers and students in the project influence area

Municipality	Students	Teachers	Schools	Kindergardens	Student/Teacher ratio
Khulo	5,463	1,051	50	5	5.2
Shuakhevi	3,417	929	No data	No data	3.7
Keda	2,909	654	53	7	4.4

Municipality	Students	Teachers	Schools	Kindergardens	Student/Teacher ratio
Khelvachauri	12,979	1,563	No data	No data	8.3

Source: Georgian Municipal Service Providers' Association (MSPA); Web site of the Ministry of Education of Adjara, http://mspa.ge.

7.3.9 Gender Equality

As shown in Table 7.16, women make up almost 50% of employed people in Adjara. Areas where women make up over 50% of the workforce include teaching, particularly primary level and agriculture.

Table 7.16: Percentage of workforce made up of women in certain sectors in Adara

Sector	Percentage of workforce who are women
Total Employed Populaton of Adjara	48
Teachers (total)	70
Primary education	83
Agriculture	57
Health and social insurance	10
Self-employed	13.8

In practice women are traditionally considered as homemakers,this may result in less access to credit and loans as generally women may be less likely to be land owners[19].

7.3.10 Ethnicity and Religion

In 2002, Georgians accounted for 93% of the population in Adjara. The two other most prevalent ethnic groups are Russians and Armenians and there is a small percentage of Greeks, Abkhazians, Ukrainians and others. The Adjarans ('Ajars') are an ethnographic sub-group of Georgians, who were once known as 'Muslim Georgians' however as discussed below, only 30% of the population in 2006 followed Islam. The population of ethnic Georgians in Adjara is currently (2011) 82% which has decreased since 2002. The people of Adjara write in Georgian but speak a local dialect of the language. Over 99% of the populations of Khulo, Shuakhevi and Keda are Georgians. The population in Khelvachauri, which is closer to Batumi City has a slightly smaller percentage of ethnic Georgians at 97%, whilst in Batumi the percentage is lower still at 86%.

Table 7.17: Ethnic make-up of Adjara (2002)

Area	Georgians	Russians	Armenians	Greeks	Abkhazians	Ukrainians	Others[a]
Adjara	93.38	2.41	2.35	0.58	0.41	0.28	0.58
Batumi	85.64	5.17	6.17	0.48	0.66	0.63	1.26
Khulo	99.84	0.04	0.01	0.01	0.07	0.01	0.03
Shuakhevi	99.75	0.06	0.02	0	0.11	0.01	0.02
Keda	99.67	0.13	0.04	0	0.07	0.01	0.06
Khelvachauri	97.22	1.13	0.39	0.1	0.71	0.11	0.33

Source: 2002 Census

Notes: a - including Azeris, Ossetians, and Yezids

[19] Rural Poverty Portal, http://www.ruralpovertyportal.org/web/guest/country/home/tags/georgia, retrieved January 2012

The collapse of the Soviet Union and the re-establishment of Georgia's independence accelerated re-Christianisation in Adjara, especially among the young. According to the 2006 estimates by the Department of Statistics of Adjara, 63% of the population of Adjara are Georgian Orthodox Christians and 30% are Muslims. The remaining denominations are Armenian Christians (0.8%), Roman Catholics (0.2%), and others (6%). In Batumi, there are 14 Christian churches and only one remaining mosque. The percentage of Muslims in the highlands of Adjara varies by village and community. According to interviews and information obtained on the Project sites there are around 35% Muslims in Dologani community, while in Zamleti the percentage is higher. In Oladauri community, Muslims account for 60% of the population. There is a large Sunni Muslim community in Khulo Municipality, whilst Christians are the majority in Khelvachauri Municipality.

7.3.11 Governance and Community Organisation

The Project is located in the Adjaran Autonomous Republic, the status of which is defined in Georgian law. There is a local legislative body called the Supreme Council which consists of 30 members and is elected every four years. The executive body is the Government of the Autonomous Republic of Adjara. In accordance with a law passed in 2004 which downgraded the level of autonomy in Adjara, the head of the Council of Ministers is put forward by the President of Georgia. The President of Georgia has the power to overrule Adjaran authorities when decisions contravene the constitution of the nation as well as being able to dissolve the assembly and the Government of Adjara. Within the five regions of Adjara there are local self-governing authorities of municipal councils and local mayors who are the executive leaders of the councils. Each municipality is divided into communities which are made up of a number of villages. Communities are named after the main village within that community.

7.3.12 Tourism and Recreation

Tourism in Georgia is centred on Black Sea Coast resorts such as Batumi, cultural heritage attractions such as churches, monasteries and fortresses, as well as skiing, hiking and wine growing regions. Tourism development is underway in some areas however the tourism potential in the Project areas inhibited by the lack of adequate infrastructure. The main tourist attractions in the wider area of influence are skiing and winter sports, hiking, spas and thermal waters as well as cultural heritage features such as bridges, religious buildings and fortresses.

In 2007 the United States Agency for International Development (USAID) helped to launch a range of projects aimed at facilitating the development of community based eco-tourism and agri-tourism in rural regions of Adjara. The main objective of these projects was to contribute to job creation, economic development, poverty alleviation and improved living conditions in the region. In the same year, a World Bank programme carried out training of youth in Shuakhevi Municipality in the following key skills: eco- and agro-tourism, marketing of tourism services, guesthouse management, business planning, budget planning and excursion planning. More recently in 2011, a United Nations Development Programme (UNDP) project with a budget of over US$ 600,000 provided assistance in boosting economic development in the region with a focus on agriculture, tourism and the development of trade.

There are a number of festivals held in summer in the wider Project area including the festivals of Selimoba, Tbeloba, Shuamtoba and Machakhloba which are held annually between July and September.

7.3.13 Poverty, Deprivation and Vulnerable Groups

Sensitive potentially project affected persons (social receptors) in the social impact assessment are those people who are considered to be vulnerable and likely to have less means to absorb adverse impacts and socio-economic shocks/risks or changes to their access to or control over socio-economic resources that ultimately affects their wellbeing, poverty levels and health, safety and security. At the same time, sensitive or vulnerable people may be less able to make the most of potential beneficial effects of a project, for example illiteracy may restrict the opportunity of people to apply for jobs.

Almost one-third (30.4%) of the Georgian population was living below the US$ 2 a day poverty line and 13.4% were below the US$ 1.25 a day poverty line between 2000 and 2007[20]. According to local municipal authorities in the wider Project area the average income per family is too low to cover all household needs.

The Adjara population includes the following categories of vulnerable people:

- Pensioners – The total number of pensioners is 63,264, which is 16.38 % of the population of Adjara. There are five types of pensions: pension by age, pension for people with disabilities, pension for victims of political repression during Soviet times, pension for female-headed households/families that have lost their main ‘bread-winner’, pension by years of service. Table 7.18 shows number of pension recipients by types of pensions.
- War veterans – according to “Human Rights Center” in Adjara veterans of the war are not receiving any allowance as the benefits for veterans are not considered in the budget of regional municipality administrations.
- Poor families with incomes lower than the subsistence minimum[21]. In the database 39,601 families are registered (166,530 persons) of them only 7,206 families (29,967 persons) receive a subsistence allowance.
- People affected by natural disasters, or in areas that are at risk of natural disasters (see Section 7.3.6 on natural hazards).

Table 7.18 shows the numbers and percentages of people receiving the various types of state pension in both Georgia and Adjara. There are a relatively high number of disabled people in the project area but in most categories a smaller percentage of the Adjaran population is in receipt of a pension than the national average.

Table 7.18: Number of the people receiving state pension by type of pension (2010)

	Pension by Age	People with Disabilities	Lost ‘bread-winner’	Politically Repressed	Pension by Years of Service	Total
Georgia	662,288	138,614	32,120	2,539	340	835,901
Georgia (as a %) of total population	14.93	3.12	0.72	0.06	0.01	18.84
Adjara	45,536	14,481	2,524	701	22	63,264
Adjara (as a %) of total population	11.66	3.71	0.65	0.18	0.01	16.20

[20] UN Human Development Report, 2009

[21] The National Statistics Office of Georgia (Geostat) calculates the subsistence minimum indicators based on the minimum food basket defined and established in accordance with the decree No 111/N, dated 2003 May 8, of the Minister of Labour, Health and Social Affairs of Georgia

Source: National Statistics Office of Georgia; Web page of the Government of Adjara

Table 7.19 provides information on the number of families registered as 'helpless' and those receiving allowances in Georgia and Adjara. There are comparatively fewer families in Adjara than there are in Georgia receiving the subsistence allowance.

Table 7.19: Vulnerable families (poor families)

	Number registered[a]		Number of Beneficiaries[b]		% of Beneficiaries in the Whole Population	
Region	Family	Population	Family	Population	Family	Population
Adjara	39,601	166,539	7,206	29,967	8.2	8.0
Georgia	510,375	1,633,164	130,781	381,889	11.1	8.7

Source: Web page of the Government of Adjara (from Ministry of Labour, Health and Social Affairs)

a – Number of 'helpless' families registered in the database; and

b – Number receiving subsistence allowance.

Refugees are likely to be more vulnerable than Georgian citizens as they may not be able to speak Georgian or able to access to the same educational or health facilities as Georgians. There are not many refugees that are receiving pensions in the Adjara region, as shown in Table 7.20, which may in part be due to Adjara being relatively far from the recent conflicts in Abkhazia and South Ossetia.

Table 7.20: Number of people receiving refugee status pension by pension type

Region	Pension by Age	People with Disabilities	Bread-winner lost family members	Politically Repressed	Pension by years of service	Total
Adjara	565	210	11	11	_	797
Georgia	31,595	9,814	1,368	30	5	42,812

Source: Web page of the Government of Adjara

The main causes of vulnerability in the project area are natural disasters and lack of available land. People, especially the elderly, the sick and the disabled, are vulnerable to heavy snowfall, flooding from heavy rain and snowmelt, and isolation caused by flooding, snow or landslides. Landslides also damage property, farmland, assets including livestock and cause injury to people or at worst, loss of life. Households generally practice subsistence farming as there is not enough land to grow cash crops and often the land owned by each household is insufficient to support the family that depends on it. Further, those who are unemployed are vulnerable as they do not have a reliable regular source of cash income. Female headed households are particularly vulnerable in the rural areas as women carry out a large share of farm work and processing work and can be put under additional pressure if male family members migrate in search of work. Poor households lack the ability to invest in their future and purchase assets such as transport or farm equipment which help to improve production.

The sensitive potentially project affected people identified in the socio-economic baseline can be summarised as follows:

- Those villagers living and farmers / land owners working closest to the construction sites, especially the most vulnerable (impoverished, landless, elderly, children, disabled, female-headed households, etc);
- Unemployed people looking for work on the Project, especially the unskilled;

- Those whose land has and will be acquired (they are sensitive due to lack of availability of replacement land); and
- Refugees and people displaced by natural disasters.

The sensitivity of these people is discussed further in the following sub-sections which identify and assess the social impacts of the project.

7.4 Assessment of Social Impacts

7.4.1 Overview

This section predicts social impacts expected to occur as a result of the Project and assess their beneficial and avderse effects by predicting their significance prior to mitigation according to the criteria specified in Chapter 5. Impacts have been considered and assessed for the site preparation and construction, operation, and decommissioning phases of the Project. Mitigation and benefit enhancement measures are proposed in section 7.5.

7.4.2 Construction Phase Impacts

7.4.2.1 Employment Generation

As of February 2012, approximately ten people are employed directly by the Project company, AGL, who work solely on the Project undertaking roles such as Project Manager and Community Liaison Officer. Approximately half of these are employed in Georgia and half in Norway, where AGL originates from. In addition, approximately 40 people have been employed on a short-term basis to carry out geological testing and drilling and to perform ancillary roles such as drivers, translators and guest house staff. When construction work commences, it will begin at Skhalta and Didachara dam sites and continue through to Chirukhistsqali dam site and further west as the construction phase progresses. Construction work will be carried out by five contractors on the Shuakhevi Scheme: one contract will be awarded for the enabling works such as roads, bridges and site levelling; one civil and one mechanical and electrical (M&E) contractor will undertake the works on the left bank of the Adjaristsqali River; and two further civil and M&E contractors will work on the right bank of the River. Works will be underway 24 hours a day, seven days a week and is likely to consist of three shifts of eight hours or two shifts of ten hours.

The availability of jobs on the Project was a key concern raised at the community and village level ESIA scoping consultation meetings held in July 2011. During the peak of Shuakhevi scheme construction phase, the Civil Contractor will have up to at total of 800 workers both skilled and unskilled on site, where possible the majority of unskilled workers will be drawn from the villages closest to each of the construction sites subject to availability of suitable candidates. It is anticipated that the project may be able to draw a large number of the unskilled workforce from the local area, but this will depend at least in part on the extent to which the contractors appointed bring an greater or lesser external workforce with them. Contractors who can demonstrate a high commitment to local employment will be given a more favourable weighting as part of the tender decision process. Table 7.21 summarises the anticipated employment generation in the construction phase of the Shuakhevi Scheme.

Table 7.21: Total estimate of workforce for the Shuakhevi Scheme

Sector	Types of Roles	No. of Anticipated Required Staff
Site Management	Project Manager, Site Manager, accountant, translators, health, safety and environment (EHS) team	55-60
Civil	Drivers, tunnelling operatives, concrete mixers, engineers, geologist, metal workers, general labourers	600
Mechanical and Electrical	Engineers, riggers/slingers, fitters, welders, crane operators, technicians	60- 65
Secondary Support Staff	Medics, security guards, firemen, emergency response team, caterers, cleaners	70-75
Total		**785-800**

Source: AGL/Mott MacDonald

Temporary employment generation in this phase has the potential to contribute to a reduction in local income poverty, especially if vulnerable local people are employed such as farmers with limited land or the unemployed. Local people hoping for employment on the Project are likely to be poor, with inappropriate skills for the Project. The availability of alternative sources of employment are minimal, although opportunities for subsistence farming are present. Local people are therefore considered to be of **medium sensitivity** to employment generation impacts. Without measures to promote local employment benefits the magnitude of the impact is **moderate** as it will affect a small number of people and they will obtain skills and experience which will extend beyond the life of the Project, The impact is therefore considered to be a **beneficial impact of moderate significance**.

7.4.2.2 Risks to Wellbeing of Workers on Site and in Camps

Site preparation, tunnelling and construction activities and the use of temporary worker accommodation pose potential risks to the health, safety, security and therefore wellbeing of construction workers if not managed appropriately. Generic community health and safety issues associated with the use of temporary accommodation sites include those relating to sanitation, disease, fire and cultural alienation. Similarly, there is the risk of adverse occupational health and safety (OHS) impacts related to personal accident or injury on any construction site. There are also potentially adverse impacts on workers related to their terms of engagement and relationship with their employer.

For each Scheme the main temporary and permanent living quarters for Project staff will be located near to the powerhouse sites. There will be a small accommodation area near to the Didachara, Shkalta, Chiruki, Khichauri, Khertvisi and Machakhela dam sites which will include temporary quarters, permanent quarters for operational staff and the site office for construction and operation. Accommodation will be provided in accordance with the size and location of the anticipated labour force.

Some of the OHS risks which are likely to arise during the construction phase of the Project, and are typical to many construction sites include: exposure to physical hazards from use of heavy equipment and cranes; trip and fall hazards; exposure to dust, noise and vibrations; falling objects; exposure to hazardous materials; and exposure to electrical hazards from the use of tools and machinery. Other risks common to power infrastructure projects specifically include working at height; exposure to chemicals; live power equipment and lines; and exposure to electrio-magnetic fields.

The use and storage of explosives presents an OHS risk to workers, especially in dusty environments where explosive dust may gather and combust, as does the risk of tunnel or excavation flooding.

Tunnellers will also be working in confined spaces where there are risks of asphyxiation and rock falls causing injury. There are risks associated with working on or near water such as the rivers or reservoirs for the workers constructing dams, weirs, other headworks facilities of tunnel outlet structures. Other likely OHS risks to Project workers include landslides and exposure to cold temperatures during winter or heat during summer.

Workers on the Project are of **medium sensitivity** as they are vulnerable to risks to wellbeing, health and safety but they have some capacity to absorb changes and take actions to protect themselves from the main risks. The unmitigated magnitude of the risk is **minor** as the resultant impact is thought to be likely to occur very exceptionally, affect a limited number of people, be limited to the Project area and will not extend beyond the life of the Project. The risk to the wellbeing, health and safety of workers during the construction phase is therefore considered to be **an adverse impact of minor significance.**

7.4.2.3 Risks to Community Health, Safety, Security and Wellbeing

There are a number of activities in the construction phase which if not mitigated are likely to cause disturbance to local communities, including the following:

- Project truck and vehicle movements will increase existing traffic volumes and is predicted to cause congestion in some locations. This could be a particular problem for vehicles travelling behind large trucks as there are few safe passing places. Journey times for local road users are likely to therefore increase. The increased number of heavy vehicles using the road may also cause deterioration in the road surface which will be exacerbated by frost shattering[22] in winter. Increased traffic may also result in road safety risks, especially in areas where there are pedestrians and cyclists on the road, in busy town centres and near schools where children are waiting for transport or are walking home. For further discussion of traffic impacts see Chapter 13.
- Blasting will be carried out for tunnelling through rock and TBMs will be used, both of which will cause disturbance in the form of noise and vibrations for people living in homes near to tunnel entrances, surge shafts, underground powerhouses and where the tunnels or excavations are at a shallow depth. In addition there will be noise, dust and vibrations from the construction sites. Noise and vibration issues are addressed further in Chapter 14 and dust impacts are discussed in Chapter 14.

In addition to these general disturbances, the following more substantial impacts may arise during construction:

- Water resources for drinking, irrigation and household use could be affected in areas where tunnels are dug underneath groundwater supplies. The highest risk areas would be where the tunnel is closest to the surface and near the tunnel faces, as a result of topography and the designed tunnel depth. This could occur temporarily or permanently drain water wells and the level of risk or likelihood of occurrence is unknown at present.
- Triggering of landslides by construction activities is a risk which could result in spoilt landscapes, ruined or damaged housing or other structures or assets, and physical harm to people or livestock through either covering with solid material or water or a mixture of both. It is well known that the wider area of influence suffers from landslides and in the recent past there have been some devastating events. It is recognised that any proposed major engineering scheme has the potential to reactivate previous landslides and instigate new ones. Landslides could cause a dam-break event either by overtopping or

[22] Frost shattering occurs when water gets into cracks in materials such as rocks, feezes and expands causing the road surface to shatter.

loss of structural integrity with potential for severe impacts on the local population downstream and those inhabiting the landslide risk area itself. Such an event may also occur independently of any of the proposed work. However, the design has carefully considered and investigated landslide hazard risks to avoid construction taking place in high risk areas, potential for construction to activitite lanslides is minimal, Chapter 11 provides a full assessment of risks. A dam-break analysis has been carried out and the results are summarised in Appendix C2.

- Vibrations or subsidence could damage or affect the stability of homes or other structures which may need to be compensated by the Project.
- In terms of site security, there will be a health and safety risk to the local community posed by the existence of construction sites and the storage and use of explosives and hazardous chemicals, all of which will require effective management.
- River water will be diverted for a period of time while the dams are built, potentially causing slope instability and the introduction of water to new areas. Deliberate flooding of areas will also occur during the filling of reservoirs which will result in a risk to local people and their livestock.
- Potential risks to community health from HIV/AIDS or other sexually transmitted infections a result of the presence of a migrant construction labour force population.

Local communities' vulnerability to health, safety, security and wellbeing impacts is **medium** as they are vulnerable but have some capacity to adapt to the changes which are expected to occur. The unmitigated magnitude of the risk is **minor** as the resultant impact is thought to be likely to occur very exceptionally, affect a limited number of people, be limited to the Project area and will not extend beyond the life of the construction phase. The unmitigated risk on the health, safety, security and wellbeing of local communities during the construction phase is considered to be an **adverse impact of minor significance**.

7.4.2.4 Induced Development, Population Changes and the Potential for Cultural Tension

It is predicted that this Project will result in project-induced in-migration which can substantially change the context in which a project operates. Depending on how it is managed and the baseline conditions, project-induced in-migration can have an adverse or a beneficial impact on local communities and the Project's performance. Potential new migrant stakeholder groups for this Project include:

- Returning family, extended family members and former residents – seeking improved living conditions and employment or opportunities to provide goods and services to the Project or local population.
- Labourers including temporary and permanent workers employed by the Project who move to the area with or without family to be close to their place of employment. Their migration and settlement introduces issues related to the adequacy of public infrastructure, services, utilities, housing, and sustainable resource management.
- Camp followers - who are entrepreneurs arriving to capture business opportunities associated with the construction labour of the Project.

The scale and magnitude of potential in-migration effects for this Project has been estimated based on probability related to the Project characteristics, as summarised in Table 7.22

.

Table 7.22: Summary of likely scale and magnitude of adverse effects of in-migration

Push/pull factors affecting in-migration	Explanation of scale and magnitude of effects
Scale of Project (project construction and operation, labour goods and services requirements)	The medium-sized construction workforce over a long period of time may attract camp followers and people who want to take advantage of economic opportunities resulting from the Project and the labour force
Area's capacity to meet Project needs	There are already some services in the Project area but these are insufficient for the local communities' needs therefore the area has limited assimilative capacity to deal with migrant populations
Opportunities for migrants to secure project benefits such as employment and resettlement and other compensation	Few opportunities for potential migrants as local people are being prioritised for skills development and employment and this may deter potential in-migrants
Proximity to large population centres	Relatively close to Batumi (20 to 93 Km), the third largest city on Georgia which provides alternative opportunities for employment, thus lessening the likelihood of in-migration
Population density of local area of influence	Population density is quite high and there is little space for migrants to settle, thus lessening the likelihood of in-migration and concentration of migrant populations. Existing population is homogeneous meaning there may be cultural tensions between host and existing populations
Summary and overall conclusion	There is the potential for significant in-migration from job seekers and camp followers which, due to the existing land, resource and social service constraints and vulnerability of the host population communities, would be an adverse impact on the Project and the local communities

Source: Mott MacDonald adapted from IFC "Projects and People: A Handbook for Addressing Project-Induced In-Migration"

In addition to the potential adverse impacts summarised in the above table, a potentially beneficial impact of the increase in population from construction workers may be a higher demand for locally produced food, goods and services, which could create benefits for local farmers, producers and traders. However, careful management will be required to prevent a localised "boom and bust" cycle that could easily accompany the construction phase.

Ultimately, whether the impact is determined as adverse or beneficial will depend on the management of the induced development, most importantly:

- The extent to which the community can provide sufficient facilities and services to cope with the enlarged population;
- How much of the government revenue and project revenue generated is spent in the local area;
- The extent to which the local population perceives their community is benefiting from the Project;
- The willingness of the local community to accommodate the presence of in-migrants for economic reasons; and
- The cultural sensitivity shown by the labour force to the hosting community.

Local people's vulnerability to in-migration is considered to be **medium** as they are already poor and the presence of migrants may somewhat limit their ability to take advantage of Project benefits. The magnitude of the impact is **minor** as it is unlikely to extend beyond the life of the Project and will be limited to the Project area of influence. Mitigation and enhancement measures will aim to help this be a beneficial impact, however without mitigation, the impact of induced development is considered to be an **adverse impact of minor significance**.

7.4.2.5 Land Acquisition and Involuntary Resettlement

The risk of resettlement was a key concern of local communities and NGOs raised during the ESIA scoping meetings. The Project has been designed so that physical and economic displacement is avoided to the greatest extent possible. A large amount of land will be required for the Project, none of which has yet been acquired. In summary, there will be:

- Temporary land acquisition for: tunnel faces, access roads, adits, water diversion whilst the dam is built and staff accommodation; and
- Permanent land acquisition for: reservoirs, reservoir buffer zones, powerhouses, surge shafts, sediment traps, penstocks, tunnel outlet structures, disposal of spoil material, road widening and realignment[23], bridges and safety zones (for changing water levels downstream of dams and weirs).

As shown in Table 7.23, there will be a land requirement of at least 41 ha for the Project however it is not known at this stage how much of this is privately owned land or what the economic displacement impacts will be upon farmers. Also, there are a number of project components where the land take sizes and locations remain undefined (as of February 2012). Spoil disposal will be deposited in and on the verges of the riverbeds and so will not require land acquisition.

Table 7.23: Estimated land requirements for the Project (as of February 2012)

Project Element	Project component		Temporary/ Permanent	Area required (m²)	Total area required (ha)
Tunnels	Portals/Access	All Schemes	Unknown at present	Unknown at present	Unknown at present
Headworks	Dams/weirs (including intakes, sediment traps and fish passes)	Skhalta	Permanent footprint	31,900	8.1
		Didachara	Permanent footprint	20,400	
		Chirukhistsqali	Permanent footprint	3,560	
		Khichauri	Permanent footprint	10,500	
		Chvanistsqali	Permanent footprint	2,400	
		Akavreta	Permanent footprint	6,000	
		Khertvisi	Permanent footprint	2,510	
		Machalistsqali	Permanent footprint	4,340	
	Reservoirs[24]	Skhalta	Permanent footprint	52,140	21.4
		Didachara	Permanent footprint	114,500	
		Khichauri	Permanent	47,300	

[23] For example, the filling of reservoirs at Didachara and Khichauri will cause flooding of the S-1 state highway for 2.5 km and 1.5 km respectively which will mean that the main road will have to be realigned, for which land acquisition will be necessary.

[24] Some reservoir areas have not been included as they are relatively small.

Project Element	Project component		Temporary/ Permanent	Area required (m²)	Total area required (ha)
			footprint		
		Khertvisi	Permanent footprint	43,50	
Powerhouse	Surface Powerhouse footprint	Shuakhevi	Permanent	5,120	3.7
	Switchyard		Permanent	13,970	
	Switchyard	Koromkheti	Permanent	Unknown at present	
	Surge Shaft		Permanent	Unknown at present	
	Surface Powerhouse footprint	Khertvisi	Permanent	3,650	
	Switchyard		Permanent	14,440	
Staff buildings (to include water treatment facilities)	Living accommodation	Shuakhevi	Temporary/ Permanent	Unknown at present	Unknown at present
	Living accommodation	Koromkheti	Temporary/ Permanent	Unknown at present	
	Living accommodation	Khertvisi	Temporary/ Permanent	Unknown at present	
	Project headquarters in Kokotauri and Dandalo	All schemes	Permanent	Unknown at present	
Construction lay-down areas (warehouse, workshops, offices etc.)	Powerhouse and dam sites	Shuakhevi	Temporary	50,000-60,000	86
	Construction Portals/Adits		Temporary	180,000 (6 portals)	
	TBM drive site		Temporary	170,000	
Construction lay-down areas (warehouse, workshops, offices etc.)	Powerhouse and dam sites	Koromkheti	Temporary	30,000-50,000	
	Construction Portals/ Adits		Temporary	120,000 (4 portals)	
			Temporary		
Construction lay-down areas (warehouse, workshops, offices etc.)	Powerhouse and dam sites	Khertvisi	Temporary	30,000-50,000	
	Construction Portals/Adits		Temporary	60,000 (2 portals)	
	TBM drive site		Temporary	170,000	
Infrastructure and services for construction	Road widening, new roads, and new bridges.	All Schemes	Permanent	Unknown at present	Unknown at present
Total Permanent land requirements known at present					**33.2**
Total Temporary land requirements known at present					**86**

Source: AGL/Mott MacDonald

There is one house on the river bed near to the Khichauri dam which is precariously located and in poor condition and may need to be displaced. There are two or three properties near to the location planned for the Khertvisi powerhouse that will be disturbed by noise, dust and vibrations from drilling, blasting and general construction activity. No discussions have been held at this stage with the owners of the properties as to whether resettlement will be necessary or desirable and then whether it will be temporary or permanent. Discussions will be held with potentially affected families closer to the time of project development. The families may move out temporarily during construction but be able to return once the temporary impacts have ceased.

The impacts on businesses are summarised in Table 7.24. Impacts on fish farms are discussed in Chapter 8.

Table 7.24: Business displacement impacts for all Schemes

Scheme	Type of Business	Temporary/ Permanent	Associated Project Feature
Shuakhevi	Petrol Station	Permanent	Didachara Reservoir
Shuakhevi	Sawmill	Permanent	Shuakhevi Powerhouse
Kormokheti	Mud Bath	Permanent	Khichauri Reservoir
Koromkheti	Petrol Station	Permanent	Khichauri Reservoir
Koromkheti	Guest House	Permanent	Khichauri Reservoir
Khertvisi	Abandoned Fishery	Permanent	

Source: AGL/ Mott MacDonald

There will be additional livelihoods impacts when the Project purchases farmland. The full scale of this is unknown as of February 2012 although it is thought that approximately 70-80% of land required for the Shuakhevi Scheme is privately owned. There may be other informal livelihood activities which are impacted by the construction and potentially the operational phases of the Project. These include use of the rivers for wood collection and the river bed for building materials collection. The Project will provide information on design and impacts during the ESIA consultations so that affected persons can use alternative parts of the river so that livelihoods are not affected.

The vulnerability of local people to land acquisition and livelihood impacts is considered to be **high** as there is little alternative to subsistence farming in the Project area, for which land is a pre-requisite. As the impact will not extend beyond the immediate area of influence and will affect a small to medium number of people, the impact is considered to be **minor**. Land acquisition and involuntary resettlement are concluded to be an **adverse impact of moderate significance.** Mitigation measures are set in out Section 7.5.2.5.

7.4.3 Operational Phase Impacts

7.4.3.1 Employment Generation

Employment generated in the operational phase will be mainly permanent, of a longer term nature and at a smaller scale than in the construction phase. Generally, staff of a medium to high skill level will be required. Once operational, the project is expected to generate approximately 60 jobs, although some roles such as office staff and Health, Safety and Environment (EHS) management may be performed by the same personnel as in the construction phase, so the actual number of additional jobs created may be slightly lower, at approximately 40-45. The majority of these jobs will be overseeing the operation and maintenance of the power plants. As well as maintaining or improving the wellbeing of the staff employed, the creation of these jobs will contribute to the development of specialist skills and experience in hydropower generation and engineering amongst the Georgian labour force if the jobs go to Georgians. The overall employment benefits anticipated from the operational phase of the Project are quantified in Table 7.25 below.

Table 7.25: Employment Generation for the Project in the Operational Phase

Sector	Types of Roles	Estimated number of staff
Management	Station Manager, Production Manager, Engineering Manager, health, safety and environment team, office administrators	13
Operation and Maintenance	Plant operators, storesman, fitters, welders	33
Secondary Support Staff	Security guards, firemen	13
Total		**59**

Source: AGL/Mott MacDonald

It is estimated that approximately 50% of the operational roles may be undertaken by local people. People hoping to obtain employment in the operational phase are considered to be of **low vulnerability** as many of them will already be formally trained and well-equipped to take advantage of opportunities. The magnitude of the impact is **minor** as although the operational jobs will be long-term a very small number of people will be affected. The employment generation from the operational phase of the Project without mitigation and benefit enhancement measures is considered to be a **beneficial impact of minor significance**.

7.4.3.2 Risks to the Wellbeing of Workers at Dams and Powerhouses

Operational health and safety risks and impacts include ventilation issues and potential for fire in the underground powerhouse at Koromkheti, as well as risk of shocks from live equipment and exposure to electromagnetic fields from switchyards and overhead lines. The extent of risks to AGL staff during operation can be mitigated through appropriate labour and OHS management and where necessary, monitoring of sub-contractors, so that works are carried out in accordance with Georgian law and international best practice. The un-mitigated impact on the wellbeing of workers during the operational phase is considered to be **an adverse impact of minor significance**.

7.4.3.3 Risks to Community Health, Safety, Security and Wellbeing

The main risk to community health and safety in the operational phase of the Project will be the sudden changes in river levels and pulsing of water during sediment flushing or high water periods. This poses a danger to people using the river such as fisher-folk, swimmers, people collecting wood or building material or people herding animals. In addition to pulsing, there will be lower river flows downstream of the largest dams and upstream of discharge points at the associated powerhouses which may affect water availability for fishing and recreational uses such as swimming. Water resource impacts are discussed further in Chapter 9 and dam-break analysis and its effects are summarised in Appendix C2. Impacts on fish stocks are discussed in Chapter 8. Impacts on community health associated with stagnant water, such as vector-borne diseases like malaria are not considered to be a risk to this Project because the water in the reservoirs will be flowing with up to 10 m of drawdown per day.

Overall, sensitivity of local people to risks to their health, safety, security and wellbeing during operation is **low** as they are expected to adjust quickly. The unmitigated magnitude of the impact is expected to be **minor** as the resultant impact is thought to be likely to occur very exceptionally, affect a limited number of people and be limited to the Project area. All of the risks to community health, safety, security and wellbeing can be mitigated through appropriate environmental and social management planning and design features, however if unmitigated, impacts during the operational phase are considered to be an **adverse impact of minor significance**.

7.4.3.4 Infrastructure Improvements

The provision of electricity for Project construction activities is considered within the preliminary Infrastructure Report[25] and a more detailed study will be undertaken into demand and available supply prior to commencement of construction. The Project will provide the necessary infrastructure such as additional substations and distribution lines or diesel generators, where required, to ensure that local communities' access to electricity is not impeded.

There will be an extensive road and bridge rehabilitation and building programme to allow access by heavy vehicles to the Project sites, which will also be of benefit to local road users such as farmers transporting produce to markets and local businesses obtaining supplies. Road improvements including widening and resurfacing are underway and will be ongoing. Widening will be undertaken with consideration of properties and physical resettlement as a result of the road improvements is considered to be highly unlikely as all feasible steps will be taken to avoid resettlement. Severance of agricultural plots caused by new access roads has been considered in the preliminary design and will be avoided to the greatest extent possible in the final design.

The road and bridge building and improvements planned for the Project will improve accessibility and could provide an enabling environment for the development of the tourism industry. It is noted within the baseline that this is a desirable direction for the improvement of the economy in Adjara and it is would create much needed cash income earning and business development opportunities for local people which would contribute to poverty reduction. An increased level of disposable income within the municipalities would drive demand for products and services and have an overall benefit for the local economy.

As discussed in section 7.4.1.4 in relation to induced development, the potentially negative side of the improved infrastructure is that there may be an influx of people, either taking advantage of the new opportunities (which would be effectively permanent) or tourists (which would be temporary but potentially constant). This would cause pressure on land and resources in the already overpopulated area and may contribute to the associated problems of erosion and land instability.

Local people's sensitivity to infrastructure improvements is **medium** as people in the Project area are often poor and opportunities are currently constrained by poor infrastructure. The magnitude is **moderate** as the impact will last for a number of years and will affect a group of people across the wider area of influence. Overall the improved infrastructure in the operational phase is concluded to be a **beneficial impact of moderate significance**.

[25] Entitled: '5.1.11 Construction Planning, Scheduling and Contracting' Report, Gross Energy Group, January 2012

7.4.3.5 Payment of Municipality Property and Land Taxes

It is widely recognised that in order for dams and hydropower schemes to be developed more equitably, those living close to them who are most affected should be considered in the distribution of benefits. In accordance with the Tax Code of Georgia, local municipalities can set property taxes of up to 1% of the value of the property to be paid each year. Khulo and Shuakhevi Municipalities recently set rates of 1% in Decree No. 24 of 18 April 2011 and Decree No. 14 of 8 April 2011 respectively. It is likely that the Project will pay taxes to the municipalities of 1% of the property value per year of operation. There will also be land taxes paid to the municipalities. This money will be under the control of the municipalities and may fund improvements to healthcare, education or other services.

The communities likely to benefit from the additional municipality budgets are considered to be **highly** vulnerable and would benefit greatly from the change. Dependent on what the revenue is spent on, the impact is considered to be of **minor beneficial** magnitude which would result in an impact of **moderate beneficial significance,**

7.4.4 Decommissioning Phase Impacts

7.4.4.1 Risks to Worker and Community Health and Safety

The Project has been designed to last 30 years. At the end of this period, it is likely that the dams and weirs will be rehabilitated rather than decommissioned. Whether the Project is rehabilitated or decommissioned there will be some health and safety risks to workers or communities such as re-flooding of dry areas and site safety risks such as working from height or being struck by moving objects.

If unmitigated, health and safety risks in the decommissioning phase are concluded to be an **adverse impact of minor significance** as workers and communities are considered to be of **medium** sensitivity and actual impacts resulting from risks to health and safety are expected to be **minor**, affecting a small number of people over a limited time and occurring exceptionally.

7.4.4.2 Retrenchment

When the Project is decommissioned there will be retrenchment of the staff employed during the operational phase, estimated to be approximately 55 in number. This could cause income insecurity for those members of staff affected. Unmitigated retrenchment upon decommissioning is considered to be an **adverse impact of minor significance** as workers will be of **medium** sensitivity to this impact and it will be of **minor** magnitude, affecting only a limited number of people.

7.4.5 Cumulative Impacts

There is a separate HPP under construction on the Chirukhistsqali River, which is upstream of this Project’s Chiruki weir. As the powerhouse of the other HPP is upstream, it will be unaffected by this Project. The exisiting Asti HPP scheme situated on the Adjaristsqali River may be affected by the Project however it is not known at this stage whether impacts are likely to be positive or negative or of what magnitude they might be. Negative effects may include loss of revenue or change in the operating regime. AGL is in discussions with the owners of Asti HPP and will compensate the company if revenue is lost. The Feasibility Study for this Project has been developed assuming that the existing HPP on the

Machakhlistsqali River will be purchased or incorporated into the Project and it will therefore cease to exist upon construction of the Khertvisi Scheme.

There is also a ski resort being developed on the Chvanistsqali River, to the north of the Adjaristsqali River which will provide construction and operation jobs for people in the area. There will also be construction traffic associated with the ski resort. As the ski resort will be developed during the construction period of the Shuakhevi Scheme, and is some distance from the first work areas of the Scheme, there is not thought to be a significant cumulative social impact.

7.5 Mitigation and Enhancement Measures

7.5.1 Overview

This section presents the measures that will be taken to avoid, reduce and compensate adverse social impacts and enhance the beneficial impacts of the Project.

7.5.2 Mitigation Measures

7.5.2.1 Employment Generation

This ESIA is complemented by a skills mapping and development exercise (hereafter called 'skills mapping') which is managed by AGL and is an integral part of the project concept aimed at improving local people's capacity to obtain employment on the Project and other similar projects in the region. The skills mapping has identified a lack of relevant skills available locally and therefore aims to provide general training for people in skills such as construction work, health and safety, and english language. It is proposed that some of those given general training will be provided additional specialist training in accredited short courses (such as welding, electrician, hydraulic plant operators etc). The specialist skills course topics will be driven by the demands of the Project at certain times. AGL will employ an Employment Services Officer who will be the link between communities, contractors and developers and who will facilitate linking people with opportunities.

The skills mapping commenced in October 2011 whereby local people interested in obtaining employment on the Project have been able to register their interest and current skill level. This data has been collated and analysed and 3,019 people have registered interest in the three municipalities as of February 2012[26]: The breakdown between municipalities is as follows:
- 1,636 people in Khulo Municipality
- 841 in Shuakhevi Municipality
- 542 in Keda Municipality.

Current skills levels registered as of February 2012 are summarised in Table 7.26.

[26] As of February 2012, data for Khelvachauri Municipality has not been collected.

Table 7.26: Current skills levels registered during skills mapping registration period (to February 2012)

Municipality	Secondary Education			Higher Education			Total
	Construction	Support Service	Unskilled	Construction	Support Service	Other	
Khulo	693	348	308	56	68	163	**1,636**
Shuakhevi	99	231	401	15	0	95	**841**
Keda	74	183	211	11	0	63	**542**
Total	**866**	**762**	**920**	**82**	**68**	**321**	**3,019**

Source: Gamma Consulting

1,000 of the registered people already have skills in construction. Those with construction skills in the secondary education category include people with skills such as welding, carpentery and stone masonry whilst those with higher education include engineers. Those described as having 'support service' skills include cooks, drivers, healthcare workers in the secondary education category and those with higher education in construction related fields. There are a large number of 'unskilled' workers (920) and 'others' with higher education in unrelated fields. Generally, people who already have skills which may be used on the Project make up approximately 60% of those who registered interest. Some of these people may be employed and given refresher training whilst some of the unskilled people would require additional investment in training.

An application for funding for skills development has been made by AGL to the Norwegian Government and is currently under consideration. How many people the project is able to train will largely depend on the success of the funding application, however AGL will as a minimum provide training to those directly affected by land aqcuisition activities.

A further element of the skills mapping and development is the actions that will be taken by AGL and its contractors to procure local goods and services. This will further benefit the local economy and reduce income poverty in the local area of influence and is discussed further in Section 7.5.2.4.

Recruitment is an issue which has the potential to exacerbate existing social tensions as a result of perceived inequity of opportunities which could result in damage to the societal cohesion of communities. This potential adverse impact can be avoided through well planned public consultation and disclosure activities (see SEP available from the Project website, www.adjaristsqali.com) and recruitment of staff based on merit (skills) and equal opportunities. In order to further the long-term employment and skills development benefits to local communities, and to manage expectations and avoid social conflict that might arise in relation to perceived inequity in recruitment, AGL will adopt the following measures:

- Disclosure of a Recruitment Policy that specifically includes a requirement to prioritise local employment equitably between villages taking into account available skills. This will extend to the selection of people for admission to training courses on offer as part of the skills development programme. The requirement will also be reflected in the contractors' employment policy. The Recruitment Policy will consider local literacy levels and will be disclosed in Georgian at Site Offices and Municipality and village halls or meeting points.
- Provision of a description of the types of employment opportunities to be provided to local people from the construction and operational phases of the project including skills levels, indicative timeframes of recruitment, remuneration and benefits packages and likely duration of contracts. Publication of the need for staff and labourers will be advertised locally prior to recruitment commencing for any phase. This will allow prospective employees to make an informed decision when applying for work, so that

they may consider their other commitments, such as labour inputs to harvesting seasons in order to avoid the risk of short-term employment resulting in neglect of farming activities which may have a negative effect on their livelihoods.

Should funding be granted and local people are able to take full advantage of the skills development opportunities being provided as part of the Project, employment generation is expected to be a **beneficial impact of moderate significance**.

7.5.2.2 Safeguarding the Wellbeing and Health and Safety of Workers

The following specific measures and/or the development of labour policies and procedures will be employed by AGL to ensure that the wellbeing of both AGL and contractor workers is protected in accordance with Georgian law, ILO core labour standards and international best practice as exemplified by IFC PS2, EBRD PR2, IFC EHS General Guidelines and IFC EHS Guidelines for Power Transmission and Distribution:

- Working conditions and management of worker relationships:
  - Develop a Human Resources Policy and Procedures detailing the principles guiding AGL's approach to management of workers, including equal opportunities, non-discrimination, non-employment of children or forced workers and AGL's approach to trade unions, collective bargaining and employment of migrant workers.
  - Issue all Project staff with an individual contract of employment detailing their rights and conditions in accordance with the Georgian Labour Code and IFC/EBRD requirements related to hours of work (no more than 41 hours per week), wages, overtime, compensation and benefits such as maternity or annual leave, and update the contract when material changes occur.
  - Provide accommodation in accordance with the IFC/EBRD guidance document 'Workers' accommodation: processes and standards, a guidance note by IFC and the EBRD (August 2009). This will be outlined in a Workers' Accommodation Plan which will govern the provision of accommodation to similar standards at all camps and will cover: provision of adequate and safe drinking water, adequate space, food, power, heating, cooling, ventilation, sanitation, water treatment, waste disposal, fire and noise protection, measures to deal with disease-carrying animals, sanitary washing and laundry facilities, lighting, storage, basic medical services and transport between accommodation and site.
  - Develop a Retrenchment Plan prior to any anticipated retrenchment in the decommissioning phase or any other periods whereby the need for workers to be laid off in accordance with Georgian Law.
  - Develop, formalise and disclose staff grievance policies and mechanisms for complaints about unfair treatment or unsafe living or working conditions without reprisal and make these available to all Project workers, including sub-contracted staff.
  - Hold toolbox talks on labour law issues and the labour grievance mechanism twice a year during the construction phase.
- Protecting the workforce, occupational and related community health and safety:
  - Develop a Worker Code of Conduct to govern the behaviour of workers on site, in camps and in the local communities. This should cover *inter alia:* cultural awareness for workers coming from outside of Adjara, a drugs and alcohol policy with information about testing and penalties for contravention and information about HIV/AIDS and the spread of sexually transmitted diseases.
  - Organise a training program and maintain individual training registers for each construction worker which they can have at the end of contract for procuring future work.
  - Develop a Worker Health and Safety Plan which covers: the hazards identified for each site, type of work and other Project activities such as driving on public roads; provision of preventive and

protective measures for all hazards; information about safe working methods including the production of individual worksheets for discreet hazardous tasks; use of Personal Protective Equipment (PPE); management and storage of explosives and hazardous chemicals; and road safety measures such as speed limits on public roads and on site, etc. Contractors will be required through contract clauses to monitor and enforce safety plans and establish penalties for violations and rewards for good compliance records.

- As part of the Worker Health and Safety Plan, develop and use formal Permit to Work (PTW) system to ensure that all potentially hazardous work is carried out safely and ensures effective authorization of designated work, effective communication of the work to be carried out including hazards involved, and safe isolation procedures to be followed before commencing work.
- Give HIV/AIDS awareness and prevention briefings and screenings, to be undertaken in a culturally sensitive manner.
- Develop an Emergency Preparedness and Response Plan covering risks to workers in emergencies, dealing with fire, flood, road accidents, landslides and rockfalls, serious personal injury, etc, and provide construction site and operational facility Emergency Response Teams.

Clauses will be inserted in contractors' agreements to ensure compliance by contractors with the following AGL documentation and procedures:

- Human Resources Policy and Procedures
- Issuing of individual worker contracts of employment
- Workers' Accommodation Plan
- Retrenchment Plan in the event of retrenchment
- Grievance Mechanism
- Worker Code of Conduct
- Worker Health and Safety Plan
- Emergency Preparedness and Response Plan.

Contractors and sub-contractors will be made aware of their role in ensuring the Project meets international standards related to labour and working conditions. In particular, overtime arrangements and the timely payment of wages will be addressed. The contractors will also be expected to provide all construction workers with a summary of their employment service and training activities at the end of each contract as a means to finding continued employment. This will be done through the provision of briefings to sub-contractors and enforced through contractual clauses and regular monitoring (internally by AGL and externally by independent monitors) of contractors' activities and performance.

Contractors will be required, through their contracts, to supply key personnel for the management of OHS risks who will include:

- An Environmental Health and Safety (EHS) Manager with overall responsibility for ensuring the health and safety of the contractor's workers, reporting to AGL's EHS Manager; and
- A Foreman on each construction and tunnelling site who is responsible for that site, reporting to the contractor's EHS Manager.

AGL will employ a suitably qualified 'Health, Safety and Environment' manager and support staff in order to assess risks to worker health and safety and implement preventive and protective measures. Each site will have a Foreman employed by the contractor who will be qualified in OHS and first aid and who will be responsible for management of all health and safety issues on their site. The Foreman will carry out daily site walkovers to identify hazards and take action based on their findings. They will report incidents (where personal injury could have occurred but did not) and accidents (where personal injury actually occurred) to

AGL's EHS Manager. AGL's EHS Manager will also be mandated to carry out monitoring of sites and workers' accommodation and hold site meetings with Foremen to discuss health and safety improvements, compliance with PPE requirements and other OHS issues as they arise. These meetings will be weekly at the opening of new sites and reduced in frequency to monthly once the site is working normally.

All workers on the Project will be given basic health and safety training including use of appropriate PPE. Training will also be given on how to conduct tasks with specific health and safety risks such as welding, use and storage of explosives and hazardous chemicals, working with live equipment, tunnelling, electromagnetic field safety measures, working at height, working on or near water, crossing water courses and the use of boats and life-jackets, road safety and general driver training, use of seatbelts, vehicle checking and dealing with adverse weather conditions on roads such as snow and ice, etc. The contractors' EHS Managers will retain a log documenting all health and safety training given to each worker and when refresher courses are due. These logs will be monitored by AGL's EHS Manager on a regular basis, at least monthly.

AGL's EHS Manager will maintain a central record of occupational incidents, accidents and diseases and follow these up on all sites to ensure that corrective measures are taken and that recurrence is prevented. AGL's EHS manager will also maintain a record of worker grievances including how grievances were closed out and in what timeframe. Grievance, incident, accident and occupational disease logs will be retained at head office for future analysis and monitoring by lenders or government inspection authorities.

AGL will review the likelihood of the use of child or forced labour or the presence of occupational safety issues within their primary supply chain prior to engaging suppliers and will not deal with companies where there are unacceptable risks. AGL will monitor its suppliers at least quarterly to identify any new risks and will take appropriate actions to remedy any significant problems which may be discovered. Where AGL foresees a lack of control over the selection of primary supply chain companies, the responsibility for ensuring compliance with the IFC PS2 requirements in this regard will be passed onto contractors through contract clauses.

In case of an injury to Project workers, trauma provision will be provided at the new hospitals in Shuakhevi or Khulo. AGL insures all workers for medical treatment and the contractors, through contract clauses, will be required to have medical insurance for all workers. In addition there will be first aid kits and facilities at the major construction sites and a nurse will be on standby at all times to provide first response care in medical emergencies as well as treating workers for minor medical problems. If needed, search and rescue will be provided by the Department of Emergency Management under the Ministry of Internal Affairs of Georgia. This service is free of charge and available to everyone.

The implementation of the mitigations specified to protect the health, safety and rights of workers is expected to reduce the predicted adverse consequences and overall result in an **insignificant** impact.

7.5.2.3 Safeguarding Community Health, Safety, Security and Wellbeing

As part of the Stakeholder Engagement Plan (SEP), a grievance mechanism has been available to communities to raise problems or concerns about Project activities since the ESIA Scoping Phase. The results of this as of Febraury 2012 are discussed in Chapter 6 on consultation. AGL's Community Liaison Officer will continue to deal with grievances raised by community members on a case by case basis, monitoring for patterns and taking appropriate action where required.

As a consequence of the landslide risks identified in Chapter 11, throughout the Project optimisation and feasibility stages, the project layout and location of individual structures have been subject to continual improvement with the final layout being developed in response to the landslide hazard assessment. The landslide hazard assessment has identified areas of medium to high risk to the Project and these areas have been avoided if possible, or mitigation measures have been identified to minimise the impact on local communities. For example, the hazard mapping in the location of the dam site at Didachara has identified a potentially unstable large relict landslide on the right bank of the river. The ground investigation identified that the depth to bedrock was relatively shallow and although some minor failures would be expected, it is deemed that these are manageable with good engineering practice and design. As there remains a residual risk of shallow movement, the extent of land acquisition in this area has been increased to mitigate the impact on the local population of loss of agricultural land. In the Feasibility Design Note it is stated that, partly in response to local people's concerns about landslides, the powerhouse at Skhalta has been located on the crest of the dam. The landslide hazard maps are located in Appendix E and further assessment of the impact of the scheme on landslides is provided in Chapter 11.

An Emergency Preparedness and Response Plan for the Project will be developed in collaboration and consultation with local community representatives, especially in areas where community response and cooperation is required for effective execution of the Plan. There will be particular emphasis in the discussions with communities placed on road safety during the construction phase and on flushing and changing water levels which will occur during the operational phase of the Project. The final Emergency Preparedness and Response Plan will be disclosed to communities via the Municipalities and village heads.

In relation to the risk of lost water resources as a result of tunnelling, potential impact on springs used by communities could be a major adverse impact, but most springs and users located on old landslip areas have been avoided by the tunnel alignment so there will be relatively low risk. Where impacts are foreseen they can be minimised by localised tunnel grouting or lining. Where loss of drinking water occurs a temporary water supply will be established so that households are not without drinking water in the short term. In order to rectify loss of drinking water resources in the long term,a permanent alternative water supply will be installed by the Project.

During the diversion of water for dam construction and the filling of reservoirs, extreme care will need to be taken by the contractor to ensure that the areas to be flooded are clear of community members and their livestock and other assets. Announcements that flooding will be occurring will be made one week in advance in local village and community centres and via local radio, and village heads will be informed so that word can be spread amongst communities. The AGL Project Manager and support staff will oversee the flooding process in all cases.

There will be a community health and safety education campaign commencing in the construction phase and ongoing into the first year of operation of each scheme covering the following key issues:
- Flooding during construction
- Changing water levels (safety risks associated with overflow and sediment flushing as well as informing people about drier areas downstream of the largest dams) during operation
- Road safety awareness

- Risks such as transportation and potential spillage of hazardous materials including chemicals and explosives[27]
- HIV/AIDS awareness
- Site safety awareness and access restrictions.

The community health and safety education campaign will be implemented according to where the relevant Project activities are being undertaken and according to the risk at each location. Community education programmes will take place in schools and community centres such as village halls and municipality buildings. The general skills training discussed in Section 7.5.2.1 also provides a platform to give further information on issues surrounding community health and safety. There will be fencing around all construction sites and areas where there is a risk to community health and safety such as excavations. There will be warning signage in Georgian and English (for tourists) in areas which may flood when sediment is flushed or when there is a requirement to release heavy rainfall through the dam. In high risk areas for example at reservoirs and fishing platforms, life rings will be provided at the water's edge. There will also be signage and fencing around all live electrical equipment.

A warning system will be used during operation when overflow or sediment flushing occurs which will include advance notification to communities via village heads and local radio where possible. Where advance warning is not possible and in every case where significant additional water and / or sediment is to be released through (or around) the dam, a siren system will be used to give people the chance to clear the riverbed of themselves and their livestock prior to the flash flood occurring. Sirens will need to be tested on a fixed day each month (for example, the first Monday) which the local community will need to be aware of and which will be stated on warning signage in the flood zone.

There will be a road safety element in the Worker Health and Safety Plan discussed in Section 7.5.2.2 including maximum speed limits for site and access routes. Contractors will be required through contract clauses to monitor and enforce safety plans, report accidents involving community members to AGL's EHS Manager and establish penalties for violations such as incidences of dangerous driving reported via the community grievance mechanism. AGL will be responsible for regular maintenance of site and access roads to reduce erosion, pot-holing and degradation of drainage channels in order to maintain access and road safety. Main roads such as the state highway will be repaired if significantly damaged by heavy trucks in order that local people retain a useful and valuable asset when the Project is complete. All roadworks, especially replacement works where the state highway S-1 (the main road from Batumi to Akhaltsikhe through the Adjaristsqali valley) will be inundated by the Didachara and Khichauri Reservoirs, will be planned and carried out so that people are not isolated.

Safety management will form a key component of the Operation and Maintenance (O&M) Plan which is an engineering related mechanism and not covered in detail here. The O&M Plan will be drawn up by the O&M engineers and safety specialists upon advice from the construction Contractors and in accordance with the requirements of the equipment manufacturers and international best practice. In accordance with International Hydropower Association guidance, the O&M Plan will include a Dam Safety Management Plan and the overriding principles within both will be that the workers and the communities in the vicinity of dams and other Project infrastructure will not be exposed to unacceptable risks. The O&M Plan which will define safety monitoring requirements and any potential problems identified will be followed up promptly with detailed investigations and will be rectified to prevent accidents or incidents from occurring.

[27] Transportation and disposal of hazardous wastes is discussed in Chapter 13.

Access to construction sites, tunnels, workers' accommodation and the powerhouses during operation will be controlled by fences, gates and security guards. Each site will have an entry and exit logs and vehical access restrictions so that the security staff know who and how many people are on site at discrete times in case of fire and so that they can restrict access to Project staff only. The Project will carry out appropriate checks to ensure that security companies and personnel do not have a history of past abuse. Security personnel will be trained in the use of force and in the applicable laws so that no contravention of national legislation takes place. AGL will provide training to security personnel using the guiding principle that force shall not be used except in defence and in proportion with the nature and extent of the threat. It is not envisaged that the Project will use government security personnel.

Depending on the contractors appointed there is the potential for a number of workers moving into the area from outside of Georgia. Although this number may be low due to the Project commitment to employ local people as much as possible, it will be important to provide the international workforce with training on the cultural sensitivities of the existing population of the four Project affected municipalities. This will be done through distribution of information brochures and introductory training upon recruitment. Depending on proximity and likelihood of interaction, language training could be appropriate. Whichever contractors are appointed, AGL will ensure that the contractors make efforts to share their cultural values and practices with the local village leaders so there is some understanding among the host community.

The implementation of the mitigations specified to protect and promote the health, safety and wellbeing of communities is expected to avoid potentially adverse impacts and to result in an **insignificant** to **minor beneficial** impact.

7.5.2.4 Measures to Manage Induced Development and Enhance Benefits

Some of the business and service opportunities linked to the Project will be accessible to local people such as: catering, cleaning and laundry services, security, pest control, floor covering, painting, vehicle maintenance, uniform production, fencing, paving, etc. The Project can modify the way in which it procures goods and services in order to maximise opportunities for local people. It is suggested that local procurement should defined as goods and services purchased within the four Project-affected municipalities of Khulo, Shuakhevi, Keda and Khelvachauri. Procurement modifications are being considered as part of the skills mapping.

Some of the ways in which procurement practices will be modified[28] in order to maximise local benefits include establishing a local procurement policy that prioritises local contracting by:

- Making minor modifications to the procurement policy such as:
  - Communicating future demand
  - Having longer contract periods to justify acquisition of capital equipment
  - Simplifying tender procedures so it is easier for local companies to participate
  - Producing tender documents in local languages
  - Holding tender workshops locally to help understanding of need and process
  - Lowering the price of tender documentation
  - Making prequalification efforts match the contract type and amount

[28] Discussed in more detail in Engineers Against Poverty's "Maximising the contributions of local enterprises to the supply chain of oil, gas & mining projects in low income countries: A briefing note for supply chain managers & technical end users available at http://www.engineersagainstpoverty.org/_db/_documents/EAP_Briefing_Note_-_Local_Enterprise_Participation.pdf

- Making price preferences for local firms
- Unbundling contracts so that local entrepreneurial services can be tapped
- Reserving a proportion of a contract value or a whole contract for local enterprises to implement
- Wavering or lowering the need for performance bonds
- Using main contractors to engage local firms in their supply chain
- AGL will inform its local suppliers and contractors of the employment policy to set a quota for local staff.

Efforts will be made to provide local gender equality benefits through including a quota for the number or value of contracts provided to local female business owners or partners in areas such as cleaning and catering for example. The enhancement measures specified to promote local employement and procurement are expected to result in a **minor beneficial** induced development impact.

7.5.2.5 Land Acquisition and Involuntary Resettlement

A separate Land Acquisition and Livelihood Restoration Framework (LALRF) has been developed for the Project, which can be accessed at the Project website (www.adjaristsqali.com). The LALRF provides a means by which to ensure compliance with both national laws and international best practice as exemplified by IFC PS5 on Land Acquisition and Involuntary Resettlement and EBRD PR5 on Land Acquisition, Involuntary Resettlement and Economic Displacement. The LALRF describes AGL's intended practice of acquiring land through negotiated settlement guided by the principle of 'willing buyer – willing seller' as well as defining the procedures to be followed in the unlikely case that expropriation is used as a last resort.

In accordance with IFC PS5, although the developer will seek to achieve land acquisition on willing buyer-seller basis, any negotiated settlements where the developer has the potential to seek expropriation is considered to be involuntary resettlement, as such the project will implement in all cases of land acquisition a RAP or LRP as defined below:

- Resettlement Action Plans (RAPs) in the event of physical displacement, defined as loss of income or livelihood due to land acquisition or obstructed access to resources (land/water) caused by the Project or associated facilities; and
- Livelihood Restoration Plans (LRPs) in the event of loss of income or livelihood due to land acquisition or obstructed access to resources (land/water) caused by the Project or associated facilities.

Where both physical and economic displacement is experienced, only an RAP will be prepared to compensate both categories of impact.

The RAP or LRP will cover the livelihood impacts identified in Section 7.4.1.5 if necessary, such as relocation of petrol stations, a mud bath and other businesses and compensation for loss of crops or trees. Prior to construction on each Scheme, focus groups discussions will be held with people engaged in informal activity identified as being affected by the Project in order to discuss alternative locations or the provision of compensation or assistance if required. In all cases of physical and economic displacement, AGL will attempt to reach a negotiated settlement with the owners and occupiers of land and houses (land or houses could potentially be used or occupied by tenants). AGL will only persue expropriation through the courts where negotiations are unsuccessful.

The LALRF will act to reduce potentially adverse impacts associated with land acquisition and economic displacement; this assessment therefore concludes that these impacts will be **insignificant**.

7.5.3 Enhancement Measures

7.5.3.1 Skills Mapping

Skills mapping is a key enhancement feature of the Project is dicussed in Section 7.5.2.1 as it is linked with employment generation impacts.

7.5.3.2 Revenue Sharing to Promote Local Socioeconomic Development

As discussed in Section 7.4.3.5, AGL will pay taxes to local municipalities on property and land. In order to maximise the benefits of the additional municipality budgets for local communities, AGL will support communities in identifying social improvement programmes that benefit them through the establishment of a committee and provision of organisational assistance such as setting up committee meetings and facilitating contacts between the committee and the municipalities. This will be done primarily by AGL's Community Liaison Officer.

7.6 Summary of Impacts, Mitigation and Residual Significance

Impacts of the Project were identified in Section 7.4 of this report. Section 7.5 presents the proposed mitigation and the residual significance of those impacts which results from implementing the mitigation measures. Table 7.27 provides a summary of this assessment.

7.6.1 Residual Impacts

Table 7.27: Summary of Key Significant Impacts and Mitigations

Activity	Potential Impact	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation & Enhancement	Residual Significance
Construction						
Construction works	Employment generation	Medium	Moderate	Moderate beneficial	Skills mapping and training for local jobseekers Disclosure of Recruitment Policy Localised disclosure of need for staff and labourers in advance of opportunities arising	Moderate-major beneficial
Construction works	Risks to the wellbeing and health and safety of workers on site and in camps	Medium	Minor	Minor adverse	To be provided in the CEMP ■ Develop and implement Human Resources Policy ■ Issue each member of staff with an individual contract of employment ■ Workers' Accommodation Plan ■ Staff grievance mechanism ■ Tool box talks on labour law and the grievance mechanism ■ Worker Code of Conduct ■ Training Program particularly covering health and safety ■ Worker Health and Safety Plan including road safety element with penalties for violation of rules and speed limits and Permit to Work system for hazardous tasks ■ Issue Personal Protective Equipment (PPE) ■ Emergency Response Teams ■ HIV/AIDS awareness and prevention	Insignificant

Activity	Potential Impact	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation & Enhancement	Residual Significance
					briefings Emergency Preparedness and Response Plan to be developed covering health and safety risks to workers in emergencies Insert clauses in contractors' agreements to ensure compliance with all policies, plans, procedures and identified mitigation measures. Also clauses to monitor and enforce safety plans and report accidents and incidents Provide all workers with a summary of their service and training activities Incidents and accidents logs to be maintained Worker grievance log to be maintained. Review of primary supply chain for OHS issues, use of child or forced labour.	
Construction works	Risks to community health, safety, security and wellbeing	Medium	Minor	Minor adverse	Project performance grievance mechanism. Emergency preparedness and response plan to be developed in collaboration with and disclosed to local communities Provide temporary and permanent community water solutions if ground water and wells are affected Advance warning that flooding of reservoirs will occur. Overseeing of flooding by AGL PM Community health and safety campaign Site security measures	Insignificant-minor beneficial
Construction works	Induced development, population changes and the potential for cultural tension	Medium	Minor	Minor adverse	Modifications to procurement practices Training of all international workers in cultural sensitivities	Minor beneficial (combined with mitigations specified for employment generation)

Activity	Potential Impact	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation & Enhancement	Residual Significance
Land acquisition	Negotiated settlement or potential involuntary resettlement of affected persons	High	Minor	Moderate adverse	Transactions to be carried out on the basis of willing buyer-willing seller. If negotiated settlement fails develop RAP or LRP in accordance with LALRF Consultation to be carried out with people engaged in informal livelihood activities affected by the Project in order to find alternatives and/or identify the need for compensation or assistance	Insignificant
Operation						
Operational works	Employment generation	Low-negligible	Minor	Minor beneficial	Skills mapping and training for local jobseekers Disclosure of Recruitment Policy Localised disclosure of need for staff and labourers in advance of opportunities arising	Moderate beneficial
Operational works	Risks to the wellbeing and health and safety of workers at dams and powerhouses	Low	Minor	Minor adverse	Issue each member of staff with an individual contract of employment Workers' Accommodation Plan Staff grievance mechanism Tool box talks on labour law and the grievance mechanism Worker Code of Conduct Training Program Worker Health and Safety Plan including road safety element with penalties for violation of rules and speed limits Issue Personal Protective Equipment (PPE) Emergency Response Teams HIV/AIDS awareness and prevention briefings Emergency Preparedness and Response Plan to be developed covering health and safety risks to workers in emergencies Insert clauses in contractors' agreements to ensure compliance with all policies, plans,	Insignificant

Activity	Potential Impact	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation & Enhancement	Residual Significance
					procedures and identified mitigation measures. Also clauses to monitor and enforce safety plans and report accidents and incidents Provide all workers with a summary of their service and training activities Incidents and accidents logs to be maintained Worker grievance log to be maintained Review of primary supply chain for OHS issues, use of child or forced labour	
Sediment flushing, flooding, operational activities	Risks to community health, safety, security and wellbeing	Medium	Minor	Minor adverse	Project performance grievance mechanism Emergency preparedness and response plan to be developed in collaboration with and disclosed to local communities Advance warning and sirens before sediment flushing or flooding Regular testing of sirens Provision of life rings Community health and safety campaign Site security measures Annual open day	Insignificant
Infrastructure works (roads and bridges)	Improved possibilities for tourism and other economic development	Medium	Moderate	Moderate beneficial	Road maintenance to leave a useful asset for communities after the construction phase	Moderate beneficial
Payment of municipality taxes	Additional revenues for municipality budgets likely to benefit local communities	High	Minor (dependent on what the revenue is spent on)	Moderate beneficial	AGL will support communities in identifying social improvement programmes that benefit them through the establishment of a committee and provision of organisational assistance.	Moderate-major beneficial
Decommissioning						
Rehabilitation or de-construction	Risks to worker and community health and safety	Medium	Minor	Minor adverse	As for the construction phase	Insignificant
Project closure	Retrenchment	Medium	Minor	Minor adverse	Develop Retrenchment Plan	Insignificant

7.7 Proposed Monitoring and Reporting

IFC PS1 and EBRD PR1 require external/independent and internal monitoring of all Category A projects or projects with significant impacts. Monitoring reports will be disclosed by AGL every six months during construction and annually during operation.

Monitoring of social issues will be important, especially with regards to worker management, workers' terms and conditions (including the labour accommodation), occupational health and safety and grievances. Internal and external monitoring will need to ensure that the Project commitments to workers' rights are implemented, in particular with regards to:

- Use of child labour
- Payment of minimum wages and overtime
- Not taking any action to prevent employees from exercising their right of association and their right to organise and bargain collectively
- Ensuring no workers are charged fees to gain employment on the Project
- Implementation of plans, procedures and training for occupational health and safety
- Non-discrimination and equal opportunity
- Treatment of migrant workers
- Use of the labour grievance mechanism
- The existence of human resource policies, job descriptions, written contracts
- Provision of information to labour force regarding rights and working conditions
- Employee training activities.

Adherence to the OHS plan and procedures will be taken seriously and audited frequently. A warning system for violations and non-compliance will be established and implemented for the monitoring system to be effective. The Project will aim to keep the number of accidents among Project workers to a rate of zero, especially accidents that could result in lost work time, disability, or even fatalities. AGL will monitor contractors' accident and incident logs and maintain a central record. AGL will also audit contractors' workers' accommodation camps.

Regular monitoring of the project performance grievance mechanism and stakeholder engagement needs to take place. The impact of the enhancement activities, will also be monitored.

Where necessary, AGL will take appropriate action to correct procedures and practices in order to prevent recurrence of any significant problems arising in terms of Project performance which affect the health, safety, security or wellbeing of affected communities or Project workers.

7.7.1 Annual Sustainability Reporting

Reports based on monitoring results will be issued annually addressing the full range of social issues addressed in this SIA, including but not limited to details on:

- The labour profile and OHS performance
- Land acquisition
- Contributions to the local economy
- Social investments, activities and outcomes
- Stakeholder engagement.

Two of the most common frameworks used by international private sector companies for annual sustainability reporting are the Global Reporting Initiative (GRI) and UN Global Compact. The GRI's Sustainability Reporting Framework sets out the principles and performance indicators which organisations can use to measure and report their economic, environmental, and social performance. The GRI has been working with the IFC to align some of its reporting requirement with the IFC's PS. The Global Compact is a framework for businesses that voluntarily commit to aligning their operations and strategies with ten universally accepted principles in the areas of human rights, labour, the environment and anti-corruption. Global Compact companies are expected to:

- Set in motion changes to business operations so that the Global Compact and its principles become part of its strategy, culture and day-to-day operations
- Publicly advocate the Global Compact and its principles
- Annually communicate on progress in implementing the ten UN Global Compact principles.

Using either approach for the Project's annual reporting will contribute to a positive corporate reputation.

7.8 Statement of Significance and Compliance

7.8.1 Georgian / Adjara Autonomous Republic Legislation and Policy

In accordance with the legislation in Georgia there are specific actions which the Project must undertake in order to demonstrate compliance.

Table 7.28: Social Laws of Georgia and Project Compliance

Legislative Requirements	How Project Compliance will be Achieved
Land laws	All land required for the Project will be acquired in accordance with Georgian law. AGL will pursue the purchase of land on the basis of negotiation and expropriation will be avoided as far as possible
Labour Code of Georgia and supporting labour laws	The Project will promote fair and safe labour conditions, protect the labour rights and occupational health of employees and ensure that the interests of employees, employers and the state are upheld in accordance with the national law. This will include: observing national minimum wages and requirements regarding hours of work; not restricting the rights of workers to organise and bargain collectively; ensuring rigorous H&S standards are in place; and basing employment decisions on principles of non-discrimination and equal opportunity
OHS laws	
Community health, safety and security	There will be an HIV/AIDS awareness programme and an Emergency Preparedness and Response Plan which will be developed considering the risks to health and safety of local communities
Women's rights and gender equality	AGL's Recruitment Policy which is discussed in the ESMP (Volume IV) will have stipulations for non-discrimination in employment of staff and equal opportunities for all. In addition, women carrying out the same work as men will be paid the same wages. There will be local skills training which will be open to women.

7.8.2 International Compliance

In accordance with the requirements of lending institutions, where adverse impacts have been identified the following table specifies actions which the Project must undertake in order to demonstrate compliance.

7.8.2.1 IFC and EBRD

Table 7.29: IFC Standards, EBRD Requirements and Project Compliance

Performance Standards/Requirements	How Project Compliance will be Achieved
IFC Performance Standard 1 – Assessment and Management of Social and Environmental Risks and Impacts EBRD Performance Requirement 1 – Environmental and Social Appraisal and Management	This ESIA and the ESMP meet the requirements for identification and mitigation of impacts set out in IFC PS1 Consultation is to be guided, monitored, recorded and reported according to SEP Benefit sharing: ■ Provision of training and jobs for local people
IFC Performance Standard 2 – Labour and Working Conditions EBRD Performance Requirement 2 – Labour and Working Conditions	Project commitments to workers' rights in accordance with international standards outlined in HR Policy and implemented across the Project Local skills utilisation Training provided for local people Local procurement Worker Code of Conduct Occupational H&S management and Worker Health and Safety Plan Workers' Accommodation Plan Staff grievance mechanism Retrenchment planning HIV/AIDS awareness sessions Emergency Preparedness and Response Plan Monitoring: ■ Prohibition on use of child labour ■ Payment of minimum wages and overtime ■ Not taking any action to prevent employees from exercising their right of association and their right to organise and bargain collectively ■ Ensuring no workers are charged fees to gain employment on the Project ■ Implementation of plans, procedures and training for occupational health and safety ■ Non-discrimination and equal opportunity ■ Treatment of migrant workers ■ Use of the labour grievance mechanism ■ The existence of human resource policies, job descriptions, written contracts ■ Provision of information to labour force regarding rights and working conditions ■ Employee training activities
IFC Performance Standard 4 – Community Health, Safety and Security EBRD Performance Requirement 4 – Community Health, Safety and Security	Emergency Preparedness and Response Plan Prior warning of changes in water levels Siren warning system before flushing of sediments and dam releases Community Health and Safety Campaign Road safety to be covered in Worker Health and Safety Plan Safety reviews of structures during operation Cultural awareness training for foreign workers Where security personnel are used appropriate due diligence must be performed on the company and the individuals Fencing of dangerous areas Signage warning of changes in water levels

Performance Standards/Requirements	How Project Compliance will be Achieved
IFC Performance Standard 5 – Land Acquisition and Involuntary Resettlement EBRD Performance Requirement 5 – Land Acquisition, Involuntary Resettlement and Economic Displacement	Maintain dossier on land and property acquisition and compensation paid in respect of livelihood impacts. The LALRF will be used to guide land acquisition, purchase of property and compensation paid in respect of loss of livelihoods. A dossier will be maintained of all processes and actions carried out
EBRD Performance Requirement 10 – Information Disclosure and Stakeholder Engagement	Project performance grievance mechanism Implementation of Stakeholder Engagement Plan Community Liaison Officer
IFC EHS General Guidelines (2007) IFC EHS Guidelines for Electric Power Transmission and Distribution (April 2007).	Project commitments to workers' rights in accordance with international standards Occupational H&S management Provision of accommodation to international standards Occupational H&S ■ Management ■ Use of Personal Protective Equipment (PPE) ■ Hazard Operational Studies (HAZOP) to identify hazards and formulate appropriate management plans ■ Use of a formal Permit to Work (PTW) system to ensure that all potentially hazardous work is carried out safely and ensures effective authorization of designated work, effective communication of the work to be carried out including hazards involved, and safe isolation procedures to be followed before commencing work ■ Provision of a first aid provider ■ Monitor and reduce exposure of workers to electromagnetic fields

8. Ecology and Biodiversity

8.1 Introduction

This chapter represents the Ecological Impact Assessment (EcIA) of the Project. It identifies the relevant framework of the legislation and identifies and assesses potential significant adverse impacts, before defining appropriate mitigation and enhancement measures that will be implemented as part of the Project. The baseline includes protected areas, habitats and species with information being used from primary and secondary sources. This Chapter also addresses the potential impact of the Project on ecosystem services.

8.1.1 General Approach

8.1.1.1 Background

Georgia is a signatory of the Convention on Biological Diversity (CBD), whereby the CBD defines biodiversity as “the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems”. As a signatory, Georgia has a responsibility to safeguard its biodiversity and in accordance with Article 14 of CBD as far as possible and as appropriate to introduce procedures requiring environmental impact assessment of proposed projects likely to have significant impacts on biological diversity and to introduce arrangements to ensure environmental consequences of its policies and procedures are duly taken into account.

As a signatory, Georgia is also under obligation to address the Aichi Biodiversity Targets, which includes goals to reduce the direct pressures on biodiversity and promote sustainable use (Strategic Goal B) and to improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity (Strategic Goal C).

8.1.1.2 Spatial Scope

The impact assessment for this ESIA follows the revised IFC Performance Standard 6 (IFC PS6, Jan 2012) guidance on biodiversity conservation and sustainable management of living natural resources. IFC PS6 objectives are:
- To protect and conserve biodiversity
- To maintain the benefits from ecosystem services
- To promote the sustainable management of living natural resources through the adoption of practices that integrates conservation needs and development priorities.

As part of the IFC PS6, it is a requirement that a conservation value is allocated to the ecological features (protected areas, habitats and species) which are likely to be directly or indirectly impacted by the Project within an area of influence (AoI). Under the IFC guidance, the requirements of PS6 apply to projects in all habitats, whether or not those habitats have been previously disturbed and whether or not they are legally protected. Specifically a project is required to:
- Assess significance of project impacts on all levels of biodiversity as an integral part of social and environmental assessment process
- Take into account differing values attached to biodiversity by specific stakeholders
- Identify impacts on ecosystem services
- Assess major threats to biodiversity, especially habitat destruction and invasive alien species.

Habitat destruction is recognised as a major threat to maintenance of biodiversity and to assess likely significance of impacts, PS6 makes the following recommendations depending on habitat status:

- Modified Habitat: exercise care to minimise any conversion or degradation of such habitat, depending on scale of project, identify opportunities to enhance habitat and protect and conserve biodiversity as part of operations.
- Natural Habitat: developer will not significantly convert or degrade such habitat unless no financial/technical feasible alternatives exist, or overall benefits outweigh cost (including those to biodiversity), and conversion or degradation is suitably mitigated. Mitigation measures need to achieve no net loss of biodiversity where feasible, this should be according to mitigation hierarchy, with residual significant impacts addressed through offsettsing and/or set asides of areas managed for biodiversity.
- Critical Habitat: in areas of critical habitat the developer will not implement project activities unless there are no measurable adverse impacts on the ability of the critical habitat to support established populations of species described or on the functions of the critical habitat; no reduction in population of a recognised critically endangered or endangered species and lesser impacts mitigated as per natural habitats, developers must achieve net gain in biodiversity if critical habtitats are affected.

As defined by IFC PS6, a 'critical' habitat is a subset of both natural and modified habitat that deserves particular attention. Critical habitats include areas with high biodiversity value, including: habitat required for the survival of critically endangered species (IUCN red list); areas having special significance for endemic or restricted-range species; sites that are critical for the survival of migratory species; areas supporting globally significant concentration or numbers of individuals; areas with unique assemblages of species; and areas having biodiversity of significant social, economic or cultural importance to local communities.

The new IFC PS6 guidance now recognises the importance of ecosystem services, whereby if a project is likely to adversely impact on ecosystem services, as determined by the impact assessment process, a systematic review to identify priority ecosystem services, and any impacts on Affected Communities must be avoided and impacts on the ecosystem services minimised. Ecosystem services is addressed within PS6 however it is a multi disciplinary topic and cross cutting issue which is relevant to several performance standards. While the results of the assessment have been described within this chapter, consideration has been given to all relevant disciplines.

8.1.1.3 Structure of Report

The structure of this chapter reflects the ESIA process. Section 8.2 provides background information on the assessment criteria and legislative framework for biodiversity, while details on how the baseline information was obtained is provided in Section 8.3. The ecological baseline assessment is provided in Section 8.4, which is sub-divided into protected areas, terrestrial ecology and aquatic ecology. A summary of the likely significant effects is given in Section 8.4. An assessment of the impacts is provided in Section 8.5 and ecosystem services assessment in Section 8.6. Section 8.7 covers the decommissioning impact. The proposed mitigation measures are presented in Section 8.8 and a summary of the residual impacts in Section 8.9.

8.2 Requirements and Assessment Criteria

8.2.1 Overview

This Section provides specific background details on:

- The legal and policy requirements against which to assess the impacts of the Project on biodiversity
- Our general approach in undertaking the ecological impact assessment

- The methodologies used in undertaking the ecological baseline
- The assessment criteria used to determine the impacts of the Project on the ecological baseline.

8.2.2 Legislative & Policy Requirements

8.2.2.1 National Legislation and Guidance

Biodiversity Policy and Strategies

The National Biodiversity Strategy and Action Plan (NBSAP) for Georgia (2005) sets out the goals, objectives and policies for the protection and conservation of biodiversity in Georgia. The NBSAP sets nine strategic goals with the vision that Georgia *"will be a country where biological diversity is sustained and rehabilitated within a political, social and economic context that favours the wise use of natural resources and adequate benefit sharing".*

Legislative Requirements

Georgian environmental legislation is based on existing international concepts and criteria. The key pieces of legislation being:

- Law of Georgia on Protection of the Environment (framework law)
- Law of the General Rules for the Protection of Wild Plants and Animals
- Law of Georgia on Protected Areas
- Law of Georgia on Wildlife
- Law of Georgia on Red List and Red Book
- Forest Code of Georgia.

The Law of Georgia on Protection of the Environment regulates legal relationship between the bodies of the state authority and physical persons/legal entities in the scope of environmental protection and consumption of natural resources on all Georgian territory including its territorial waters, airspace, continental shelf and special economic zones.

The law concerns environmental education, environmental management, economic sanctions, licensing, standards, environmental impact assessment and related issues. The law considers various aspects of ecosystem protection, protected areas, global and regional environmental management, protection of ozone layer, biodiversity and the Black Sea, as well as discussing international cooperation aspects.

The main goals of the law are promotion of biological diversity, conservation of the country-specific, rare, endemic and endangered species of flora and fauna, marine environmental protection and provision of ecological balance. Law defines "*biological diversity conservation principle*", meaning that an activity should not lead to irreversible degradation of biodiversity.

The Law of the General Rules for the Protection of Wild Plants and Animals defines general rules for wildlife and plant protection:

- To maintain self-reproduction of wild plant and animal resources and biodiversity conservation, their extraction from the environment is strictly limited and is a subject to licensing;
- Any activities that could damage wildlife, plants, habitats, reproduction areas and migration routes are prohibited;
- Endangered wild animals and plants are registered in the "Red List" and "Red Book" of Georgia; and

- Any kind of activity regarding wild animals and plants, registered in the "Red List" and "Red Book" of Georgia are prohibited, including: hunting, trade, catching, cutting, mowing, except in special cases, which decreases the plants and animals number, deteriorates their habitats and living conditions.

The Law of Georgia on Protected Areas gives a definition of protected areas (including national parks, reserves, State Preserves and multiple use areas) and sets frameworks of activities, permitted in those areas. Eligible activities are determined according to the area designation, territory legislation, specific provisions and protected area management plans, as well as in accordance with the requirements of international agreements and conventions signed by Georgia. It defines limits of the natural resource use within national parks and other protected areas. Generally, following activities are prohibited in the protected areas:

- To damage or modify natural ecosystems
- To destroy natural resources due to use or other purposes
- To seize, damage or disturb natural ecosystems and species
- To pollute the environment
- To introduce and multiply alien and exotic species of living organisms
- To import into the territory explosive or poisonous materials.

The Law of Georgia on Wildlife provides protection and restoration of the wildlife and its habitats, conservation of species diversity and genetic resources, sustainability and creating conditions for sustainable development, taking into account interests of future generations; legislative provision of the state regulation, regarding animal protection and animal wildlife use.

The Law of Georgia on Red List and Red Book (2003) regulates the Red List of Georgia and Red Book of Georgia, in relation to endangered species protection and their use, with the exception of issues related to aspects of international trade in endangered animals and plants. These aspects are framed in Georgian Legislation through enactment of a law covering the requirements of the convention on “International Trade with Flora and Fauna Species, Endangered by Extinction”, issued in Washington. The main objectives of this law being: providing protection and recovery for endangered species registered on Georgian territory; conservation of species diversity and genetic resources; sustainability and creation of conditions for their sustainable development through use of the Red List and Red Book of Georgia and corresponding legislative regulation on protection and use of endangered species, taking account of present and future generations’ interests.

There are 137 species protected under the Laws in Georgia. Together with species protected by international conventions, the number increases to 200. Most of these are listed in the International Red List (Red Data List of IUCN), Red List of Georgia and in the Conventions’ appendixes.

The Forest Code of Georgia regulations relate to functions and use of forest, including protection, management of water catchment basin, wood production, etc. It allows for private ownership of forest and commercial woodcutting. According to the law, the Forest Department of Georgia does not undertake commercial woodcutting itself, but controls and manages these operations by granting this function to private enterprises. However, the Forest Department carries responsibility for maintenance woodcutting and forest management. According to the Code, the Ministry of Environment Protection and Natural Resources delegated to the Department a right to issue woodcutting licenses. The Forest Code sets categories of protected forests, including those regulating soil and catchment basins, riparian and sub-alpine forest zones, floral species of the Red List, etc. The Forest Code is a framework law and requires execution of detailed regulations.

- At present Georgia has no fisheries law.).

Recently the Ministry of Agriculture (MoA) started to prepare a new law on fisheries for Georgia. Governmental approval of this law is expected to take place in coming years, after which a number of regulations under the law will still need to be produced.

As a member of the Food and Agriculture Organisation of the United Nations (FAO), Georgia has agreed to the Code of Conduct for Responsible Fisheries. Georgia has aimed to be a member of relevant regional and international fisheries bodies such as General Fisheries Commission for the Mediterranean (GFCM), the European Inland Fisheries Advisory Committee (EIFAC), Network of Aquaculture Centres in Central and Eastern Europe (NACEE) and the Black Sea Fisheries Commission, to be established under the Convention for Fisheries and Conservation of Living Resources of the Black Sea (The Commission on the Protection of the Black Sea Against Pollution, 2008).

8.2.2.2 International Conventions

International policies and legislation of relevance include:
- Agreement on Chiropteran Protection in Europe (EUROBATS), (ratified 21.12.2001)
- Agreement on African - Eurasian Migratory Water Birds Protection (AEWA) (Georgia joined 1.05.2001)
- Bucharest Convention on Protection of the Black Sea against Pollution (1994)
- Convention on World Heritage Protection (signed 04.11.1992)
- Convention on Biological Diversity (CBD), 1992 (signed 02.06.1994)
- Convention on Conservation of Migratory Species (CMS), Bonn, 1979 (ratified 11.02.2000)
- Convention on Wetland Protection (Ramsar Convention 1971) (ratified 30.04.1996)
- Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) (1996)
- Convention on Conservation of European Wildlife and Natural Habitats (Bern Convention, 1982) (ratified 30.12.2008)
- Convention on the Protection of the Black Sea against Pollution, signed in Bucharest in 1992.

8.2.3 Consultation

Table 8.1 below summarises the comments received from relevant ecological and biodiversity NGO bodies during the consultation phase and the responses which were provided by the local ESIA team. Additional consultation has been undertaken as part of the Adjaristsqali Hydropower Biodiversity Action Plan (BAP) (Mott MacDonald, 2012). A workshop was held in Batumi on 14 September 2012 and the feedback from the stakeholders has been incorporated into the BAP and the ecological baseline, impacts and mitigation sections of this ESIA.

Table 8.1: Consultation Outcomes from Relevant NGOs

Relevant Consultee	Issues Raised	Response
"Green Alternative"	What methods will be used for calculating the ***ecological flow***?	The ecological flow downstream of the designed dams shall be calculated under consideration of the practice, adopted in Georgia, as well as international standard requirements. The ecological flow will provide water volumes, required for existence of the biological environment and functioning of water consumers downstream of the dam.
	Will ***another meeting*** be held when the scoping report is completed?	Stakeholder meetings will be held after scoping report disclosure, as well as after disclosure of the preliminary ESIA; after disclosure meetings with NGOs will take place.
	Who will be the ***operating company*** of the power plants?	The Project will be the operated by Adjaristsqali Georgia LLC.
	What is to be expected in terms of ***population resettlement***?	Identification of the Project impacted land parcels is finished. After verifying the final designs it will be possible to determine the number of affected land parcels more accurately and detect the number of residents, who will be subject to physical or economic resettlement. According to preliminary data, only a few households will be affected by physical resettlement.
	How do you calculate the ***ecological flow***? At 10%? There are different methods and you should select the best approach.	The ecological flow will be calculated using international standard methods and will take into account local specifics, in particular: the ecological flow will be calculated under consideration of water volumes, necessary for existence of the biological environment and the functioning of water consumers downstream of the dam.
	Is it possible to reflect in the report the importance of the Adjaristsqali River for the ***transport of solid sediment to the Black Sea***? The Chorokhi River is even more important. This issue should be given a separate chapter in the ESIA.	Gamma Consulting company has a team of specialists that will prepare a separate document about possible adverse impacts on the sea coastline development by the Chorokhi River confluence. Sediments, transported by the Adjaristsqali River, play a very small part in the sea coastline development at Chorokhi River marine confluence and their influence is mainly related to the operation of existing dams on the territory of the Turkish Republic.
Georgian Green Movement, co-chair	The possible impact on ***fish*** is quite serious, especially the impacts on Salmon.	Gamma's ichthyologist, provided with guidance from Mott MacDonald specialists, is studying the ichthyofauna baseline conditions. For the ichthyofauna in general, as well as for the Black Sea Salmon appropriate mitigation measures will be elaborated, including development of salmon farming for its artificial reproduction.
	There is an evaluation of water run off in the Caucasus region that was prepared in April (2011) by the UNCC. It suggests that river water will be significantly reduced in the future. The people involved in climate change should see this report.	Thank you for your information. We will surely take into account materials, provided by this document, when elaborating the assessment of possible climate changes.

Relevant Consultee	Issues Raised	Response
	The most significant impact of this Project is the ***impact on biodiversity***. Therefore, we request that as soon as the biological part, i.e. flora and fauna, is completed, and the final location of the infrastructure is specified, a discussion of this chapter is arranged.	The investor would not oppose this suggestion of additionally discussions with non-governmental organizations. It would be better if all the problematic issues are discussed intensively. A meeting should be held after the disclosure of the preliminary ESIA report, which we will discuss with you.
Association "Flora and Fauna"	What research has been undertaken to examine ***the ichthyofauna***? And who is undertaking this survey? When will these materials be available for review?	The study was carried out by reviewing the existing literature sources. An ichthyologist is currently carrying out field work (which include control fishing, interviewing local fishers, identification of species according to standard methods, etc.). The research is carried out by an ichthyologist from Gamma Consulting, Mr. Archil Partsvania, under guidance from Mott MacDonald specialists. The materials will be available for review in the preliminary ESIA report, which will be disclosed so that people can comment on it. In addition we will introduce you the research materials and receive your comments and suggestions.
	Will the ***geology, and possibility of landslides*** *in the area* be considered?	Engineering-geological, topographic and seismic surveys of the Project area are being carried out; all landslide zones will be explored, the design solutions will be adopted based on results of these studies.
Wildlife Protection Society "Chobi"	Why was Adjaristsqali River gorge chosen? This is an area susceptible to ***landslides*** with unique biodiversity, especially at Shuakhevi high conservation forest grove. In addition, presumably climate change is anticipated. Is a map of landslide areas provided?	According to the energy policy of the Georgian government, the utilization process of existing hydro potential has begun in the country. Adjaristsqali River is very important in terms of the hydro-energy potential and the Project construction will be implemented sooner or later anyway. Our main goal is to implement the Project under consideration of environmental and social risks. Lower-risk areas should be selected for installation of the Project facilities/communications and mitigation measures should be implemented to minimize the negative impacts. Identification of the areas, sensitive to landslides and erosion will include pre-design research (engineering geology, topography and seismic surveys); after their completion it will be possible to identify the zones at risk of landslides and develop maps accordingly.
	Shuakhevi region, in particular the Chirukhistsqali River gorge is very important in terms of ***eco-tourism***. Will the hydropower facilities prevent the development of tourism in this region?	Impacts on the region's tourism potential should be reviewed during the ESIA preparation, as the tourism is important to the Adjara region. If the Project goes to plan and the necessary mitigation measures are considered, neither Chirukhistsqali River gorge eco-touristic potential nor the region's tourism development in general will be negatively impacted. Tourism infrastructure development, can include the possibility of the reservoirs being used for recreation purposes.

8.2.4 Methodology

8.2.4.1 Ecological Area of Influence

An ecological impact assessment needs to identify all ecological features which occur within the areas which are likely to be affected by a project, this area being known as the AoI. As part of this ecological assessment, all ecological features within the AoI of each of the Project components were reviewed (following a reconnaissance visit) and specific surveys undertaken for specific taxa and specific locations. The AoI includes:

- Areas directly within the land take for the Project
- Areas which will be temporarily affected during construction, including access routes, site compound
- Areas likely to be impacted by hydrological disruption
- Areas where there is a risk of pollution and noise disturbance during construction and/or operation.

For this assessment, the AoI was considered as the 90 km stretch of the Adjaristsqali River, with the top of the Scheme beginning at the confluence of the Adjaristsqali and Ghojomi Rivers, all the way down to the confluence of the Adjaristsqali and Chorokhi River. It also encompasses a number of tributaries which include the Chirukhistsqali, Skhalta, Chvanistsqali, Akavreta, and Machakhlistsqali Rivers.

The ecological baseline within the AoI was formulated from information obtained from various primary and secondary sources. Details on the methodologies used are provided in the following Sections.

8.2.5 Previous Studies

A detailed desk-based review of available information from national and international sources was undertaken. This included information from international databases and information held by various international NGOs and by individual Ministerial departments in Georgia.

A review was undertaken to gather information on the ecological requirements of various fish species present in Georgia. Databases such as Fishbase, the IUCN web site and other online resources were researched.

8.2.6 Reconnaissance & Ecological Surveys

8.2.6.1 Overview

In May 2011 a field reconnaissance was undertaken by Mott MacDonald and Gamma ("Local Environmental Consultant") environmental staff and by the Project engineers, with the objectives to:

- Understand the nature and size of the Project
- Influence the outline design of the Project so as to avoid or minimise the environmental impacts
- Gain an appreciation of the general environmental and ecological value of the areas in which the Project would be taking place
- Identify those areas which were regarded as being of biological importance and potentially more sensitive to impacts
- Agree upon the ecological survey protocols and survey areas.

Detailed ecological surveys of areas of specific interest and sensitive to potential disturbance within the AoI to inform the ecological baseline for the ESIA were undertaken by Gamma between May and October

2011. The full and detailed reports of the baseline surveys are included in ESIA Volume III Appendix D. The ecological surveys undertaken by Gamma included:

- Descriptions of the vegetation types
- Floristic surveys
- Birds surveys
- Mammal surveys (including bats)
- Reptile and amphibian surveys
- Fish surveys.

The ecological surveys as part of this ESIA were undertaken throughout the AoI; these locations were identified as either being of ecological interest at each of the different components of the Project. All surveys were undertaken by qualified local ecologists with regional knowledge and experience of flora and fauna in Georgia Table 8.2 below provides a summary of local and international experts who undertook the biodiversity surveys and assessments.

Surveys for autumn migratory birds (carried out by Batumi Raptor Count) and habitats/flora were carried out in September and beginning of October 2012 as part of the electricity transmission line routing study. A botanical walkover of the sites likely to be affected by the Project on the Shuakhevi Scheme was undertaken in September 2012 by Mott MacDonald botanists. In addition, fish surveys were repeated in August 2012.

Table 8.2: Local and international specialists

Discipline	Local Expert	International Expert
Flora	Ms. Nino Tsqvitishvili; Mr.Gia Chelidze; Ms. Mariam Qimeridze	Dr. Mark Johnston
Fauna	Mr. Bukhnikashvili Alexander; Mr. Gia Edisherashvili; Mr. David Bekoshvili	Dr. Mark Johnston
Aquatic Ecology and Fisheries	Mr. Archil Partsvania	Nicole Price and Dr. Celia Figueira

Vegetation and Floristic Surveys

Description of the habitats and an inventory of the floristic diversity within the areas around each component of the Project were undertaken in May-June 2011. Additional habitat and flora surveys were undertaken in September 2012 as part of the electricity transmission line routing study and to inform the BAP. The main habitat types were identified and plant species lists were recorded. The focus was on recording the plant species listed in the Red Data Book of Georgia, Adjara Plant Red List or Caucasus List of Endemic Plants, and not to record a comprehensive species list for each site.

8.2.6.2 Bird Surveys

Birds are observed in routes, transects and registration sections. Legally protected species and their nests, and concentration areas were registered and identified as areas important for the species. Surveys for bird numbers were carried out by various standard methods (separately for lowland and mountainous landscapes) including by detection of bird song for forest species.

Vantage point surveys for migratory birds were undertaken between 18 September and 4 October 2012. The counts were conducted by an experienced raptor counter, and two assistant birdwatchers. Birds were found by eye, or by scanning the sky with binoculars or telescope. When a bird was found, an estimation of the height at which the bird was flying was made.

8.2.6.3 Mammal Surveys

Large and medium-sized mammals were recorded based on footprints findings in 1-5 km routes and transects, as well as visual sightings, in the daytime and at night. Species composition and number of small mammals were determined by standard methods of trap-lines (by means of live catching traps). This approach allowed determination of a percent of species that were caught in the traps per 100 trap-days. In order to determine the presence of moles evidence of ground diggings are registered.

Chiropterans (including bats) are recorded during long term observations in routes, as well as in transect, forests, lanes, separate trees, underground hideouts, buildings and reservoir banks. Chiropterans are registered both visually and by means of ultrasonic detectors - Pettersson D 200 and Pettersson D 240. Existence of large numbers of a specific species within a small area indicates likely presence of a colony. In this case the colony is registered and its approximate size is detected.

8.2.6.4 Reptile & Amphibian Surveys

A key habitat, including ponds, river edges and riparian habitats were hand searched for reptiles and amphibians, including searches under natural hibernacula. Records of individual sightings while undertaking other surveys were also noted.

8.2.6.5 Fish Surveys

2011 Surveys

A series of surveys were undertaken from 25 August to 3 September 2011, which included a walkover within the AoI and subsequent field surveys for fish, zoo-benthos and interviews with fishermen. Detailed results are presented in the Fish Survey Report (Gamma, 2011) which is included in Volume III Appendix D.3 of this ESIA.

Based on the preliminary project layout options, the main rivers and tributaries were divided into separate sampling reaches, with each reach encompassing one dam or one weir. A walkover survey was then undertaken to identify suitable survey sites which encompassed a range of different habitats available for fish as well as the identification of sensitive sections, these included:

- Shallow stony water riffles for fish that need flowing water;
- Fast flowing rapids for fish needing oxygen rich water;
- Marginal vegetation with overhang that acts as a cover for smaller species;
- Deeper flowing channels for potentially some larger fish;
- Deeper slack water pool margins for other fish; and
- Identification of key sensitive sections (i.e. spawning sites).

A total of 11 sites were selected with a range of different morphological conditions so as to detect as many fish species as possible.

Ichthyology and zoo-benthos (prey for fish) samples were taken using established techniques (Spork *et al.*, 2006 in Gamma, 2011), these included gill nets, landing nets, throwing nets, fishing rods and dragnets for fingerlings. Fish were sorted according to species and counted. The relative numbers were expressed as the number of fish caught per one meter of net, in case of the dragnets used for fingerlings – per 1 m^3, in case of use of throwing nets – per each 1 m^2 of the river bottom. Various keys were used to identify the fish species.

Zoo-benthos samples were obtained using established techniques with approximately two to three samples collected within each river section and within a 0.25 m^2 area.

2012 Surveys

The Draft ESIA Report submitted in March 2012 proposed the implementation of an environmental monitoring system in which annual fish surveys are included. This monitoring programme has started in summer 2012 with the first year of fish surveys complete in August 2012. A brief summary of the results is included in this report as full data analysis has not yet been finalized.

8.2.6.6 River Habitat Surveys

Along with fish surveys, river habitat surveys where also conducted in 2012 to map different meso-habitats in the following rivers:

- Adjaristsqali River;
- Chirukhistsqali River; and
- Skhalta River.

Details on the methodology as well as preliminary results are present in Chapter 10 of this ESIA.

8.2.6.7 Interviews with Fishermen (2011)

Local fishermen were interviewed to obtain further information on the fish present (e.g. general species including any rare, protected and/or migratory species), preferred areas, as well as identification of any known sensitive areas (e.g. spawning sites). These interviews would also provide information on how socio-economically important fishing is to the local community. Fishermen were provided with a map showing the location of the proposed development and were asked to clearly mark on the preferred areas for certain species (including upper and lower territorial limits) and sensitive areas.

Local fishermen were then interviewed using a questionnaire, with each fisherman interviewed separately. The information obtained was considered reliable, if it was confirmed by more than three fishermen. The field survey time coincided with the fishing ban period (May-August), nevertheless 20 fishermen were interviewed. The questionnaire is provided in Volume III, Appendix D5.

8.2.7 Assessment of Impact Significance

8.2.7.1 Determining Sensitivity and Magnitude

In accordance with IFC PS6, the conservation value (sensitivity) or weighting attributed to each ecological feature which occurs within the AoI of the Project needs to be undertaken, and these are defined in Table 8.3. The magnitude of the potential impacts upon each feature (Table 8.4) is then assessed for the construction and operation of the Project.

Table 8.3: Criteria for Determining Conservation Value (Sensitivity of the receiving environment)

Conservation value (sensitivity)	Examples	Species criteria	Habitat or Site Criteria
Very High	Very high importance and rarity. International scale with limited potential for substitution.	IUCN Critically endangered and endangered species.	Internationally designated sites (or equal status). Critical habitats of significant international ecological importance.
High	High importance and rarity, national scale, or regional scale with limited potential for substitution, species of international status but not within designated areas.	IUCN Vulnerable species. European species and nationally protected species of significant population size and importance.	Nationally designated sites (or equal status). Areas of critical habitats of national ecological importance, and natural habitats of significant ecological importance and/or high biodiversity with limited potential for substitution.
Medium	High or medium importance and rarity, local or regional scale, and limited potential for substitution, species of national status but not within designated areas.	IUCN Near Threatened species. Nationally protected species or rare species, but not a significant population size and not of national importance.	Regionally important natural habitats. Natural habitats. Modified habitats with high biodiversity or under significant threat of loss within the region.
Low	Very low or low importance and rarity, and local scale.	IUCN Least Concern. Species of local national importance.	Undesignated sites and habitats of natural habitats of some local biodiversity and cultural heritage interest. Modified habitats with limited ecological value. Other sites with little or no local biodiversity and cultural interest. Modified habitats with limited biodiversity value.
Negligible	Very limited ecological importance.	IUCN Least Concern species. Species of no national importance.	Highly modified habitats of no biodiversity value.

Table 8.4: Guidelines for Definition of Magnitude in the ESIA

Magnitude (positive or negative)	Definition (considers duration of the impact, spatial extent, reversibility and ability of comply with legislation)
Major	Fundamental change to the specific environmental conditions assessed resulting in long term or permanent change, typically widespread in nature (regional national and international), would require significant intervention to return to baseline; exceed national standards and limits.
Moderate	Detectable change to the specific environmental conditions assessed resulting in non-fundamental temporary or permanent change.
Minor	Detectable but minor change to the specific environmental conditions assessed.
Negligible	No perceptible change to the specific environmental conditions assessed.

8.2.7.2 Assigning Significance

The significance has been determined by the interaction between the magnitude of impacts and the sensitivity of receptors affected, as depicted in the significance matrix shown in Table 8.5, following the EIA methodology in Section 5.3.4.4.

Table 8.5: Impact Significant Matrix

Magnitude of Impact	Sensitivity of Receptors			
	Negligible	Low	Medium	High / Very High
Negligible	Insignificant	Insignificant	Insignificant	Insignificant
Minor	Insignificant	Minor	Minor	Moderate
Moderate	Insignificant	Minor	Moderate	Major
Major	Insignificant	Moderate	Major	Critical

As part of the impact assessment, appropriate mitigation measures are reviewed and included to minimise any potential adverse impacts of the Project on biodiversity. The residual impacts are then determined.

8.2.7.3 Assessment of Cumulative Impacts

Cumulative impacts are those impacts that may result from the combination of past, present or future actions of existing or planned activities in a Project's AoI. While a single activity may itself result in an insignificant impact, it may, when combined with other impacts (significant or insignificant) in the same geographical area and occurring at the same time, result in a cumulative impact that is significant.

The assessments within this ES have included, where relevant, an assessment of the cumulative impact of the Adjaristsqali Project with other present and planned developments in the AoI.

8.2.8 Approach to Biodiversity Mitigation

Mitigation measures detailed in the ESIA will be developed around international best practice and adherence to the general policies for biodiversity conservation in Georgia. Mitigation measures proposed will follow the mitigation heirarchy as defined within PS6 of avoidance, minimisation, and restoration. All mitigation meaures will be documented within a Biodiversity Action Plan (BAP) for the Project. The biodiversity approach in the ESIA and BAP are summarised as follows:

- Aim for conservation and "no net loss" of biodiversity (positive planning for biodiversity)
- Take an ecosystems approach (framework for biodiversity conservation)
- Seek sustainable use of biodiversity resources
- Ensure equitable sharing of biodiversity resources
- Apply the precautionary principle
- Take a participatory approach.

Depending on the nature and significance of residual impacts, biodiversity offsets may need to be considered. Biodiversity offsets are measurable conservation outcomes resulting from actions designed to compensate for significant adverse biodiversity impacts arising from project development and persisting after appropriate avoidance, minimisation and restoration measures have been taken.

8.2.9 Data Limitations

The ecological surveys only focused on the typical habitats and areas of ecological interest. Due to the large scale of the Project it was neither possible nor practical to survey the entire 90 km length of the Adjaristsqali River and all its tributaries. As such, unexpected ecological features may arise during the course of construction and operation work. Where possible this assessment has considered the nature of potential unexpected ecological features and this is addressed directly in the ESMP (Volume IV).

8.3 Baseline Description

8.3.1 Regional Biodiversity Importance

Georgia is located within the southern Caucasus region, a region of rich and diverse flora and fauna. The Caucasus region has been identified as a Global 200 ecoregion (by the WWF) and biodiversity hotspot as one of the top 25 biological rich regions (by Conservation International). Faunal diversity is also rich across the region, although the key interests are in the habitat and floristic diversity. The region is also of particular importance for agrobiodiversity, with Georgia regarded as one of the centres of origin of domestic plant species. This rich diversity being explained because of its juncture between two land forms between the Black Sea and the Caspian Sea, the variation in landscapes and variations in climatic conditions. The region as a whole is therefore considered to be of very high conversation value.

While the Adjaristsqali river system is within this ecoregion, the area within which the Project is located is degraded with agricultural expansion and village settlements along the entire length of the river basin.

8.3.2 Protected Areas for Nature Conservation

There are three nature conservation areas within 10 km of the Project: Kintrishi Nature Reserve and Important Bird Area, Machakhela National Park and Mtirala National Park (Figure 8.1). Brief descriptions of these sites are provided below.

Kintrishi Nature Reserve and Important Bird Area

The Kintrishi Nature Reserve, Protected Landscape and Important Bird Area (IBA) has an area of 13,893 ha and is located approximately 5 km north-west from the Project (Koromkheti Scheme). It is protected for its important habitats (broad-leaved deciduous forests, alpine/subalpine/boreal grasslands, rocky areas and wetlands) and bird species, notably the Caucasian grouse (*Tetrao mlokosiewiczi*), listed as 'near threatened/decreasing' on the IUCN Red List, and Caspian snowcock (*Tetraogallus caspius*), listed as 'least concern/decreasing' on the IUCN Red List.

The Kintrishi IBA site supports at least two of the 10 species in Europe that are restricted (when breeding) to the Eurasian high-montane biome. Other notable species that do not meet IBA criteria and are present in the Kintrishi IBA include: *Falco naumanni, Gypaetus barbatus*, *Aquila chrysaetos* and *Falco peregrinus;* all these species are listed as being of 'least concern' on the IUCN Red List (IUCN, 2012). The Birdlife International information sheet for Kintrishi IBA can be found in Appendix D of this report.

Machakhela National Park

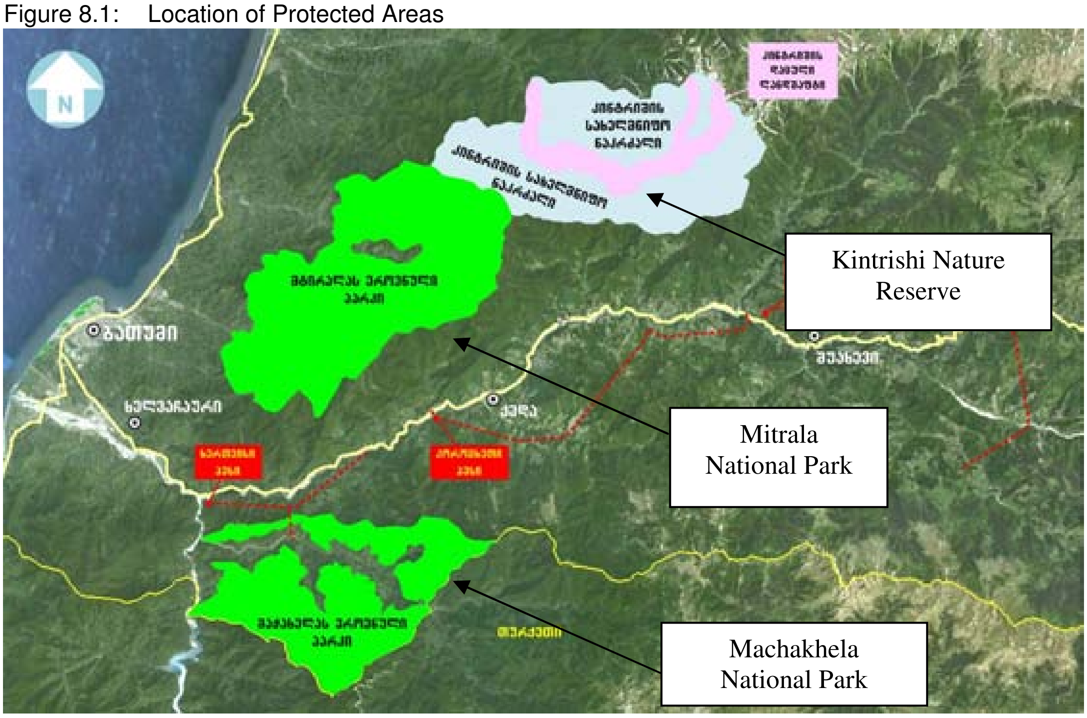
To the south of the Adjaristsqali River is the Machakhela National Park, which was designated in May 2012. A USAID funded project has facilitated the transboundary cooperation and the development of an action plan for Machakhela-Jamili transboundary park between Georgia and Turkey (http://map.usaid.gov/ProjectDetail?id=a0cd00000012aSaAAI).

Machakhlistsqali River is currently outside the park boundary, but it is understood it will be incorporated in the near future. Machakhlistsqali River feeds into the Chorokhi River and is upstream of the confluence with the Adjaristsqali River. A run of river weir and sediment trap, as part of the Khertvisi Scheme, are located within the Machakhlistsqali River. The Machakhlistsqali valley is characterized by a unique variety of relict and endemic plants. Approximately 10,868 ha of the Machakhlistsqali valley is covered by forests, 75% of the territory is represented by virgin forests. Most of the territory of the valley is occupied by the colchic type mixed forests with domination of beech.

Mtirala National Park

This park is located approximately 4.5 km to the north-west of the Adjaristsqali River. Mtirala National Park was established in 2006 through initiative of the Government of Adjara Autonomous Republic and the Agency of Protected areas of the Ministry of Environment Protection and Natural Resources, with WWF's assistance and financial support provided by the Norwegian Government. This park is within the Adjara-Imereti Range, which is characterised by a humid climate and is covered with relict Colchic forests. Mtirala National Park is a model protected area in Georgia, combining conservation with mountain tourism and ecotourism.

Figure 8.1: Location of Protected Areas



8.3.3 Terrestrial Ecology & Biodiversity

8.3.3.1 Vegetation across the Adjara Region

A detailed description is provided in the Flora and Vegetation Report (Gamma, 2011) in Volume III Appendix D1, with a summary provided in this Section.

Forests represent over 37% of the total land cover of Georgia, and 68% of the Adjara river basin. The forest vegetation is of particular importance due to the endemic mixed broad-leaved forests and its associated relic flora and European forest flora.

The Adjara flora, as all vegetation typical for mountainous countries, is characterised by vertical belting. In the Adjara lowland little of the natural habitats remain due to agricultural intensification. Such forests are formed by hornbeam (*Carpinus caucasica)*, Imeretian oak (*Quercus imeretina)*, ash (*Fraxinus excelsior*), Khertvisi oak (*Quercus hartvissiana*), elm (*Ulmus elliptica*), lime (*Tilia caucasica*), persimmon (*Diospyros lotus*). These forests are characterized by well developed understory, which in some areas is formed by deciduous shrubbery: pontic azalea (*Rhododendron luteum*), buckthorn (*Rhamnus imeretina*), spindle tree (*Evonymus latifolia*), bladder nut (*Staphylea colchica, St. pinnata*), hazel nut (*Corylus avellana, C. pontica*), etc and in other areas by evergreen understory, such as: holly (*Ilex colchica*), rhododendron (*Rhododendron ponticum*), Colchic holly (*Ruscus hypophyllum*). In these forests, especially within lowlands, liana vegetation is also abundant. In some thinned areas the vegetation is so abundant, that access is impossible. The described forests are located up to 500 m above sea level (masl).

The vegetation in the middle montane zone ranges from 500 m to 2,150 m asl and is rich with plant communities reflected in the occurrence of the numerous trees and shrub species as a result of diverse ambient conditions and impacts of human economic activities. Beech forests are common in the middle montane zone, but do not exist in the areas where annual precipitation is less than 500 mm. Beech forests with evergreen understory are widely distributed around Adjara highlands. The understory is formed by Pontic rhododendron, Black Sea holly, cherry-laurel (*Prunus laurocerasus*), in some areas by *Rhododendron ungernii.* On the less humid slopes, the predominant type of beech forest is comprised of beech shrubs. In these forests the understory is formed by deciduous bushes, e.g. yellow azalea (*Rhododendron luteum*), Caucasian whortleberry (*Vaccinium arctostaphyllos*), and common hazel.

Hornbeam forests are found in combination with beech formations, particularly in the lower part of beech distribution area, approximately up to 1,100 masl. Individual hornbeams mixed to the beech forest may be found even at higher altitudes. The hornbeam stands develop in the various soil conditions. For example, in the lowlands hornbeam grows in the podzol soils, and in other areas in the humus-rich carbonate and brown forest soils. Structurally and floristically hornbeam forests are similar to the beech forests and comprise the analogous forest types, but are developed over significantly smaller areas. In Adjara, as well as around the entire West Georgia, hornbeam forests are often replaced with black alder stands mainly due to human economic activities. Specifically the alder is extensively propagated after felling of the hornbeam forests that often results in formation of the mixed alder and hornbeam stands.

The coniferous forests are extensively distributed in Adjara within a range of 900-1,000 m to 2,000 m, although the pine forests are also found at significantly lower elevations, over the southern slopes of lower reaches of Adjaristsqali River. Adjara pine forests are distributed fragmentally and are dominated by *Pinus kochiana*. The pine forests have open canopies, and thus shrub and herbaceous synusiae are well developed. The forests with closed canopies are formed by spruce (*Picea orientalis*) and fir (*Abies nordmanniana*), and therefore in these forests shrub and herbaceous understories are rare. Typologically, such forest type is associated with beech forests. The fir in combination with the beech often forms co-dominant coenoses, which are quite common in the Adjara highland. Other coniferous forest extending over the larger areas are represented by pure spruce, spruce-and-fir and pure fir stands, mostly found at the upper tree line.

The area above the forests described above is occupied by the subalpine zone, which has an upper boundary elevated in average up to 2,200-2,300 masl. No component of the Project reaches into this subalpine zone.

8.3.3.2 Habitats & Floristic Diversity

Overview

A detailed description is provided in the Flora and Vegetation Report (Gamma, 2011) in Volume III Appendix D1. A summary of the habitats within the Project AoI is provided in Table 8.5 and brief description is provided below.

The fast flowing rivers, riverine deposits, river beds, bare rock and modified riverside grasslands along the corridor of the river system are the dominant habitats throughout the Project AoI (Appendix D1). Up the side of the river gorges open areas of bare rock with scattered trees graduate into various forest habitat types of varying conservation value. In accessible areas, agricultural habitats (fields managed by local farmers with scattered cultivated trees) dominate, which has lead to erosion and localised landslips.

The forest habitats within the Project AoI are the most important habitat for biodiversity, although their conservation value varies depending on the species composition and degree of disturbance. Forest habitats in the lower Schemes (Khertvisi) are typically patchy, deciduous, partly modified and of low to medium conservation value. Within the areas of the Koromkheti Scheme there are patches of natural, high conservation value forest types, typically mixed-species deciduous forests, including oak, hornbeam and chestnut forest types. At higher elevations (Shuakhevi Scheme) the forest habitats change with a gradual increase in the abundance of conifer tree species. Immediately along the river and road access areas, these forests are typically natural, but degraded, mixed deciduous & coniferous forests of medium conservation value.

Figure 8.2: Typical riverine habitats along the Adjaristsqali

Source: Mott MacDonald

Figure 8.3: Typical forest habitats of the Koromkheti & Khertvisi Schemes: beech woodland habitats graduating into grazed grassland habitats down to the river

Source: Gamma

Figure 8.4: Typical agricultural areas which dominate the bank of the Adjaristiqali River

Source: Mott MacDonald

Habitats around the Shukhevi Scheme

The key habitats of the Shukhevi Scheme area are as follows:

- On the Chikhuristsqali River; downstream of village of Karapeti; man-made walnut plantation are scattered across the gorge. Tree storey is represented by the following species: *Juglans regia, Alnus barbata, Picea orientalis, Carpinus caucasica.* Shrubs include the following species: *Crataegus microphylla, Rubus sanguineus, Hedera colchica*. Herbaceous species include: *Fragaria vesca, Sanicula europaea, Bellis perenis, Poa* sp., *Cyclamen coum ssp. caucasicum (C. vernum), Salvia glutinosa, Cynaglossum officinale, Tamus communis, Phyllitis scolopendrium, Asplenium trichomanes;*

- Also the Chirukhistsqali has patches of degraded spruce forest (due to felling activities). The following tree species are represented: *Picea orientalis, Carpinus caucasica, Alnus barbata, Salix caprea*. Herbaceous plants include *Pteridium tauricum;*
- Along the tributaries off the Adjaristsqali areas of Pontic rhododendron scrub (*Rhododendron ponticum*) occur (of high conservation value) together with degraded spruce forest; the following plants form the tree storey: *Picea orientalis, Populus tremula, Alnus barbata, Corylus avellana, and Thelycrania australis;*
- At the Confluence of the Didadjaristsqali and Adjaristsqali Rivers downstream of Didadjara village, the riverside terrace consists of *Salix alba, Robinia pseodocacia* and *Alnus barbata; and*
- Along the gorge of the Adjaristsqali natural oak forest (*Quercus petraea ssp. dschorochensis*) occur with patches of pine and spruce forest (*Pinus kochiana, Picea orientalis*) which are of high conservation value. Slightly further downstream degraded (due to felling) spruce forest with admixed *Quercus petraea ssp. dschorochensis, Fagus orientalis, Ulmus glabra, Carpinus caucasica.*

Habitats around the Koromkheti Scheme

The key habitats around the Koromkheti Scheme are as follows:

- At the confluence of Akavreta and Medzibnis Gele rivers natural mixed deciduous forest of high floristic diversity occur with *Castanea sativa*, *Alnus barbata*, *Acer campestre*, *Rhododendron ponticum*, *Prunus larocerasus* (*Laurocerasus officinalis)*, *Hedera colchica, Aristolochia pontica, Tamus communis, Arum albispathum, Oxalis acetosella, Phyllitis scolopendrium, Driopteris filix-mas,* and *Pteris cretica*. The spruce trees rarely grow in the liana-rich mixed deciduous forest;
- On the Adjaristsqali River; at Phurtio Bridge, natural oak and hornbeam forest occur above the riverside with *Carpinus caucasica, Acer campestre, Fraxinus angustifolia ssp. oxycarpa, Crataegus sp., Mespilus germanica, Robinia pseudoacacia, Prunus divaricata, Pteridium tauricum, Eupatorium cannabinum, Sambucus ebulus, Arctium lappa, Helleborus caucasicus, Fragaria vesca, Cicerbita macrophylla, Digitalis ferruginea* ssp. *schischkinii,* and *Campanula cordifolia;*
- Along the edges of the Adjaristsqali River on the rocky riverside terrace the habitats are dominated by tree vegetation composed of *Alnus barbata*;
- Patches of Hop-hornbeam (*Ostrya carpinifolia*) and elm-leaved sumach (*Rhus coriaria*) forest type also occur; and
- Downstream of the Village of Khokhona and its surroundings natural chestnut forest can be found with mixed cherry-laurel forest occur with *Castanea sativa, Acer campestre, Alnus barbata*. *Castanea sativa*; *Acer campestre, Alnus barbata,* and shrub species including *Prunus laurocerasus* (*Laurocerasus officinalis), Rhododendron ponticum, Staphylea colchica, Ilex colchica.* Herbaceous cover comprises *Smilax excelsa, Hedera colchica, Phyllitis scolopendrium, and Asplenium trichomanes.*

Habitats around the Khertvisi Scheme

The key habitats around the Khertvisi Scheme are as follows:

- At the confluence of Chorokhi and Adjaristsqali Rivers. The riverside terrace act as a floodplain during high flow and are inundated, supposedly, with water level rising over the slope up to 3 m height. The species observed include *Alnus barbata* and *Salix alba*;
- The areas along the Machakhela River largely consist of treeless riverside terrace and adjoined agricultural landscape, as well as degraded (due to felling) alder forest mixed with cherry-laurel, lime-tree, hornbeam and maple. Herbaceous cover is formed by the following species: *Vinca herbacea, Phyllitis scolopendrim, Sanicula europaea, Pteridium tauricum, Ranunculus* sp., *Urtica dioica, Driopteris filix-mas,* etc. Shrub species noted include *Rubus sanguineus, Coryllus avellana* and *Lonicera caucasica; and*

- On the Chorokhi River a fragment of hornbeam-chestnut forest is visible downstream of the alignment, at the right riverbank, with *Castanea sativa, Carpinus caucasica, Hedera colchica, Pteridium tauricum, Phyllitis scolopendrium, and Polipodium vulgare*. At the right riverbank, on the riverside rocky terrace grow *Alnus barbata, Robinia pseudoacacia,* and *Salix alba.*

Protected and Notable Flora of the Adjaristsqali

The region, including the Adjara gorge and areas within the Project AoI, are well known as being of significant botanical interest with high floral diversity and refugia for genetic diversity of domestic cultivars. Hence, detailed floristic surveys were undertaken as part of this Project. Six plant species included in Georgia Red Data Book and Adjara Plant Red List were identified in the AoI: *Castanea sativa*, *Juglans regia*, *Ostrya carpinifolia*, *Quercus hartwissiana*, *Staphylea colchica*, and *Ulmus glabra*. Of these, *Staphylea colchica* is listed as vulnerable on the Red List of Endemic Plants of the Caucasus Region.

Besides the above-mentioned, populations of some rare, endangered and vulnerable species also occur within the Project AoI: *Prunus laurocerasus* (*Laurocerasus officinalis), Hedera colchica, Vinca herbacea, Digitalis ferruginea ssp. schischkinii (D. schischkinii)*, *Helleborus caucasicus* (threatened species), *Tilia rubra ssp. caucasica (T. caucasica), Quercus petraea* ssp. *dschorochensis (Q. dschorochensis), Pyrus caucasica, Fraxinus angustifolia ssp. oxycarpa (F. oxycarpa), Origanum (Amaracus) rotundifolium*, *Ficus carica*. *Cyclamen coum* ssp. *caucasicum* (C. *vernum*) is locally rare and protected by the Convention on International Trade in Endangered Species (CITES).

Table 8.6: Summary of Terrestrial Habitat Types within the Project Zone of Influence

Habitat Type	IFC Category	Conservation value	Shuakhevi	Koromkheti	Khertvisi
Oak forest – Quercus petrea subsp. dschorochensis	Natural	High	X	X	
Hornbeam-chestnut forest – Castanea sativa, Carpinus caucasica	Natural	High		X	X
Oak & hornbeam forest - Carpinus caucasica with Quercus petrea subsp. dschorochensis or Quercus hartwissiana	Natural	High		X	
Mixed,species rich deciduous forest with Colchic understorey- Castanea sativa, Aristolochia pontica, including Quercus	Natural	High		X	
Liana-rich mixed deciduous forest with mixed spruce trees – Picea orientalis, Carpinus caucasica, Alnus barbata, Salix caprea	Natural	Medium	X		
Chestnut forest with mixed cherry-laural – Castanea sativa, Acer campestre, Alnus barbata	Natural	Medium		X	
Degraded spruce forest with mixed species – Quercus dshorochensis, Fagus orientalis, Ulmus glabra, Carpinus caucasica	Natural	Medium	X		
Alder forest – Alnus barbara dominant	Natural	Low	X	X	X
Walnut plantation – Juglans regia, Alnus barbata, Picea orientalis	Modified	Low	X		
Riverine forest & scrub – Salix alba, Robinia pseudoacacia, Alnus barbata	Natural	Low	X	X	X
Pontic rhododendron scrub	Natural	High	X		
Riverside grassland- river terrace typically used for agricultural/grazing purposes	Modified	Negligible	X	X	X
Bare rock, cervices and riverside deposits	Natural	Low	X	X	X

Table 8.7: Summary of Protected and Notable Flora within the Project Area of Influence

Latin name	Common name	Conservation value	Georgia Red Data Book status	IUCN Red Data Book status	Shuakhevi	Koromkheti	Khertvisi
Castanea sativa	Chestnut	Medium	VU	LC		X	X
Juglans regia	Walnut	Medium	VU	LC	X	X	X
Ostrya carpinifolia	European hop hornbeam	High	EN	LC		X	
Quercus hartwissiana	Hartvisian oak	Medium	VU	LC	X	X	
Staphylea colchica	Colchic bladdernut	Medium	VU	LC		X	
Ulmus glabra	Elm	Medium	VU	LC	X	X	X
Lauricerasus officinalis	Cherry-laural	Low	Locally rare	LC		X	X
Hedera colchica	Ivy	Low	Locally rare	LC	X	X	X
Vinca herbacea	Periwinkle	Low	Locally rare	LC		X	
Digitalis schisckinii	Foxglove	Low	Locally rare	LC		X	
Helleborus caucasicus	Helleborine	Low	Locally rare	LC		X	
Tilia caucasica	Caucasian lime	Low	Endemic	LC		X	
Quercus petrea dschorochensis	Sessile oak	Low	Endemic	LC	X	X	X
Pyrus caucasica	Pear	Low	Endemic	LC		X	
Fraxinus oxycarpa	Caucasian ash	Low	Locally rare	LC		X	
Lonicera caucasica	Caucasian honeysuckle	Low	Endemic	LC		X	X
Amaracus rotundifolius	Round-leaved oragano	Low	Locally rare	LC		X	
Ficus carica	Common fig	Low	Locally rare	LC		X	
Cyclamen vernum	Cyclamen	Medium	Locally rare	(CITES listed)	X	X	X

8.3.3.3 Faunistic Diversity

A detailed description is provided in the Study Report of the Fauna (Gamma, 2011) in Volume III, Appendix D.2, and only a summary is provided here.

Fauna around the Shukhevi Scheme

The Skhalta and Chirukhistsqali River gorges are deep, almost canyon-like down from the Shuakhevi-Khulo road. There are rocky and erosive slopes along the road, steep rocks in the lower part and mixed forested in the upper side dominated by oak and hornbeam. The left river bank is forested nearly to the water edge, mainly with fir-pine. The faunal diversity within these areas is some of the highest within the Project AoI, which includes the presence of numerous mammal species, including jackal (*Canis aureus*), European pine marten (*Martes martes*), European otter (*Lutra lutra*), brown bear (*Ursus arctos*), common wild boar (*Sus scrofa*), European roe deer (*Capreolus capreolus*), Caucasian squirrel (*Sciurus anomalus*) and Radde's shrew (*Sorex raddei*).

Bats are found foraging along the river systems and across open habitats, with species present including whiskered/Brandt's myotis (*Myotis mystacinus/brandti/aurascens*), common noctule (Nyctalus noctula) and lesser horseshoe (*Rhinolphus hipposideros*) and Savi's pipistrelle (*Hypsugo savii*).

In addition to the common bird assemblages found with AoI of the Shuakhevi scheme the presence of notable species includes the endemic Caucasian grouse (*Lyrurus mlokosiewiczi)*, boreal owl (*Aegolius funereus*), golden eagle (*Aquila chrysaetos*) and common rosefinch (*Carpodacus erythrinus*). Of particular note was the presence of the Caucasian grouse adjacent to the Modulistsqali River. Note that as part of the design phase the intake on Modulistsqali River has been dropped, avoiding any impacts on this tributary.

The Ghorjomi River has mixed forest habitats on the slopes and agricultural landscapes along the river embankments areas. Willow, alder-tree, and acacia are growing along the river; oak, hornbeam, fir-tree are found in the forest.. For mammals, jackals, European badger *(Meles meles)* and wildcat *(Felis sylvestris)*, as well as whiskered/Brandt's myotis (*Myotis mystacinus/brandti/aurascens*) bats. Several of these species are of high conservation value, and a summary is provided in Table 8.9. Note that as part of the design phase the intake on Ghorjomi River has been dropped, avoiding any impacts on this tributary.

Fauna around the Koromkheti Scheme

The faunal diversity across the various components of the Koromkheti Scheme is lower than upstream at Shuakhevi, including the Akavreta River gorge, largely due to the higher level of human disturbance, larger areas of modified habitats and fragmentation of natural habitats. Along the margins of the Adjaristsqali River, the habitats are predominantly modified with agricultural land. However, bird diversity is relatively high and in addition to the common bird assemblages found within the AoI of the Koromkheti Scheme notable species include red-footed falcon (*Falco vespertinus*), greater spotted eagle (*Aquila clanga*), eastern imperial eagle (*Aquila heliaca*), Egyptian vulture (*Neophron percnopterus*), Levant sparrowhawk (*Accipiter brevipes*), long-legged buzzard (*Buteo rufinus*), common rosefinch and lesser kestrel (*Falco naumanni*). Bats forage commonly along the Adjaristsqali River and along its margins, including, Serotine's bat (*Eptesicus serotinusi*), although no bat roosts have been found within the direct footprint of the Scheme, all bat species are of high conservation value.

The Akavreta River gorge is dominated with forested slopes - beech, alder-tree, chestnut, walnut; and agriculture areas. European otter are likely to be foraging along the river and the great noctule bat *(Nyctalus lasiopterus),* which is listed as Near Threatened by the International Union for Conservation of Nature (IUCN) is present. Colchic slow worm *(Anguis colchica)* are also present.

The Adjaristsqali River meanders through the gorge with small grove fragments, artificial plantation of acacia and open sites, and erosive rock. Red-backed shrike, Eurasian crag martin (*Ptyonoprogne rupestris*) and common house martin (*Delichon urbica*) are in abundance. Bats present include whiskered/Brandt's myotis, Serotine's bat and Leisler's bat (*Nyctalus leisleri)*. The Dahl's Whip snake (*Platyceps najadum)* occurs along the river margins.

Fauna around the Khertvisi Scheme

At the confluence of Adjaristsqali and Chorokhi Rivers, greenwood forest dominates the southern slopes with beech, hornbeam, chestnut, and oak present. Few animals, besides a number of bird and bat species are present, which is likely to be due to the current level of disturbance and habitat fragmentation. In addition to the common bird assemblages notable bird species recorded in the AoI of the Khertvisi Scheme include red-footed falcon, greater spotted eagle, eastern imperial eagle, Dalmatian pelican (*Pelecanus crispus*), Egyptian vulture, Levant sparrowhawk, long-legged buzzard, ruddy shelduck (*Tadorna ferruginea*)and lesser kestrel. A high diversity of bat species occurs, probably due to bats foraging and commuting along the river system. Bat species present include greater horseshoe bat (*Rhinolophus ferrumequinum*), lesser mouse-eared bat (*Myotis blythii*) Daubenton's bat (*Myotis daubentonii*), lesser Noctule bat (*Nyctalus leisleri*), and Serotine bat. According to local residents, brown bear (*Ursus arctos*) have been seen in this area in winter months

Along the Machakhela River gorge the species diversity is high. Forests dominate the slopes of the gorge - beech, hornbeam, chestnut, and oak are growing. The river gorge is wider at the weir. Besides the common bird and reptile species, little ringer plover and greenish warbler are present. Numerous bat species forage along the river system, including greater and lesser horseshoe bat, whiskered/Brandt's myotis, Serotine bat, and particoloured bat (*Vespertilio murinus*).

Other faunal species

Several faunal species of conservation value not recorded as part of these surveys could potentially still occur within the Project AoI.

Two legally protected reptile species occur in Georgia, Clark's lizard (*Darevskia clarkorum*) and Caucasus viper (*Vipera kaznakovi)*, and while these species were not found during these surveys (largely due to the scarcity of the species) it is should be assumed that they are present within the AoI.

The Caucasian salamander (*Mertensiella caucasica*), IUCN listed as Vulnerable, has been recorded in the Chorokhi and Adjaristskali River conjunction area. The Caucasian salamander is present in the Kintrishi Nature Reserve to the north of the Adjaristsqali. The Caucasian salamander is a habitat specialist, found mainly in beech (*Fagus orientalis*), coniferous (*Abies nordmanniana* and *Picea orientalis),* box forest (*Buxus* sp.) and subalpine belt and in alpine meadows. The species tends to avoid large streams and lives mainly in the tributaries of rivers, usually no more than 1-1.5 m in width and about 20-30 cm in depth in spring, and therefore only likely to be in the AoI for the Shuakhevi Scheme.

Globally and nationally threatened bird species are present along the Adjaristsqali throughout the year and particularly during bird migration periods. The autumn migration of soaring species is on average more intensive in the western half of the AoI which corresponds with the concentration effect of the bottleneck located along the coast. The occurrence of large flocks of soaring birds can be expected anywhere within the AoI however the proportion of soaring birds flying at low altitude is relatively low within the Adjaristsqali valley in optimal migration weather conditions. Migratory birds other than soaring species were much less numerous in the later part of the autumn migration period possibly as a result of difficulties in detecting smaller migratory species. Notable bird species recorded during late autumn migration surveys along the Adjaristsqali include great spotted eagle, eastern imperial eagle, Levant sparrowhawk, golden eagle, long-legged buzzard, white stork (*Ciconia ciconia*), black stork (*Ciconia nigra*), griffon vulture (*Gyps fulvus*) and lesser kestrel.

Downstream of the Adjaristsqali is the Chorokhi Delta which is of national importance and has been periodically surveyed, in part, by Wetlands International and by members of the Batumi Raptor Count (BRC). Wetlands International recorded 42 waterbird species in autumn and winter surveys between 1995 and 2010 (Kostiushyn, 2012a,b). The wildfowl assemblage was estimated to be a maximum of 12,822 birds (Kostiushyn, 2012a). BRC have recorded 93 species, including passerines, in autumn (BRC, 2012a,b,c). Notable species recorded in the Chorokhi delta include red-footed falcon, Dalmatian pelican, Yelkouan shearwater (*Puffinus yelkouan*), Eurasian stone-curlew (*Burhinus oedicnemus*), black stork and red-necked grebe (*Podiceps grisegena*).

Summary of Protected & Notable Fauna within the Project AoI

Over 300 terrestrial faunal species have been recorded across the region, of which 20 are regarded as being endemic and 61 protected under Georgian legislation. Of these the protected species and species of conservation value which occur within the AoI are listed in Table 8.8 and Table 8.9. While many of these species occur with the Project AoI, few are likely to be directly impacted by the Project, and this is discussed in the subsequent Section.

The most important and sensitive faunal species which occur with the Project AoI include otter, bear, Inyx and numerous bat species. In the Georgia Red Data Book only otter is noted along the Adjaristsqali River. The otter is regarded as being relatively rare along the river mainly due to lack of food sources (fish), which is caused by unauthorized and poaching of fish. According to local population information bear and lynx are found within the Project AoI in each Municipality, all are of high conservation value. A large number of bat species (total of ten) have been recorded along the river system, and although no bat roosts have been found during the surveys within the AoI. The high level of bat activity does however indicate that the Adjaristsqali river system is of importance for bats, and significant bat roosts are likely to be present within the AoI.

Bird diversity along the Adjaristsqali is relatively high, reflective of the diversity of modified and natural habitats along the gorge and its position within the internationally important Batumi migratory bottleneck. Bird diversity is greatest in the Khelvachauri and Keda municipalities followed by the Chorokhi delta. A total of 222 species has been recorded within the AoI to date of which two are endemic, 101 are listed on two relevant international conventions (72 species on the CMS and 70 species on the AEWA), five species are globally threatened (IUCN Red List classification Vulnerable to Critically Endangered) and 18 species are nationally threatened (Georgia Red Data Book classification Vulnerable to Critically Endangered).

Table 8.8: Number of Faunal Species: Total number, endemism and protection status of vertebrates.

Class	Total Quantity of Species	Species Protected by Law	Endemic and Sub-endemic Species
Amphibians	5	1	2
Reptiles	14	2	5
Birds	148	37	1
Mammals	62	23	12
Total	**229**	**63**	**20**

Table 8.9: Notable Protected & Notable Faunal Species, including fisheries, within the Project Area of Influence

Latin Name	English Name	Georgia Red Data Book Status	IUCN Red List Data Book Status	EU Listed [29]	Conservation value	Chorokhi Delta	Shuakhevi	Koromkheti	Khertvisi
Mammals									
Lutra lutra	European otter	VU	NT	X	Medium/High		X	X	X
Ursus arctos	Brown bear	VU	LC	X	Medium		X	X	X
Lynx lynx	European Lynx	VU	LC	X	Medium		X		
Sciurus anomalus	Caucasian squirrel	VU	LC		Medium		X	X	X
Canis aureus	Golden jackal	-	LC		Low		X	X	
Sus scrofa	Common wild boar	-	LC		Low		X	X	
Felis sylvestris	Wildcat	-	LC	X	Medium		X		
Myotis mystacinus/brandti/aurascens	Whiskered/Brandt's myotis bat	-	LC	X	Medium		X	X	X
Nyctalus noctula	Common noctule bat	-	LC	X	Medium		X	X	
Rhinolophus ferrumequinum	Greater horseshoe bat	-	LC	X	Medium				X

[29] Includes species listed under the EU Habitats Directive and bat species listed under the Treaty on Protection of European Chiropteran (Eurobats)

Latin Name	English Name	Georgia Red Data Book Status	IUCN Red List Data Book Status	EU Listed [29]	Conservation value	Chorokhi Delta	Shuakhevi	Koromkheti	Khertvisi
Rhinolphus hipposideros	Lesser horseshoe bat	-	LC	X	Medium		X		X
Eptesicus serotinusi	Serotine's bat	-	LC	X	Medium			X	X
Nyctalus leisleri	Lesser Noctule bat	-	LC	X	Medium			X	X
Hypsugo savii	Savi's pipistrelle	-	LC	X	Medium		X		
Myotis blythii	Lesser mouse-eared bat	-	LC	X	Medium				X
Myotis daubentonii	Daubenton's bat	-	LC	X	Medium				X
Vespertilio murinus	Particoloured bat	-	LC	X	Medium				X
Birds									
Tetrao mlokosiewiczi	Caucasian grouse	-	NT		Medium		X		
Buteo rufinus	Long-legged buzzard	VU	LC		Medium		X		
Athene noctua	Little owl	VU	LC		Medium				
Reptiles & Amphibians									
Bufo verrucozissimus	Caucasian toad	-	NT		Medium			X	X
Darevskia clarkorum	Clark's lizard	EN	EN		Very high		X	X	X
Vipera kaznakovi	Caucasus viper	EN	EN		Very high		X	X	X
Mertensiella caucasica	Caucasian salamander	VU	VU		High		X		

Latin Name	English Name	Georgia Red Data Book Status	IUCN Red List Data Book Status	EU Listed [29]	Conservati on value	Chorokhi Delta	Shuakhevi	Koromkheti	Khertvisi
Fisheries									
Salmo labrax (1)	Black sea salmon	EN	LC	X	Medium – High				X
Salmo trutta (2)	Brown trout	VU	LC		Medium		X	X	X
Augilla angilla	European eel	-	CE	X	Very high				X
Capoeta sieboldii	Colchic khramulya	VU	LC		Medium		X	X	X

Notes: 1 and 2 - Denomination recently changed (source Black Sea Monitoring Agency, personnel communication) to:

- Black sea salmon *Salmo labrax pallas* and
- Black sea trout *Salmo labrax fario*

The two different ecotyoes differ in that the Black sea salmon undertake migration to the sea while remaining individuals are referred to as resident Black sea trout. The black sea salmon and freshwater trout (black sea trout), where they live together form a single freely inter-breeding population (Solomon *et al.*, 2000).

8.3.4 Fish Ecology & Diversity

8.3.4.1 Physical Environment

The Adjaristsqali River originates from the western slope of the northern part of Arsiani Range at 2,435 masl. The length of the river is 90 km, elevation at the headwater of 2,397 m, average inclination of 26.6%, catchment area 1,540 km^2 and average elevation 1,400 m. The river basin includes 988 rivers with total length 2165 km. The main tributaries are: Satsikhuri (length 14 km), Skhalta (length 29 km), Chirukhistsqali (length 32 km), Chvanistsqali (length 21 km), and Akarevta (length 19 km). Figure 2.2 in Chapter 2 shows the location of the Adjaristsqali River basin.

The landforms in the boundaries of the river basin are mountainous and strongly divided. In the upper reaches, up to the Akavreta River, deep sharply split gorges are found. Beds of the tributaries are narrow and sharp, sometimes with precipitous banks.

8.3.4.2 Fish Species of the Adjara Region

General Distribution

In the Adjara region, the fish (ichthyofauna) diversity is determined by the physical-geographical and climatic conditions of the area. A total of 47 species and 17 families are known to be present which include freshwater and anadromous fish species. The fish community is considered to be diverse but with a low abundance. None of the species present are abundant enough to be important for commercial fishing, however subsistence fishing is popular and valued past time of the local population.

Within the Project, 18 species belonging to five different families which include the salmonids Salmonidae, gobies Gobiidae, freshwater eels Anguillidae, loaches Cobitidae and carps Cyprinidae have been recorded. Most of the species recorded belonged to the cyprinidae family.

Protected species present within the AoI include the black sea salmon (S*almo labrax* ecotype *pallas)*, and the trout (S*almo labrax* ecotype *fario)*, Colchic khramulya (*Capoeta sieboldii)* and the European eel *(Anguilla anguilla).* A brief description on the black sea salmon is provided later in this section).

2011 Fish Survey Results

A full species list for the Adjara region, those within the AoI and under which legislation they are protected under is provided in the Fish Survey Report (Gamma, 2011) in Volume III Appendix D.3. The location of these fish species in the Adjaristsqali River and its tributaries is summarised in Table 8.10.

During the 2011 surveys, the density of fish inhabiting the surveyed rivers was shown to vary and appeared to relate to water flow, i.e. with rheophillic species favouring areas of high flow within the reaches (see Appendix D). However, on comparing the location of rheophillic fish species which like fast running water and limnophilic fish species which like still waters, such as ponds with velocity and flow measurements it is apparent that these species are present in a range of flow conditions, albeit they may favour particular low or fast sections within a reach.

Table 8.10: Location of Fish species and Environmental Groups in the River Adjaristsqali and Tributaries - 2011 Surveys (Gamma 2011)

Taxonomic group	Environmental group	Skhalta	Khikhanistskali	Chirukhistskali	Chvanistskali and Adjaristskali	Ghorjomistskali and Adjaristskali5)conflu	Adjaristskali Makhuntseti	Adjaristskali Tega bridge	Adjaristskali and Chorokhi confluence	Machakhlistsqali	Akavreta	Chirukhistskali (2)	Information source
Salmo trutta	F.R.	In tributaries	In tributaries		✓					✓	✓	✓	ch
Salmo labrax										✓			i
Ponticola constructor	F.R.			✓	✓		✓		✓			✓	i
Anguilla anguilla	Pas.								✓				i
Squalius cephalus orientalis	F.R.			✓	✓		✓		✓			✓	ch
Gobio gobio lepidolaemus n. caucasicus	F.R.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	ch
Luciobarbus escherichii	F.R.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	ch
Capoeta sieboldii	F.R.			✓			✓		✓	✓		✓	i
Capoeta tinca	F.R.	✓	✓		✓		✓		✓	✓		✓	ch
Alburnus derjugini	F.L.								✓				i
Alburnoides fasciatus	F.L.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	ch
Phoxinus colchicus	F.L.	✓		✓		✓		✓	✓		✓	✓	ch
Rhodeus colchicus	F.L.				✓	✓	✓	✓	✓	✓		✓	ch
Rutilus rutilus	F.L.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	ch
Chondrostoma colchicum	F.L.			✓	✓		✓		✓	✓		✓	ch
Cobitis satunini	F.L.			✓					✓				i
Nemacheilus angorae	F.L.	√	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	i

F.L. = freshwater limnophilic, F.R.=freshwater reophilic, pas. = passing, ✓ =present, I =interview with local fishermen; ch = control fishing; fm =flow measurements

* Classified in the 2012 surveys as the resident form *Salmo labrax fario* (balck sea trout) of the black sea salmon

** Anadromous form Balck sea salmon (*Salmo labrax pallas*).

Table 8.11 gives details on the preferences for different groups of fish species (known as guilds). These flow requirements are variable, for example brown trout have been known to move into the mid channel areas after sunset to feed on invertebrates and then return to lower velocity areas at night. In some studies fish have been known to occupy positions under banks or cover for 63% of the time, which provide valuable resting areas with lower velocities. Within the Adjara region, the density of some species is also related to other factors such as altitude for the brown trout, and mid to lower reach areas for some species such as gudgeon, colchic barbel, minnows and roach which occurred at most of the survey sites. Table 8.19 provides the depth and flow preferred requirements for four Cyprinidae species of various sizes.

Table 8.11: Ecological guilds “Flow” preferences

Groups	Location	Fish species
Rheophillic Salmonids	All freshwater water stages of life history are confined to the main channel	Trout, salmon and grayling
Rheophillic Cyprinids	All freshwater stages of life history are confined to the main river channel (-some life stages may prefer well connected side channels)	Chub, dace, gudgeon and barbel
Eurytopic (can tolerate a wide range of conditions)	All stages of life history can occur in both lentic and lotic waters	Perch, pike, bream, roach, bleak
Limnophilic	All stages of life history are confined to lenthic waters with macrophytes	Tench, rudd, crucian carp

Source: Aarts and Nienhuid, 2003; Schiemer and Waidbacher, 1992).

The 2011 surveys indicated the following protected fish species are present and located in the following areas:

- The Black Sea salmon used to migrate or, as mentioned by some interviewees – permanently live in the Machakhlistsqali River;
- Trout (Black Sea trout) are present in the tributaries of the Skhalta and Chirukhistsqali, Chvanistsqali and Adjaristsqali confluence, Machakhlistsqali, and Akavreta;
- Colchic khramulya are present in the Chirukhistsqali, Adjaristsqali and Chorokhi confluence, and Machakhlistsqali, and;
- European eel are occasionally found at the Adjaristsqali and Chorokhi confluence.

Interviews with fishermen revealed that their catch tends to be dominated by Colchic barbel and chub throughout the catchment and in areas of low flow minnows and khramulya dominated the catch. The ecoregion is characterised by a pronounced vertical zonation in the dispersal of fish. At an elevation of 800 m to 1,500 m, in the mountainous areas and the upper reaches of the tributaries, the trout is present. Whereas Colchic barbel and other species are not observed above 1,000 m, the remaining species belonging to the Cyprinidae family and tended to be located up to 700-800 masl.

Table 8.12: Cyprinidae Requirements

Cyprinidae Species Within the AoI below Scheme 1	Preferred Environmental Group	Life Stage	Indicative Water Depth Requirements	Indicative Velocity Requirements
Gudgeon** ***Gobio gobio* replacing *Gobio gobio lepidolaemus n. caucasicus	Rheophillic Small fish rarely over 0.15 m long	Larvae	Shallow	<0.20 m.s^{-1}
		Juvenile	<0.20-<1 m	0-0.40 m. s^{-1}
		Adult		<0.55 m. s^{-1}
		Spawning	0.05-0.08 m	0.02-0.80 m. s^{-1}
Common barbell *Barbus barbus* replacing Colchic barbell *Luciobarbus escherichii	Rheophillic Larger fish and long lived which can reach 1.2m in length	Larvae	0-0.40 m	<0.20 m. s^{-1}
		Juvenile	<0.20-1 m	Still-1.2 m. s^{-1}
		Adult		0.40-1 m. s^{-1}
		Spawning	0.15-0.40 m	0.25-0.49 m. s^{-1}
Common bleak *Alburnus alburnus* replacing Colchic bleak *Alburnus derjugni	Limnophillic Small fish usually 0.15m in length but can reach 0.25m	Larvae	0.20-<1 m	<0.5 m. s^{-1}
		Juvenile	<0.20->1 m	<0.5 m. s^{-1}
		Spawning	0.25-0.50 m	<0.20 m. s^{-1}
Common roach *Rutilus rutilus*	Limnophillic Usually 0.35 m in length but can reach 0.45 m	Larvae	0.20-1.50 m (<1 m preferred	<0.05 m. s^{-1} (lentic preferred)
		Juvenile	0.20-~1.75 m (~0.50-1 m, preferred)	<0-0.40 m. s^{-1} (lentic preferred)
		Spawning	0.15-0.45 cm	>0.20 m. s^{-1}

* Species for which there are known flow measurements replacing other species within the AoI which belong to the same genus.

Source: Cowx *et al* 2004

During the interviews many of the fishermen confirmed the presence of protected species such as the European eel and Black Sea salmon in the Chorokhi and Machakhistsqali River. Although, these species are migratory, local fishermen believe migration had declined due to the regulation of flows in the higher reaches of the Chorokhi. The presence of the protected fish species Brown Trout was also confirmed with migration for spawning and feeding grounds occurring in the upper reaches above Shuakhevi. Colchic Kramulya was also noted as mainly present in the Chorokhi, but it also moves into the lower reaches of the Adjaristsqali River.

The fishermen noted that throughout its flow the Adjaristsqali River is important for providing different fish species with food and other resources. Furthermore, it was noted that during the spawning period the fish enter upper sections of Adjaratsqali River, as well as Adjaratsqali tributaries, which confirms the importance of the Adjaratsqali main tributaries for fish spawning.

During the field surveys, fry schools were detected in the tributaries of the Adjaristsqali. Fry species detected included roach, European bitterling (*Rhodeus amarus)*, rock minnow, Caucasian chub and Colchic minnow. In autumn these species move into the Adjaristsqali River. The presence of these species indicates a favourable habitat for fry to thrive.

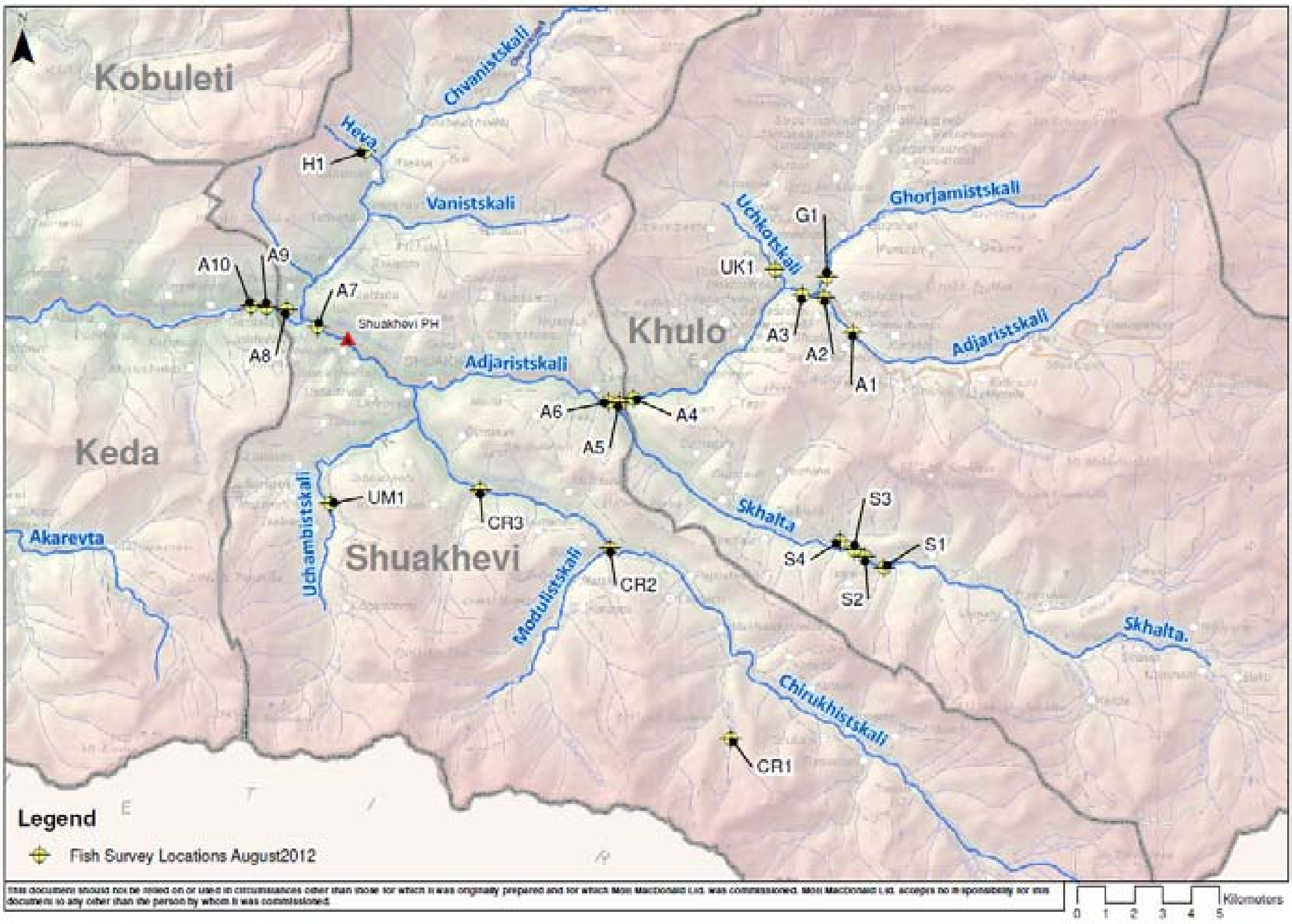
The locations of the potential spawning sites are shown in Volume III Appendix D4. The time of spawning and migration (upstream and downstream) varies among the various species and and indicative fish calender is presented in Volume III, Appendix D8.

2012 Fish Survey Results

Surveys were carried out between 21 August and 29 August 2012. Surveys covered the area of the Shuakhevi Scheme only. Table 8.13 presents a summary of the results. Figure 8.5 shows the location of the 2012 surveys. Full data is presented in Volume III Appendix D.

The fish assemblage was similar to the results recorded in 2011 with no evident differences. The cyprinid *Barbus escherichii* was the most common species at all locations. The protected species Colchic khramulya *Capoeta sieboldii* was found at different locations in the Adjaristsqali River but not in the Chirukhistsqali as in the September 2011 survey. Of note is the presence of the Black Sea trout in upstream tributaries of the Chirukhistsqali and Chvanistsqali. The presence of Black Sea salmon was not recorded.

Figure 8.5: 2012 Fish Survey sampling Locations



8.3.4.3 Fish Prey

Most of the surveyed rivers have biotopes, which are suitable residence for aquatic life. In most of the rivers there are areas suitable for different fish species to undergo offspring fattening. Although, as the local fishermen noted, mother-fish shoals of the main game-fish species migrate to the upper part of Adjaristsqali or its main tributaries (Skhalta, Chirukhistsqali, Chvanistsqali, Akavreta).

Overall, food composition of the fish species described in the surveyed rivers contained 43 groups of food subjects which included animal, vegetable, periphyton and detritus (Data is provided in Volume III, Appendix D9). The vegetative components were represented by diatoms and green algae and plants seeds. Animal food was diverse and included infusorians, various groups of worms, jointed-legged animals, as well as adult fish and whitebait.

For the fish inhabiting the surveyed rivers, it is apparent that they not only feed on aquatic invertebrates but also terrestrial invertebrates found in water. Representatives of 17 terrestrial invertebrate species were found in the studied fish feed groups, such as ants, lepidopterous insects, spiders and others. Food composition of various fish species contained 7 - 32 food subject groups. The diet of trout and barbel was found to be the most diverse. Most of the fish species feed extensively in the Adjaristsqali River.

The Black Sea Salmon and Black Sea Trout

The Black Sea salmon (*Salmo labrax*) use to be classed as a sub-species of the European trout (*Salmo trutta*) and was previously known as *Salmo trutta labrax*. It is similar to the *Salmo trutta* of NW Europe as it migrates to sea to feed and returns to freshwater to spawn. Female *Salmo labrax* (and *Salmo trutta*) are predominant in the migrating population and can interbreed with non-migratory individuals of resident populations in which males predominate (Solomon *et al*., 2000). Caryological studies support the belief that the Black Sea salmon is genetically closer to *Salmo trutta* than the Atlantic salmon *Salmon salar* (Solomon *et al*., 2000).

In a Romanian study phylogenetic analysis, using mitochondrial ribosomal genes as markers, was carried out which allowed for the classification of salmonid species from Romania within the Salmonidae family. Results indicted that The *Salmo labrax*, endemic in the Black Sea, appears to be the sister taxa of the sea trout *Salmo trutta trutta* from the northwest of Europe (Atlantic coast) and Baltic Sea (Dudu *et al.,* 2011). These results are in agreement with the caryological results.

The distribution of the anadromous[30] form, Black Sea salmon, is not clear. Resident trout populations are reported in the most upstream reaches of the Adjaristsqali catchment but Black Sea salmon are not. However, Solomon *et al*. (2000) recognised that the Black Sea salmon and freshwater trout, where they lived together formed a single freely inter-breeding population.

This freshwater trout (previously recorded as *Salmo trutta fario*) is now believed to be the non migrating ecotype of the Black Sea salmon i.e. *Salmo labrax fario*.

This is now believed to be the non migrating ecotype. Recently the classification of two subspecies has been revised and two ecotypes are denominated as:

- The Black Sea salmon *Salmo labrax pallas* and;

[30] spending most of the time at sea and returning to freshwater to spawn

- The Black Sea trout *Salmo labrax fario*
 (source: Black Sea Monitoring Agency, personnel communication)

The Black Sea trout (*fario* ecotype) presents seasonal migration in freshwater but does not migrate to the sea. Before smoltification every Black Sea salmon individual presents the same behaviour with no clear differences between the two different ecotypes. The larvae spend the first feeding period in the most upstream reaches of the rivers moving later to other areas after depending on temperature, food abundance and instinctual drive (Aksungur *et al*., 2011).

The different sub-species or ecotypes present behavioural, phenotic, morphological and ecological differences. Most likely the key difference lies in the physiology characteristics with the migrating Black Sea salmon undergoing physiological changes to be able to adapt to the marine environment.

As with other salmonids, spawning and early juvenile life takes place in clean, fast flowing rivers and streams. A year later m some fish migrate while other juveniles remain in the river. The reason some of the juveniles migrate to the sea whilst others do not remains unclear (Aksungur *et al*., 2011).

Growth in the sea is fast and fish usually come back to the river every year to spawn for the next four (sometimes more) years. Spawning takes place early winter, but exact timing may vary between rivers. Smolt migration starts early in the spring and lasts the whole summer and autumn. Salmon returns to the river between March and July, but do not spawn until November to December (Solomon *et al*., 2000).

The differences in behaviour between the black sea salmon and trout appear to be the same as that of the sea trout and brown trout in NW Europe and Scandinavia.

According to Solomon (2000) some populations are totally non-migratory. While in some cases this appears to be a natural development where some conditions make migration to sea difficult, in other cases human influence may prevent migration due to the presence of dams. Pollution and over-fishing may also have been important factors eradicating migratory behaviours in some rivers.

In the Adjaristsqali catchment the Machakhela is historically known as the unique salmon river (David Bagration, personnel communication, 2000). Key point is at the mouth of the Adjaristsqali River at the confluence with the Chorokhi River where large catches were still happening in the late 90s.

The EU Tacis Black Sea Environmental Programme (Dangerfield, 2000) included recommendations for a “Strategy for the Black Sea salmon”. With regards to the Adjaristsqali catchment this document only includes information on the Machakhela River. The document confirms the presence of Black sea salmon in the Machakhela River, addresses major threats to this species in the Machakhela River and presents recommendations to protect the river and the Black Sea salmon.

As part of the EU Tacis Black Sea Environmental Programme and the Black Sea Salmon Project a Draft Strategy for the conservation, rehabilitation and future management of Black Sea salmon has been produced. The general aims of this strategy are:

- To conserve the maximum number and genetic diversity of *Salmo trutta labrax* (currently denominated as *Salmo trutta labrax s explained above*);

- To rehabilitate and enhance depressed stocks to safeguard biodiversity and to allow exploitation when and where it is safe to do so;

- To re-establish runs of migratory stock in rivers that have lost them; and

- To develop, promote and implement sustainable management plans and actions.

A number of steps and approaches have been identified under this strategy which includes the selection of rivers for priority actions and measures to ensure that the environment in rivers and in the sea is optimal for natural production (factors will include freshwater flow and quality, obstructions to migration, food production in the river as well as in the sea).

The draft strategy also seeks to implement changes to legislation to better control and mange fisheries dealing with illegal fishing which is one of the key pressures affecting stocks in rivers (e.g the Machakhela River). However, since the TACIS programme was completed in 2000, no specific measures have been undertaken with regards to the above objectives within the Adjaristsqali catchment.

Therefore it is important to determine if the Project is likely to impact the Black Sea salmon in the Adjaristsqali catchment. If this is found mitigation measures should be implemented so that the project does not interfere with the potential future implementation of the Black Sea Salmon Strategy. To determine this it is crucial to understand the distribution of this species in the AoI of the Project.

Based on the fish surveys carried out in 2011 (including interviews with fisherman) and in 2012 there is no evidence of the presence of Black Sea salmon in the AoI of the Shuakhevi and Koromkheti Scheme. However, they are known to reside within Machakhela River which is affected by the Khertvisi Scheme. No individuals were recorded during both surveys at any sampling site. However, it is still not possible to categorically conclude the absence of the Black Sea salmon in Adjaristsqali River where the surveys were carried out.

Black Sea trout was recorded during the 2011 surveys in tributaries of the Skhalta and Khikhanistskali, as well as in the Chvanistsqali, Adjaristsqali, Machakhlistsqali, Akavreta and Chirukhistsqali. In 2012 the distribution was much reduced with individuals present only in the Uchambistskali (a tributary of the Chvanistsqali) and in Heva (a tributary of the Chvanistsqali). Surveys were carried out at the same time of the year.

The existing dam in the Adjaristsqali is considered to be, at present, an impassable barrier to upstream migration and therefore it is not expected that the Black Sea salmon is present upstream of this dam. However, downstream migration is thought to be possible and therefore any further developments should allow potential for downstream migration of trout present in upstream tributaries.

Ongoing surveys will be undertaken at different times of year to try and identify the Black Sea salmon at different life cycle stages and determine population presence and potential upstream and downstream migration in the Adjaristsqali River.

8.3.4.4 Fisheries

There is an insufficient quantity of fish for a commercial fishery to operate, however, an amateur fishery exists which is of recreational importance and most of the fish caught are for own consumption or sold on the roadside / delivered to local restaurants. Fishing techniques include so called screens and throw fish nets. Fishing is general practice in all rivers within the AoI, however several priority sections were identified, which included:

- The Adjaristsqali River from junction with the Chorokhi River to Asti HPP

- The Adjaristsqali River from Asti HPP to the Akavreta River tributary
- The Adjaristsqali River from village Dandalo to the Chvanistsqali River tributary
- The Chvanistsqali river 3 km upstream the junction with the Asjaristsqali
- The Adjaristsqali river from the Chvanistskali river tributary to the Chirukhistskali River tributary
- The Chirukhistsqali River upward from the junction with the Adjaristsqali River
- The Skhalta River.

In these sections a “free fishing” regime is common practice, which means that any fisherman can catch fish in that particular location. However, the situation is different for trout fishing. Trout mostly dwells in the upper reaches of the Adjaristsqali tributaries or in small rivers (secondary tributaries) that join the latter. The village communities along these streams strictly protect the trout resources in “their territories” and do not welcome “strangers”. Selling of trout was not detected as it is used within the community.

The fishermen revealed that they catch 3-7 kg of fish per day which mostly consist of Black and Caucasian chub, Anatolian khramulya, Colchic barbel, Colchic nase, Colchic bleak, Roach, and Royal fish. The average price of fish is 7 GEL per 1 kg (approximately $4 USD), which represents an annual value of approximately 95,000 GEL ($56,900).

Interviewed fishermen (Volume III, Appendix D5), felt that quantitatively the fish stock over the last five to ten years has decreased. The interviewees consider this to be linked to the regulation of flow on the Chorokhi River, although it is uncertain how this relates directly to fishries abundance in the Adjaristsqali River and its tributaries.

The local communities are concerned about the future of the fish resources in relation to potential impact of the planned development on the fish stocks/availability. Fishing is a part of the local culture and subsistence fishing is important for the local economy.

The field surveys also revealed that a number of fish (trout) farms are operating within the AoI. For example, in the Keda municipality in particular, more than 50 small, medium and large fish farms are rearing rainbow trout (*Oncorhynchus mykiss* (Walbaum 1992)). The owners and the staff expressed their concern about the future of this business - both water availability and its physical and chemical characteristics were considered as crucial issues.

8.4 Summary of Likely Effects

This Section provides a summary of the likely effects of main activities associated with the Projects construction and operation and the characteristics of the potential impacts on key ecological features prior to mitigation. A summary of the area of land take for each of the key components is provided in Table 8.13.

8.4.1.1 Construction effects

During construction of the Project the potential effects could include:
- Noise and light disturbance from construction activities affecting birds and mammals;
- Dust deposition around working areas affecting adjacent habitats;
- Localised changes in hydrological conditions and increased risk of localised pollution events due to use of construction vehicles affecting adjacent habitats and subsequent local effects on ground-nesting bird species and mammals;
- Localised changes in air quality resulting from construction activities and increased vehicle movements through the area;

- Reductions in water quality in the river system resulting from potential release of contaminants into the river as well as localised water quality issues due to discharges from construction facilities;
- Sediment release into the river system resulting from the depositing of construction and tunnelling waste into the river;
- Compaction of soils and habitat degradation resulting from an increase in off-road vehicle movements which is likely to effect the condition of habitats;
- Temporary habitat loss resulting from the extraction of aggregates for the construction of the tunnels, dams and roads, spoil disposal, site compounds, and construction access roads;
- Degradation of habitats for construction activities, including local felling of trees for timber, increased disturbance for construction workers.
- Hunting of local wild mammals and birds, and fishing from the construction work force, and
- Accidental introduction and dispersal of invasive species from construction activities, which could have a long-term and irreversible effect on the local biodiversity.

8.4.1.2 Operational effects

During operational activities of the Project the potential effects could include:

- Reduction in river flows along the Adjaristsqali to 10% of the average annual flows which is likely to have a direct effect on fish populations and indirect effect on bird and mammal species dependent on the river habitats;
- The dams and weirs acting as ecological barriers preventing the movement of fish along the Adjaristsqali.
- Changes in water quality in the main river system, especially during low flows;
- Permanent habitat loss resulting from the project infrastructure, notably access roads, dams, weirs, powerhouses and substations;
- Permanent habitat loss from inundation due to the creations of some reservoirs;
- Degradation of habitats resulting from the ‘dead zone’ around each of the reservoirs; and,
- Sediment release and change in water quality during the flushing of the dam system

The most significant indirect construction and operational impacts are likely to be associated with the likely increased urbanisation and increased agricultural activities (and subsequent habitat loss) which may result because of the Project. Once the Project is established, with improved access roads, employment opportunities and infrastructure, it is likely that this will incentivise local people and local businesses to move into the area selling food stuffs and other commodities to construction workers and in search of other opportunities associated with such a project. These activities are likely to then lead to additional pressures on the local natural resources and could impact on biodiversity.

Table 8.13: Summary of Approximate Land Take (m^2) for Key Components for each of the Three Schemes

Activity	Shuakhevi		Koromkheti		Khertvisi	
	Construction	Operations	Construction	Operations	Construction	Operations
Dams/weirs	*	56,000	*	19,000	*	8,000
Reservoirs	*	391,000	*	172,000	*	91,500
Powerhouses	*	19,000	*	20,000	*	21,000
Staff buildings	6,000	2,000	6,000	2,000	6,000	2,000
Waste disposal from tunnelling		508,000		295,500		123,000
Construction laydown areas	150,000	-	100,000	-	100,000	-
Infrastructure &	120,000	-	75,000	-	75,000	-

Activity	Shuakhevi		Koromkheti		Khertvisi	
services for construction						
Roads (assuming a working width of 5 m)	*	295,000	*	36,500	*	6,500
Total	**270,000**	**1,271,000**	**181,000**	**545,000**	**180,000**	**252,000**

* The main land take is associated with operational impacts, but habitats will also be disturbed and lost as part of the construction activities.

8.5 Impact Assessment

8.5.1 Construction Impacts

In this Section the impacts associated with the construction of the Project on the ecological features within the AoI is evaluated using the assessment criteria defined in section 8.2.7.

8.5.1.1 Protected Sites

Kintrishi Nature Reserve/Important Bird Area and Mtirala National Park are outside the AoI, and would not be impacted by the Project.

The Machakhela National Park is within the Project AoI of the Khertvisi Scheme. However, no project infrastructure would be located directly within the national park. The installation of these structures (notably sediment release from excavation for the installation of the weirs and intake structures and risk of pollution by fuel and oils from construction machinery) is likely to result in minor and localised negative impacts, prior to mitigations, on the national park. The Machakhela National Park is of high conservation value and the therefore the significance of the impact before mitigations would be moderate adverse

8.5.1.2 Terrestrial Habitats & Flora

Across all three Schemes, the impact of the Project on the terrestrial habitats are largely associated with the habitat loss result from the construction of the infrastructure relating to the Project, notably access roads, site construction laydown areas and site worker access. A summary of the habitat loss for each of the schemes is provided in Table 8.20 and briefly outlined below.

A total of ten key habitats occur within the AoI of the **Shuakhevi Scheme**, in summary:

- The habitat with the highest conservation value in this Scheme area is the oak forests lining the gorges of the river valleys, however a majority of these habitats are outside the immediate footprint of the work thereby limiting the number of trees (and minimising tree loss as a proportion of the total habitat) that would be lost, and therefore only a **minor impact** is likely because of habitat loss associated with construction activities, notably access roads and laydown areas.
- The main habitat type which will be impacted by the Scheme is the riverside grassland and terraces, with patches of riverine forest and scrub dominated by alder being lost as a result of construction of project infrastructure, access road, site compounds and construction facilities; the impact is therefore likely to be a moderate negative of **minor adverse** significance.
- Area of pontic rhododendron scrub occurs within the AoI of the Scheme, but most of this relic scrub is outside the immediate and direct footprint of the Scheme resulting in limited loss of plants so a minor

impact is anticipated from habitat loss associated with site access and road construction. But these habitats are of high conservation value and therefore the significance would be **moderate adverse.**
- The main forest habitat within the AoI of the Scheme is deciduous forest with mixed spruce, with patches of degraded spruce forest. The impact on this habitat is likely to be moderate due to habitat loss from construction activities (see Table 8.13 and Table 8.14) and likely degradation of habitats from timber use. These habitats are of medium conservation value and therefore the significance would be **moderate adverse**.
- Regarding individual plant species, only three of the protected (red listed) plant species (see Table 8.9) have been confirmed as occuring within the AoI of the Shuakhevi Scheme, although other species may occur. The impact on these species is likely to be minor to moderate because of habitat loss largely associated with site clearance for access and construction activities, depending on the actual number of plants being affected. These species are of low to medium conservation value and the significant would therefore be **minor to moderate adverse**.

A total of nine key habitats occur within the AoI of the **Koromkheti Scheme** and this section of the Project represents the most important area for habitats and floristic diversity, with three habitats of high conservation value and all 19 protected and notable plant species being present. The predicted impact is summarised as follows:
- The most important habitats of high conservation which will be directly affected by the Scheme are the deciduous forests of oak, hornbeam-chestnut and mixed species composition, with relic scrub and herbaceous species. During construction the impact on these habitats would be from construction site access and working areas needed around the water intakes and tunnelling activities and the impact is likely to be moderate. As these habitats are sensitive and of high conservation value therefore significant is likely to be **major adverse**.
- The impact on areas of bare rock, riverside grassland and terraces, riverine scrub and alder forest is likely to be moderate negative, as large areas will be lost of degraded as part of the construction activities (notably road access and construction areas around the intake tunnels (Table 8.14). These habitats are of low conservation value and the significance would be **minor adverse**.

The deciduous forest habitats through the Scheme are important for a large number of protected, relic and notable plant species. While the location of individual plants is not quantified, prior to mitigations, the impact on these species due to habitat loss and degradation from the construction activities, notably access routes and working areas is likely to be **moderate and significant**.

A total of six key habitats occur within the AoI of the **Khertvisi Scheme**, which in summary are:
- The lower elevation of the Adjarastsqali River are dominated by habitats of low conservation value, notably riverside grassland, riverine forests & scrub, and alder forests and the impact on these habitats is likely to be moderate. Large areas of habitat would be lost for site access, site lay down areas, and working areas around the intake structure and dam. The significant would be **minor adverse**.
- The most important habitats within the Machakhlistsqali gorge are deciduous forests of high conservation value, along the forest gorge. The Scheme is, however, likely to only have a minor negative impact on these forest habitats, as most of the construction activities will be occurring along the riverside habitats (of lower conservation value). However some areas of forest habitat will be lost, typically due to construction works and access associated with the intake structures and tunnelling. However, because these habitats are of high conservation value (and are within the proposed Nature Reserve), the significance would be **moderate adverse**.
- The main impact in the Machakhistsqali gorge is likely to be on the riverine alder forests and scrub of low conservation value with a moderate negative impact associated with habitat loss and degradation

from site access, working areas, contractor compound, possible bridge and possible sand-gravel quarry and works associated with the installation of the weir. The impact significance would be **minor adverse**.

Three protected plant species and a number of endemic and locally rare species have been recorded within the AoI of the Khertvisi Scheme (Table 8.9).The Project impacts on these species, prior to mitigations is likely to be moderate, because of habitat loss and degradation due to construction site access and construction working areas, notably tunnelling and weir construction on the Machakhistsqali River.

Table 8.14: Estimated Total (construction & operations) Terrestrial Habitat Loss (m^2) for Each Scheme

Habitat type	Shuakhevi	Koromkheti	Khertvisi	Total
Oak forest – Quercus petraea ssp. dschorochensis	14,500	9,000	-	23,500
Hornbeam-chestnut forest – Castanea sativa, Carpinus caucasica	-	8,000	12,500	20,500
Oak-hornbeam forest - Carpinus caucasica, Quercus petraea ssp. dschorochensis or Quercus hartwissiana	-	2,500	-	2,500
Mixed, species-rich deciduous forest with Castanea sativa, Alnus barbata, Aristolochia pontica, Tamus communis	-	5,500	-	5,500
Liana-rich mixed deciduous forest with spruce – Picea orientalis, Carpinus caucasica, Alnus barbata, Salix caprea	25,500	-	-	25,500
Chestnut forest with cherry-laurel – Castanea sativa, Acer campestre, Alnus barbata	-	7,500	-	7,500
Degraded spruce (Picea orientalis) forest with deciduous species – Quercus petraea ssp. dshorochensis, Fagus orientalis, Ulmus glabra, Carpinus caucasica	55,750	-	-	55,750
Riparian woodland – Alnus barbata dominant	3,750	8,500	27,500	39,750
Walnut plantation – Juglans regia, Alnus barbata, Picea orientalis	6,500	-	-	6,500
Riverine forest & scrub – Salix alba, Robinia pseudoacacia, Alnus barbata	128,000	95,000	82,000	305,000
Pontic rhododendron (Rhododendron ponticum) scrub	4,500	-	-	4,500
Riverside grassland- river terrace typically used for agricultural/grazing purposes	896,500	315,00	135,000	1,346,500
Bare rock, crevices and riverside deposits	412,000	275,000	175,000	862,000
Total (m2)	1,547,000	726,000	432,000	2,705,000

8.5.1.3 Terrestrial Fauna

Shuakhevi Scheme

Of the protected and notable fauna across the Project, a total of eight mammal, seven bird, two reptile and one amphibians species have been recorded within the Koromkheti Scheme, the impact of these terrestrial fauna can be summarised:

- The significance of any likely impacts related to the construction of the scheme is dependant on the presence or absence of species of high conservation concern and their specific sensitivity to likely impacts. This is particularly relevant to the potential disturbance and potential increased hunting of raptor species. The exact distribution of species of high conservation concern in relation to the scheme footprint is not known and under the precautionary principle all species of high conservation value are assumed to be present with the area impacted by construction. Of the eight bird species of high conservation value recorded in the Koromkheti Scheme AoI common rosefinch is most likely to be directly affected as a result of loss and fragmentation of the scrub habitats associated with access roads, construction working areas, loss of nesting sites and noise disturbance. This impact is likely to be minor negative in magnitude and of moderate adverse significance. The remaining seven species of high conservation value are all raptor species and are most likely to be affected by the scheme through noise disturbance and the potential increase in hunting. Potentially disturbing activities likely to take place within proximity to an active nest site of one of these species (i.e. red-footed falcon, eastern imperial eagle, Levant sparrowhawk, long-legged buzzard, lesser kestrel) has the potential to result in the loss of a breeding pair. The resulting impact is likely to be of minor negative magnitude and of **moderate adverse** significance. Little ringed plover (Charadrius dubius), low conservation value, breed along the river edges and both their breeding and foraging areas would be impacted during construction, as well as physical and noise disturbance.
- Jackal and wild boar all occur within the AoI of this Scheme. The most significant construction impact to these species is likely to be increased risk of, combined with temporary habitat loss and disturbance is likely to result in a minor negative and therefore only of **minor adverse** significance.
- At least four bat species, and a further six possible, were recorded within the AoI of the Scheme, and these are likely to be impacted during construction from tree removal for access roads, noise and light disturbance, and temporary severance of commuting routes. No known bat roosts occur within the AoI, although it is likely that some minor tree roosts will be disturbed and lost. The impact on bats is likely to be moderate negative, but because all bat species are of high conservation value the impact significance is likely to be **major adverse**.
- The Caucasian toad is known to occur within the riverine habitats and forest margins within the lower reaches of the river. And various construction activities are likely to have a minor negative impact on this species due to localised habitat loss and degradation and disruption to local hydrological conditions and changes in water quality. The toad is of medium conservation value and therefore the significance is likely to be **minor adverse**.
- While otters are not particularly abundant in the river systems of Adjara (potentially due to the existing level of disturbance), they do occur. Otters are of high conservation value and the impact during construction has the potential to be moderate negative, due to disturbance, sediment release into the rivers, habitat loss, noise disturbance and construction activities in the river acting as an ecological barrier and of **major adverse** significance.
- Two reptile species, Caucasus viper (*Vipera kaznakovi)* and Clark's lizard *(Darevskia clarkorum*), which are both of very high conservation value, are likely to occur, at low abundance in forest edge habitats across the Scheme. The habitat loss, especially for access roads and construction activities although relatively localised is likely to result in a minor negative impact on these species which is likely to be of **moderate adverse** significance.

Khertvisi Scheme

Of the protected and notable fauna across the Project, a total of 11 mammal, six bird, two reptile and one amphibians species have been recorded with the Khertvisi Scheme, the impact of these terrestrial fauna can be summarised:

- The significance of any likely impacts related to the construction of the scheme is dependant on the presence or absence of species of high conservation concern and their specific sensitivity to likely impacts. This is particularly relevant to the potential disturbance and potential increased hunting of raptor species. The exact distribution of species of high conservation concern in relation to the scheme footprint is not known and under the precautionary principle all species of high conservation value are assumed to be present with the area impacted by construction. Of the eight bird species of high conservation value recorded in the Khertvisi Scheme AoI common rosefinch is most likely to be directly affected as a result of loss and fragmentation of the scrub habitats associated with access roads, construction working areas, loss of nesting sites and noise disturbance. This is impact is likely to be minor negative in magnitude and of **moderate adverse** significance. The remaining seven species of high conservation value are all raptor species and are most likely to be affected by the scheme through noise disturbance and the potential increase in hunting. Potentially disturbing activities likely to take place within proximity to an active nest site of one of these species (i.e. red-footed falcon, eastern imperial eagle, Levant sparrowhawk, long-legged buzzard, lesser kestrel) has the potential to result in the loss of a breeding pair. The resulting impact is likely to be of minor negative magnitude and of **moderate adverse** significance. In the absence of species of high conservation value there is likely to be a minor negative impact on species of medium and low conservation value and the magnitude of such impacts from habitat loss and increased hunting is likely to be minor negative and of **minor significance**.
- Brown bears are likely to occur within the AoI of this Scheme. The most significant construction impact to these species is likely to be increased risk of hunting and temporary habitat loss and disturbance is likely to result in a minor negative and because the brown bear is of medium conservation value the significance is likely to be **moderate adverse**.
- Eight bat species were recorded within the AoI of the Scheme, and these are likely to be impacted during construction from tree removal for access roads, noise and light disturbance, and temporary severance of commuting routes. No known bat roosts occur within the AoI, although it is likely that some minor tree roosts will be disturbed and lost. The impact on bats is likely to be moderate negative, but of **major adverse** significance due to the high conservation of the species.
- The Caucasian toad is known to occur within the riverine habitats and forest margins within the lower reaches of the river. The various construction activities are likely to cause localised habitat loss and degradation, and local hydrological changes are likely to reduce the suitability of the available habitat, this is likely to have a minor negative impact on this species, which would be of **minor adverse** significance.
- While otters are not particularly abundant in the river systems of Adjara (potentially due to the existing level of disturbance), they do occur. Otters are of high conservation value and the impact during construction has the potential to be a significant and moderate negative, due to disturbance, sediment release into the rivers, habitat loss, noise disturbance and construction activities in the river acting as an ecological barrier. The significance of the impact would be **major adverse** this is due to the high conservation value of the species.
- Two reptile species, Caucasus viper (*Vipera kaznakovi)* and Clark's lizard *(Darevskia clarkorum*), which are both of very high conservation value, are likely to occur, at low abundance, across the Adjara region. The habitat loss especially from the construction access roads and construction activities leading to habitat loss and degradation and accidental killing/injury of retiles, although relatively

localised is likely to result in a minor negative impact on these species. The significance is likely to be **moderate adverse** due to the very high conservation value and protected status of these species.

8.5.1.4 Fisheries and Aquatic Habitats

In this section the impacts of the Project on the aquatic habitats and fisheries are described. More detail on the impacts is provided here, compared to the terrestrial impacts, due to the greater disturbance and the extent of construction activities and the potential for significant impacts on aquatic ecology.

Shuakhevi Scheme

For the Shuakhevi Scheme it is anticipated that the construction period will take approximately three years. The potential impacts that could be generated for each element of the Scheme are described below. See Figure 2.19 which shows the location of the weir and dams, including sediment trap.

On the Chirukhistsqali (Chi1), a 3 m weir and intake is to be constructed at an elevation of about 900 masl. The works will involve the following potential impacts:

- While the weir and intake structures are being constructed there is likely to be disturbances to down stream in the water flows and a reduction in water quality;
- Temporary disturbance of up to to 500 m of river bed due to construction work on installing the weirs and sediment traps within the bed of the river;
- Temporary small increase in suspended sediments due to disturbance of the sediments during parts of construction and depositing of tunnel waste areas along the river banks;
- Permanent loss of 50 m of river bed due to installation of the weirs and sediment trap; and
- Temporary obstruction to fish movements/migration.

It is envisaged, however, that the magnitude of impact will be reduced for the following reasons:

- There is no indication from the fish surveys that this river bed area is utilised as spawning habitat;
- There will be no obstruction to the migratory movement of protected fish species, as the brown trout population within the AoI are spawning at higher altitudes and do not migrate out to sea. No other protected migratory fish species are present within the River, and
- Adult fish are capable of avoiding areas with elevated suspended sediments and this area is already subjected to frequent increases in suspended sediments from regularly occurring landslides.

Consequently the magnitude of impact is considered to be **minor negative.**

On the Skhalta (Skh1), an approximate 21 m high dam is to be constructed, located at about 780 m elevation, which will involve the following potential impacts:

- Permanent obstruction of upstream fish movement to feeding areas;
- Temporary loss of habitat 500 m of potential spawning river habitat within the actual footprint of the reservoir;
- Disturbances to river flow downstream of the dam site with potential to impact on spawning habitat, for two years during construction; and
- Temporary increase in suspended sediments which could result in the smothering of fish eggs and their subsequent failure to hatch around the time of spawning.

However, the magnitude of impact will be reduced for the following reasons:

- There is sufficient available habitats elsewhere along the Skhalta which could be utilised by spawning Cyprinids from April to the end of August.

- Adult fish are capable of avoiding small localised areas of high suspended solids. It is also important to consider that within the AoI, frequent landslides occur and therefore the ecology of the river is already subject to an increase in suspended solids.

Consequently the magnitude of impact is considered to be **moderate negative.**

On the Adjaristsqali (Adj7), the Didachara dam, approximately 36 m high, is to be constructed at an elevation of about 780 m, consequently the potential impacts include:

- The permanent loss of 800 m length of river bed within the footprint of the reservoir;
- Permanent obstruction to fish upstream movement and movement to different feeding areas;
- Temporary disturbance to 800 m length of river bed for access and construction of the dam; and
- A temporary increase in suspended solids and their subsequent downstream deposition.

However, the magnitude will be reduced as:

- The fish surveys indicate there would be no loss of spawning habitat on the Adjaristsqali. The only spawning areas are in the adjacent tributaries (see Volume III, Appendix D4), which will not be affacted by the Scheme;
- Adult fish will move away from areas with elevated suspended sediments, although they are already accustomed to infrequent inputs of elevated levels of suspended sediments; and
- Interviews with fishermen indicate there are no protected species migrating along this route to sea.

Consequently the magnitude of impact is considered to be **minor negative**.

The Adjarastsqali (Adj 5) powerhouse is to be constructed on the right bank of the Adjaristsqali River. Excavation work could cause some temporary disturbance to the banks and a potential release of sediment into the river due to excavation works in river bank. Subsequently, there could be a temporary deterioration in water quality from an increase in suspended sediments and their subsequent deposition on the river bed. There will be no interruption to the water supply, and no known loss of spawning habitat. Consequently the magnitude of impact is envisaged to be **minor negative**.

Overall the cumulative impact of each of the different components of the Shuakhevi Scheme is likely to result in a moderate negative on the aquatic ecology of the river system, including impacts on the fish population, and spawning habitats. The significance of the impact on brown trout, Colchic khramulya and other fish species is likely to be moderate adverse, this is because of the medium conservation value of these species.

Koromkheti Scheme

For Koromkhet Scheme it is anticipated that the construction period will last over a three year period. Similarly to Shuakhevi there are also potential impacts and subsequent effects associated with each element of the Scheme.

The Khichauri (Adj 5a) 17 m high dam is located at an elevation of 350 m. The same impacts and subsequent effects as described previously for dam construction with the permanent loss of 800 m length river bed. However, the fish surveys do not indicate this as a potential spawning site and there would only be a temporary obstruction to fish movement upstream during construction.

Consequently a moderate negative impact is envisaged during construction.

On the Chvanistsqali (Chv 1) a 10 m dam with diurnal storage and sediment trap constructed at an elevation of 355 m. The same impacts and subsequent effects as described previously for construction in Shuakhevi Scheme could potentially occur. The dam, without mitigations, would act as a significant obstruction to the movement of fish species along the river. This part of the Chvanistqali River is known as a spawning area for fisheries (see Appendix D4).

Consequently, a moderate negative impact on the aquatic ecology is envisaged.

A weir, sediment trap and intake will be installed on the Akavreta River (Aka 2), at an elevation of 355 m. This location has been identified as potential spawning sites from April through to the end of August. Brown trout are also recorded on the Akavreta. Thus, potential effects include the loss of spawning habitat for some rheophillic and limnophillic species. However, while there would be a loss in spawning habitats, fishery survey indicate other spawning along the Akavreta and its tributary which would be used by these species There would be no permanent obstruction to fish movement including potential passage of brown trout. Consequently a moderate negative impact is envisaged.

A powerhouse is to be constructed for the Koromkheti (Adj 5b), at an elevation of 155 m in an underground cavern adjacent to the main Adjaristsqali River. Potential temporary effects include deterioration in water quality from a small increase in suspended sediments and subsequent deposition on the river bed associated with construction activities and tunnelling. While any significant sediment release could act as a temporary barrier to fish movement, impacts on the river will be minimal with no loss of spawning habitat and adult fish are capable of moving away from areas of sediment loading and temporary disturbance. A minor negative impact is envisaged.

Consequently, for the Koromkheti Scheme, the overall impact, including the cumulative impact of each component is likely to be a moderate negative, and the significance is likely to be moderate adverse on brown trout, Colchic khramulya and other fish species.

Khertvisi Scheme

For the Khertvisi Scheme it is anticipated that the construction period will take two years. The potential impacts and subsequent effects will be similar to the other Schemes, and outlined below.

On the Adjarastsqali River (at Adj 1) an 8 m high concrete dam, located at an elevation of 90-100 m, is to be constructed. Similarly to the construction methods described for the other Schemes, there would be a permanent loss of about 750 m of river bed and a potential increase in suspended solids. However, as the fish surveys do not indicate that area is utilised as spawning habitat, there would only be a temporary obstruction to fish movement upstream and this route is not utlised for the migration of the protected fish species the magnitude of impact is less than for other Schemes. Consequently a **minor negative** impact is envisaged.

On the Machakhlistsqali River (Mac 1) a run of river weir and sediment trap is to be constructed. Temporary construction work would result in the permanent loss of spawning habitat for Cyprinds and the Black Sea Salmon. And while as the fishery survey indicates that there is significant suitable spawning habitat elsewhere along the Machakhlistsqali River, these habitats will be temporarily impacted during construction. Consequently a **moderate negative** impact is envisaged.

For construction of the Khertvisi powerhouse, on the left bank of Adjaristskali near the Chorokhi confluence, bank excavation will be required, which could result in a temporary short term deterioration in water quality from an increase in suspended sediments and their subsequent deposition on the river bed. The fish survey recorded 15 species in this locality along with the protected European eel and colchic khramula. However, the impact on the fish will be minimised because of the temporary nature of the impacts and as adult fish would be capable of moving away from areas with elevated suspended solids. The fish surveys confirm that there are no spawning sites and there will be no obstruction to fish movement. Consequently, a **minor negative** magnitude of impact is envisaged, largely due to an increase in sediment release.

The overall impact of the Khertvisi Scheme on fisheries and aquatic ecology is likely to be moderate negative, but only because of the impacts associated with the Machakhlistsqali component of the Scheme, and this is likely to be of **major adverse** significance for European eel due to its very high conservation value, and **moderate adverse** on the Black sea salmon during construction phase.

8.5.2 Operational Impacts

In the following Section, the impacts associated with the operational activities of the Project on the ecological features within the AoI.

8.5.2.1 Protected Areas

Kintrishi Nature Reserve/Important Bird Area and Mtirala National Park are outside the AoI, and would not be impacted by the Project.

Machakhela National Park is within the Project AoI. However, the only infrastructure which would impact on the national park is part of the Khertvisi Scheme, which would involve a run of river weir and sediment trap. The run of river weir and sediment trap is likely to act as a partial barrier to fish movement and potentially otters. However, these impacts would be localised and the integrity of the national park would be not affected.

The flows downstream of the run of river weir on the Machakhlistsqali would be reduced, but would only affect, at maximum, a 4 km reach of the river downstream of the weir location until the river meets the Chorokhi. The impact on the Machakhela National Park is likely to be minor, especially given the large size of the park and the relatively small areas of the Machakhlistsqali River which would be impacted. Nevertheless, given the high conservation value of the national park, the impact significance would be **moderate adverse**.

8.5.2.2 Terrestrial Habitats & Flora

The impacts of the operational activities of the Project on the terrestrial habitats and flora are likely to be similar to that of construction. A summary of the habitat loss for each of the Schemes is provided in Table 8.14 and Table 8.18 and summary of the impacts in Table 8.20 to Table 8.25.

A total of ten key habitats occur within the AoI of the **Shuakhevi Scheme**, in summary:
- The habitat with the highest conservation value in this Scheme area is the oak forests. Some oak forest habitat will be lost as a result of inundation and permanent habitat loss from associated infrastructure; (notably roads and welfare facilities, but the actual areas of oak forests permanently lost is likely to be limited the impact will be minor negative of **moderate adverse** significance.
- The main habitat type which will be impact by the Scheme is the riverside grassland and terraces, with patches of riverine forest and scrub dominated by alder, the impact is likely to be moderate because of

the large areas of this habitat being lost as a result of inundation and operational infrastructure. However these habitats are of low conservation value and therefore the significant is only likely to be **minor adverse.**

- Area of pontic rhododendron scrub occurs within the AoI of the Scheme, some areas of this relic scrub are likely to be lost as a result of inundation and a minor impact anticipated as the area inundated is a small proportion of the total rhododendron scrub area. These habitats are of high conservation value and therefore the impact significance is likely to be **moderate adverse**.
- The main forest habitat within the AoI of the Scheme is the degraded spruce forest with mixed species. The impact on this habitat is likely to be moderate as a result of significant habitat loss associated with inundation and infrastructure associated with the operational works, with an impact significance of **moderate adverse**.
- Regarding individual plant species, only three protected (red listed) plant species of medium conservation value or higher have been confirmed as occurring within the AoI of the Shuakhevi Scheme, although other species occur. The impact on these species is likely to be **minor to moderate** due to the loss and degradation of habitat, especially in the forest habitats around the dam sites, and habitats lost as part of the associated infrastructure, depending on the actual number of plants being affected.

A total of nine key habitats occur within the AoI of the **Koromkheti Scheme** and this section of the Project represents the most important area for habitats and floristic diversity, with three habitats of high conservation value and of critical importance for endemic plant species and protected fauna, in summary:

- The most important habitats of high conservation which will be directly affected by the Scheme are the deciduous forests, of oak, hornbeam-chestnut and mixed species composition, with relic scrub and herbaceous species. The impact on these habitats due to the land area lost through inundation and roads is likely to be **moderate adverse**.
- The impact on areas of bare rock, riverside grassland and terraces, riverine scrub and alder forest is likely to be **moderate adverse** due to the significant areas of habitat which will be lost as a result of inundation (see Table 8.13 and Table 8.18), and maps presented in Volume II, Appendix D10.

The deciduous forest habitats through the Scheme are important for a large number of protected, relic and notable plant species (Table 8.5 and Table 8.6). While the location of individual plants is not quantified, prior to mitigations, the impact on these species due to habitat loss and degradation from the construction activities is likely to be **moderate and significant**.

A total of six key habitats occur within the AoI of the **Khertvisi Scheme**, in summary:

- The lower elevation of the Adjarastsqali River are dominated by habitats of low conservation value, notably riverside grassland, riverine forests & scrub, and alder forests and the impact on these habitats is likely to be moderate due to the significant areas of habitat being lost as a result of inundation and associated infrastructure. The impact significance being **minor adverse**.
- The most important habitats within the Machakhlistsqali gorge are deciduous forests of high conservation value, along the forest gorge. The Scheme is, however, likely to only have a minor negative impact on these forests as these habitats would only be lost from the works associated with the intake tunnels and operational infrastructure. The main impact in the Machakhistsqali gorge is likely to be on the riverine alder forests and scrub of low conservation value with a moderate negative impact due to localised habitat lost and local changes in hydrological condition upon which these riverine forests are dependent. The impact is likely to be of **minor adverse** significance.

Three protected plant species and a number of endemic and locally rare species have been recorded within the AoI of the Khertvisi Scheme, although other species will probably occur. The Project impacts on these species, prior to mitigation, are likely to be moderate; this is because of the local habitat loss, associated inundation and operational infrastructure. The floristic diversity along the riverine terraces is notable, including the presence of cyclamens which are abundant along the terraces of the Machakhlistsqali.

8.5.2.3 Terrestrial Fauna

Shuakhevi Scheme

A number of protected and notable fauna across the Project have been recorded, the impact on these terrestrial fauna can be summarised as follows:

- The Caucasian salamander is likely to occur in the forest habitats at higher elevations associated along the Chirukhistsqali, and would be impacted by habitat loss associated with inundation. However, given the likely scarcity of the salamander and the localised impacts, it is only likely to be very local and minor negative impact of this species of high conservation value, the significance is likely to be **minor adverse**.
- The significance of any likely impacts related to the operation of the scheme is dependant on the presence or absence of species of high conservation value and their specific sensitivity to likely impacts. The main impact is likely to be the loss of terrestrial habitat from inundation. There is likely to be a minor negative impact of **moderate adverse** significance on notable common rosefinch and boreal owl if present in the breeding season in the surrounding forest habitats. In the absence of species of high conservation value there is likely to be a minor negative impact on species associated with habitats lost as a result of inundation and that this is of minor negative magnitude and **minor adverse** significance. The open water habitats created from the reservoir may benefit certain bird species, such as waders and waterfowl, which could potentially benefit the overall bird diversity along the river catchment. The impact of such habitat creation is likely to be of a **minor beneficial** magnitude because the structure of the waterbodies and therefore the habitat features of the new waterbodies will inherently be limited as a result of the local topography.
- The impact on mammals (excluding bats & otters) will be associated with habitat loss from inundation, and potential occasional hunting due to the permanent increased access to the area from improved access roads. The impact is only likely to be **minor and insignificant**.
- Otters are, however, likely to be significantly impacted from the reduced flows and the dams/weirs acting as physical barriers to movement up and down stream. Otters will also be impacted from changes in food availability (due to river flow changes) and loss of terrestrial habitats along the river margins. The impact, prior to mitigation, is likely to be large and of **major adverse** significance.
- Four bat species were recorded within the AoI of the Scheme, and these are likely to be impacted from the loss of forest habitats (notably tree as roosting sites). However, this will in part be compensated from the creation of open water habitats which will provide favourable foraging habitats for bats. The impact on bats is therefore likely to be minor negative, but of **moderate adverse** significance due to the high conservation value of bats.

Koromkheti Scheme

Of the protected and notable fauna across the Project, a total of eight mammal, seven bird, two reptile and one amphibians species have been recorded, the impact of these terrestrial fauna can be summarised:

- The significance of any likely impacts related to the operation of the scheme is dependant on the presence or absence of species of high conservation value and their specific sensitivity to likely impacts. The main impact is likely to be the loss of terrestrial habitat from inundation. There is likely to be a minor negative impact of **moderate adverse** significance on notable common rosefinch present in the breeding season in the surrounding habitats. In the absence of species of high conservation value there is likely to be a minor negative impact on species associated with habitats lost as a result of inundation and that this is of minor negative magnitude and **minor adverse** significance. The open water habitats created from the reservoir may benefit certain bird species, such as waders and waterfowl, which could potentially benefit the overall bird diversity along the river catchment. The impact of such habitat creation is likely to be of a **minor beneficial** magnitude because the structure of the waterbodies and therefore the habitat features of the new waterbodies will inherently be limited as a result of the local topography.

- The impact on mammals (excluding bats and otters) will be associated with habitat loss from inundation, and potential occasional hunting. However the impact is likely to be minor and due to the low conservation value, the impact is likely to be **insignificant**.
- For bats, while habitat loss as part of the reservoirs will have a negative impact, this would be compensated by the areas of open water being created as part of the reservoir. Large areas of water bodies attract insects and in turn act as favourable foraging areas for bats. Therefore the operational impacts on bats are likely to be neutral as part of the Koromkheti Scheme.
- Otters are likely to be significantly impacted from the reduced flows and the dams/weirs acting as physical barriers to movement up and down stream. Otters will also be impacted from changes in food availability (due to river flow changes). The impact, prior to mitigation, is likely to be major and because otters are of high conservation value the impact significance is likely to be **major adverse**.
- Two reptile species, Caucasus viper and Clark's lizard, which are both of very high conservation value, are likely to occur, at low abundance, across the habitats of the Scheme. The permanent habitat loss associated the reservoir, dam sites and roads across the entire Project area is likely to result in a minor negative impact on these species and of **moderate adverse** significance.

Khertvisi Scheme

The impact on the terrestrial fauna during the operational activities of the Project will be significantly less, and predominately associated with habitat loss from the reservoirs, and roads, as well as general disturbance from increased activity across the area.

- The significance of any likely impacts related to the operation of the scheme is dependant on the presence or absence of species of high conservation value and their specific sensitivity to likely impacts. The main impact is likely to be the loss of terrestrial habitat from inundation. There is likely to be a minor negative impact of **moderate significance** on notable ruddy shelduck if present in the breeding. In the absence of species of high conservation value there is likely to be a minor negative impact on species associated with habitats lost as a result of inundation and that this is of minor negative magnitude and of **minor adverse** significance. The open water habitats created from the reservoir may benefit certain bird species, such as waders and waterfowl, which could potentially benefit the overall bird diversity along the river catchment. The impact of such habitat creation is likely to be of a **minor beneficial** magnitude because the structure of the waterbodies and therefore the habitat features of the new waterbodies will inherently be limited as a result of the local topography.
- A possible ten bat species were recorded within the AoI of the Scheme, and these are likely to be impacted from habitat loss (notably loss of roosting sites) and possible fragmentation of these habitats.. However, this will in part be compensated from the creation of open water habitats which will provide favourable foraging habitats for bats. The impact on bats is therefore likely to be minor negative.
- Otters are likely to be significantly impacted from the reduced flows and the dams/weirs acting as physical barriers to movement up and down stream. Otters will also be impacted from changes in food availability (due to river flow changes) and potentially from the loss of terrestrial habitats. The impact, prior to mitigations, is likely to be major and given that this species is of high conservation value the impact significance is likely to be large adverse.

- The Caucasian toad is known to occur within the riverine habitats and forest margins within the lower reaches of the river. The permanent habitat loss associated with inundation and infrastructure is likely to have a minor negative impact on this species and of moderate adverse significance.
- Two reptile species, Caucasus viper and Clark's lizard, which are both of very high conservation value, are likely to occur, at low abundance, across the habitats of the Scheme. The permanent habitat loss associated the reservoir, dam sites and roads across the entire Project area is likely to result in a minor negative impact on these species and of moderate adverse significance.

8.5.2.4 Fisheries and Aquatic Habitats

The following sections outline the operational impacts of the Project on fish and aquatic habitats for each Scheme. The main impacts during the operational phase include i) reduced flows downstream of each dam and weir, ii) the dams, weirs and discharges from the powerhouses acting as physical barriers to the migration of fish, and iii) sediment flushing from the dams, iv) creation of small reservoirs.

Hydrological changes and associated impacts are described in detail in Chapter 9 of this report. The assessment of operational impacts has assumed that there will be a reduction of river flows downstream of dams and weirs to 10% of the mean annual flow. This value has been considered as the minimum environmental flow as part of the Phase I assessment. Chapter 10 provides an overview of the approach taken to assess environmental flow requirements as part of a two stage process. Phase I of which is to review impacts at catchment level based on inputs to hydraulic model to assess overall potential impacts of the scheme using a uniform measure for setting minimum flows. Phase II of the approach will be to further refine environmental flow requirements from an ecological basis by undertaking detailed and long term *in situ* monitoring and identification of habitat reinstatement measures as well as confirmation of sensitive reaches. The impacts identified in Phase I as major or moderate magnitude will be subject to further assessment as part of Phase II. The following sections assess each of the rivers affected by the scheme individually as well as dividing each river to discuss the impact of reduced flows on specific reaches which, in many cases, benefit from additional inflows from tributaries. Each section provides an illustration of the different impacted reaches assessed (per scheme), discussion of the changes compared with the annual average flows as well as low flows, and daily flow records which provides a clear illustration of variation in flows across an average year (1964 chosen as representative average year from 40 year data series) pre and post-construction.

During this Phase I assessment the sensitivity of habitats is focused on the presence/absence of spawning habitat. This approach has been adopted due to information availability at the time this assessment is being carried out, although the use of spawning grounds as the indicator habitat can also be used as a surrogate for other stages of fish life cycles such as juveniles. Requirements of spawning habitats are mainly related to availability of suitable substrate, however tt is known that young fish will stay close to the site where their parents spawned during their first years, and therefore it is important to have good juvenile habitat next to spawning sites. The presence of spawning habitat is a good indicator that juvenile habitat will need to be protected in the same reach of the river. Phase II of the environmental flows assessment will look in more detail at juvenile as well as suitable adult habitat requirements.

Shuakhevi Scheme - Chirukhistsqali River

On the Chirukhistsqali River, the main impacts result from a reduction of the natural flows downstream of the weir (Chi 1) to a minimum of 10% of the long term annual flow average. However, in reality this is not a constant fixed environmental flow due to the fact that the intake capacity of the weir (i.e. how much water can actually be diverted into the scheme) is limited and therefore there will be times during the year that water will spill over the weir supplementing the environmental flow. Despite occasional spilling, there will be a major impact on the hydrology of the river and on the riverine habitats immediately downstream of the Chirukhistsqali weir, but due to the presence of several tributaries further downstream the magnitude of the hydrological changes will diminish along the river. The following section provides an assessment of the significance of impact for different reaches along the Chirukhistsqali River. The proposed scheme has the potential to result in the following impacts on the Chirukhstsqali River:

- Permanent reduction in suitable riverine habitats;
- Alteration in the bankside vegetation and associated shelter for some fish species;
- Risk of fish mortality during downstream migration as result of entrainment into intake structure; and
- Barrier to further upstream migration.

For brown trout residing at higher elevations (above 800m), the dams would, without mitigation, pose a significant obstacle to migratory movement for spawning. In the long-term this could potentially reduce the genetic diversity within the populations. The dams will also be an obstacle for other fish species of lower conservation value accessing spawning sites, notably on the Skhalta but also on the upper tributaries of the Adjaristsqali. Consequently, the magnitude of the impact is assessed to be major negative from the Shuakhevi Scheme on the fish species and aquatic ecology is likely, and due to the medium conservation value of the fish species in this Scheme area the impact significance is likely to be **moderate adverse**. This is related to the presence of the dam and therefore is not addressed in the following sections.

All of the above impacts may be experienced as a result of the project; however site specific characteristics and sensitivities are described for each reach and taken into consideration in determining overall impact significance.

Chi1 (A)

The following characteristics, based on the baseline information, have been considered when defining the ecological sensitivity of this reach:

- No suitable spawning habitat (and therefore likely presence of juvenile feeding grounds) was recorded to be present in this section of the river;
- Existence of a small weir and hydropower scheme located immediately upstream of Chi 1 acting as barrier to upstream and downstream migration;
- The presence of a small tributary, not affected by the scheme, located downstream of Chi1 which will continue to provide some flows into the Chirukhistsqali and therefore maintain some suitable fish habitat and bankside vegetation; and
- Many of the cyprinids present in this stretch of the river are able to tolerate a range of flow conditions.

Figure 8.6 shows the different sections of the Chirukhistsqali River based on the different tributaries inputs. Section Chi1 A receives inflow from two small rivers on the right bank. Impacts will be greater on the first two kilometres downstream the weir. Figure 8.8 shows the estimated flows just downstream the weir once the scheme is in operation. In an average year, annual flows overall would higher than 10% of the annual average and would be approximately 20% of this value. This is due to the weir spilling during high flows, thus increasing flows above the minimum 10% from March to May; however it is expected that flows will not exceed the 10% minimum of 0.46 cumecs during the low flow periods (approx 6 months of the year). The estimated daily flows for an average year (Figure 8.6) show a significant change to the flow pattern at this location with shorter high flows periods and never exceeding the environmental flow of 10% of the long term annual average during the low flows season.

The ecological sensitivity of this reach is considered to be low, as no spawning habitat as been identified during the fish surveys, and the magnitude major, therefore the significance of impacts on fisheries are likely to be **moderate adverse**.

Chi 1 (B)

The following characteristics based on the baseline information have been considered when defining the ecological sensitivity of this reach:

- Presence of suitable spawning habitats within this reach;
- The presence of several tributaries, with the Modulistsqali River and Tbeti River being the most significant which will continue to provide some flows into the Chirukhistsqali and therefore maintain some suitable fish habitat and bankside vegetation; and
- Many of the cyprinids present in this stretch of the river are able to tolerate a range of flow conditions.

Spawning habitat for cyprinid species has been recorded in this section during the fish surveys carried out in summer 2011. The Modulistsqali River joins the Chirukhistsqali approximately 6.5km downstream of the Chi 1 weir and is an important tributary which provides significant inflows to the Chirukhistsqali River as well as increasing flow variability from the confluence onwards. Figure 8.5 shows that the estimated flows just downstream the confluence once the scheme is in operation would be 45% of the long term annual average and follow the natural river flow variability much more closely, both in high and low flows seasons. Looking at the low flows in August (Figure 8.6), for example, the estimated flows on a day in August were approximately 7.2 cumecs but post-scheme the flow would be 2.1 cumecs. This is higher than the proposed environmental flows (0.46 cumecs) but still much lower than would be in the river in a low flow period in an average year. This is a very simple comparison based on just one day but is an indication of the magnitude of impact during the low flow season, the daily flows represented in Figure 8.5 illustrate the potential impact in the summer months. However, these values are for the very top of this section and, as detailed below, the flows gradually improve further downstream and 6.5km downstream constituting 51% of the long term annual average.

The ecological sensitivity of this reach is considered to be medium (given the presence of cyprinid spawning habitat) and the magnitude moderate, therefore the significance of impacts on fisheries are likely to be **moderate adverse**.

Chi 1 (C and D)

Within these two sections spawning habitat is also present and suitable for cyprinid species. However flows in these sections are much improved due to a number of tributaries to the Chirukhistsqali. Post-scheme flows are expected to be in between 51% to 63% of the annual average flows (long term average). In addition the flow time series shown in Figure 8.5 for 1946 (an example of an average year) indicates that flow pattern in this section of the river is following the natural pattern very closely (Figure 8.6). In the low flow months the estimated pre and post-scheme are also very similar with post-scheme flows in August ranging from 12 to 8.5 cumecs, significantly higher than the proposed environmental flows.

The ecological sensitivity of this reach is considered to be medium (given the presence of cyprinid spawning habitat) and the magnitude minor, therefore, the ecological impacts on the fisheries are likely to be a **minor adverse**.

See Table 8.15 for a summary of flows at each affected reach pre and post-scheme as well as overall significance of the impacts.

Shuakhevi Scheme – Skalta River

The main impacts on the Skhalta River will result from a reduction of the natural flows downstream of the dam (Skh 1) to a minimum of 10% of the annual average flows. As in the previous section, the Skahlta River has been divided into three reaches taking in consideration the different tributaries that contribute to the Skhalta River. Figure 8.5 illustrates the different reaches considered and Table 8.15 includes a summary of the impact assessment as well as estimates of flow statistics pre-and pos-scheme.

The proposed scheme has the potential to result in the following ecological impacts on the Skhalta River:
- Permanent loss of spawning habitat for various Cyprinid species within reservoir area;
- Permanent reduction in flow and subsequent alteration/loss of riverine habitats downstream of the dam;
- Permanent alteration of the riparian vegetation and elimination of some slower backwater flood areas which shield some species from predation as well as providing important resting areas;
- Increase in limnophilic species; and
- Risk of fish mortality during downstream migration as result of entrainment into intake structure; and
- Barrier to further upstream migration.

All of the above impacts may be experienced as a result of the project. These potential impacts are different from the ones expected in the Chirukhistsqali as this proposed dam is larger with no fish pass provision. Site specific characteristics and sensitivities are described for each reach and taken into consideration in determining overall impact significance. The following section provides an assessment of the significance of impact for different reaches along the Skhalta River.

Skh1 (A)

From the dam site up to Skh 1(B) (distance of reach is approximately 4.2 km), the following characteristics based on the baseline information have been considered when defining the ecological sensitivity of this reach:
- The potential for suitable cyprinid spawning habitat was identified from the baseline along all the length of the Skhalta River, for this reason all different sections in this river are considered to be of moderate sensitivity.
- The river is subject to frequent landslides and river morphology is frequently changing as a result and characterised by very wide river bed with meandering channel.

The presence of the dam and the operation of the scheme will results in a reduction in flows, the post-scheme flows are estimated to be 28% of the pre-scheme annual average (long term average). This is due to the dam spilling during high flows (maximum intake capacity of Skhalta is 25 m^3/s), thus increasing flows above the minimum 10% from March to May (the 10% of annual average being 0.52 cumecs).

The expected daily flows for an average year (Figure 8.7) indicate an important reduction in flows during the low flow season. Estimated flows in August, during the scheme operation, in an average year, in this first reach downstream the weir would not go above proposed environmental flows (0.52 cumecs). Conversely, the estimate flows during the same month pre-scheme would range between 1.6 and 2.6 cumecs approximately.

The reduced flows in this reach will potentially result in significant changes to the riverine habitat and therefore has the magnitude of the impact is major, which when combined with a moderate sensitivity is assessment to have a potentially **major adverse** on fisheries. The larger impact on the Skhalta River, compared to the Chirukhistsqali, is due to the likely presence of suitable spawning habitat downstream of the dam site (see Volume III, Appendix D4).

Skh1 (B)

Skh 1 (B) reach is approximately 3km long, the following characteristics based on the baseline information have been considered when defining the ecological sensitivity of this reach:

- The potential for suitable cyprinid spawning habitat was identified from the baseline along all the length of the Skhalta River, for this reason all different sections in this river are considered to be of moderate sensitivity.
- The river is subject to frequent landslides and river morphology is frequently changing as a result and characterised by very wide river bed with meandering channel.
- Some small streams along the Skhalta River within this reach contribute to available flows in the River.

The potential impacts likely to result in this section are similar to the ones listed for Skh1 (A); however as several tributaries along the Skhalta River contribute to add flows along this section, post-scheme flows are gradually becoming closer to the pre-scheme conditions. At the top of this section it is estimated that average flows will be approximately 37% of the annual average (long term). In this reach post-scheme low flows are estimated to be between 1.0 and 1.2 cumecs (values for August), approximately twice the proposed environmental flows. Looking at Figure 8.7 the natural low flows in August are estimated to be within 2.2 and 3.4 cumecs, showing an important improvement from the upstream reach (Skh1 A). This will reduce the magnitude of the change in flows and consequently loss of important habitat.

The ecological sensitivity of this reach is considered to be medium and the magnitude moderate, therefore the significance of impacts on fisheries are likely to be **moderate adverse**..

Skh1 (C)

In the last section of the Skalta River just before the confluence with the Adjarisqali River confluence (approximately 4.1 km) the following characteristics based on the baseline information have been considered when defining the ecological sensitivity of this reach:

- The potential for suitable cyprinid spawning habitat was identified from the baseline along all the length of the Skhalta River, for this reason all different sections in this river are considered to be of moderate sensitivity.
- The river is subject to frequent landslides and river morphology is frequently changing as a result and characterised by very wide river bed with meandering channel.
- Some small streams along the Skhalta River within this reach contribute to available flows in the River.

It is estimated that at the top of this section flows will be approximately 42% of the annual average (long term). Figure 8.7 indicates that estimated post-scheme flows during the low flow months are likely to be in between 1.0 and 1.2 cumecs (in August), approximately twice the proposed environmental flows; however these are still lower than it would be during August in an average year.

At the top of this reach the flows post-scheme do not improve significantly from the upstream reach. Daily flows are still below the natural flows; however there are a few tributaries within this reach that will add flows and variability to the flow pattern in this reach. Downstream this section just upstream the confluence with the Adjarisqali River flows will be approximately 42% of the annual average (long term).

This reach constitute approximately 1\3 of the affected length of the river and the sensitivity is considered to be medium due to the potential presence of cyprinids spawning habitat, the magnitude of the change is considered moderate and therefore impacts in this reach are considered **moderate adverse**.

Shuakhevi Scheme – Adjarisqali River (Adj 7)

Impacts from the operation of the Didachara dam (Adj 7) and subsequent effects on the river ecology are likely to include the following:
- Loss of riverine habitat from a reduction in flow downstream;
- Dam acting as an obstruction to fish movement and the loss of aquatic habitats; and
- Loss of important feeding habitat.

Fish surveys indicated that spawning does not occur on the main Adjaristsqali River downstream of the Didachara and therefore there would not be any loss of spawning habitat. But while the Adjaristsqali is not a spawning area, in the autumn, many of the fry present in the tributaries move into this river to feed. A reduction in food availability is however not so much of a problem for some species with a varied diet and they will be at a competitive advantage as they would be readily able to select other prey items. Whereas, for species such as the Caucasian chub, kramulya and goby, which have a lower prey diversity, would be at a disadvantage (see Fish Survey Report in Volume III, Appendix D3). Subsequently the impact of the Didachara Scheme on fisheries is likely to be a **moderate adverse**.

Adj 7 (A)

The following characteristics based on the baseline information have been considered when defining the ecological sensitivity of this reach:
- Presence of suitable feeding habitat for cyprinid species; and
- Adjaristsqali River is important as a migratory route for some reophilic species and flows must not be reduced as much that would prevent the fish from moving up and down the main river and consequently isolating populations in the tributaries.

At this location the environmental flows will be provided by the Diakonidze River as no flows will be released from the dam. A water transfer from the Diakonidze River will be undertaken from the confluence to a few meters downstream the dam in the Adjaristqali River. Flows at this location are expected to be approximately 19% of the long term annual average, therefore almost twice the proposed environmental flows. Although the flow pattern (Figure 8.8) shows some variability in estimated post-scheme flows with pulses of higher flows even during the low flow season (in July), flows are significantly reduced in this section. Flows in August are expected to be within 0.5 and 0.16 cumecs contrasting with the 1.3 and 3.5 cumecs verified in pre-scheme flows during this period.

The ecological sensitivity in this reach is considered medium due to the presence of feeding habitat for some species; the magnitude of hydrological changes are expected to be major and consequently the impact is **major adverse.**

Adj7 (B)

The sensitivity criteria are the same as for the upstream reach:
- Presence of suitable feeding habitat for cyprinid species; and

- Adjaristsqali River is important as a migratory route for some reophilic species and flows must not be reduced as much that would prevent the fish from moving up and down the main river and consequently isolating populations in the tributaries.

Impacts from the operation of the Didachara dam (Adj 7) and subsequent effects on the river ecology in this reach (approximately 9.1km long) are likely to include the following:
- Loss of riverine habitat from a reduction in flow downstream; however flows are much improved due to the presence of some tributaries including the Skalta River.
- Dam acting as an obstruction to fish movement and the loss of aquatic habitats; and
- Loss of important feeding habitat.

In this reach flows are much improved due to inflow from the Skalta. It is expected that annual average flows (on an average year) will be approximately 34%, three times higher than the proposed environmental flows. Impacts in this section are for this reason of minor magnitude as flows are closer to the pre-scheme conditions. However as showed in Figure .8.8 during the low flow months the expected post-scheme flows are still significantly below the pre-scheme flows, decreasing from 1.9-2.8 cumecs (post-scheme interval in August) to 5.6 – 10.1 cumecs (pre-scheme interval in August).

The ecological sensitivity in this reach is considered medium due to the presence of feeding habitat for some species; the magnitude of hydrological changes are expected to be moderate as flow time series indicates that even in average conditions flows would be far from the pattern exhibited in pre-scheme conditions (Figure 8.8) and consequently the impact is **moderate adverse.**

Adj7 (C)

Impacts from the operation of the Didachara dam (Adj 7) and subsequent effects on the river ecology in this reach (approximately 9.1km long) are likely to include the following:
- Loss of riverine habitat from a reduction in flow downstream; however flows are much improved due to the presence of some tributaries including the Chirukhistsqali River; and
- Dam acting as an obstruction to fish movement and the loss of aquatic habitats; and
- Loss of important feeding habitat.

At the most upstream location in this reach, just downstream the confluence with the Chirukhistsqali River once the scheme is in operation, flows are expected to reach 47% of the annual average, almost five times the proposed environmental flows for the overall scheme. The expected daily flows during operation of the scheme for an average year at this location follow a very similar pattern to the pre-scheme conditions (Figure 8.8) even during low flows. In August the estimated post-scheme flows would be within 8.5 and 12.0 cumecs compared with 7.8 and 13.4 cumecs (pre-scheme). Consequently the magnitude of the change in flows is considered to be minor and impacts in this section are considered to be **minor adverse**.

Shuakhevi powerhouse

At Shuakhevi power house the most likely significant impacts would be:
- The release of a large volume of water at the tail race discharge point could result in a change in the river morphology along with some scouring effects, loss of vegetation and macroinvertebrates, but no loss of spawning habitat.
- There is also the potential for the force at which the water will be released to create a barrier to fish movement along the Adjaristsqali and into the various tributaries. The velocity is currently estimated to be around 1.5 m/s which could cause an obstruction to fish movement, however, this depends on how

quickly the velocity will dissipate in the receiving water course and the river width at that point, which will affect whether there is any of the river that does not get so affected by the discharge velocity.

The magnitude hydrological impacts downstream of the Shuakhevi powerhouse are likely to be major, and as the sensitivity of habitats in this section is considered moderate, the ecological impacts are likely to be **moderate adverse**.

Summary

Overall the Shuakhevi Scheme would significantly reduce the flows downstream along the Adjaristsqali River system and into the upper Adjaristsqali River which could adversely affect future fish populations and the aquatic ecology within the river system. Nevertheless it is important to note that due to the nature of this scheme (a run of river which results in dam/weirs spilling during high flows) and the fact that important tributaries contribute to the flows in all rivers adding to the flow pattern variability, the impacts need to be considered in a smaller geographic scale as they change considerably along the affected rivers. Table 8.15 presents a summary of the impacts along the rivers in the Shuakhevi Scheme, values presented are for an average year (1946).

Table 8.15: Summary of Potential Impacts from the Shuakhevi Scheme

	Distance (km)	Pre-scheme Annual average (m^3/s)	Post-scheme Annual average (m^3/s)	%of annual average (post-scheme)	Sensitivity	Magnitude	Significance
Chirukhistsqali River River (10% of long term average mean = 0.46 m^3/s)							
Chi 1 (A) – downstream the weir and intake to the confluence with the Modulistsqali River							
Chi 1 (A)	6.5	4.7	1.0	20	Low	Major	Moderate
Chi 1 (B) – Sections between the confluence with the Modulistsqali River and Adjarisqali River							
Chi 1 (B)	6.5	6.9	3.1	45	Medium	Medium	Moderate
Chi 1 (C)	3.7	7.6	3.9	51	Medium	Minor	Minor
Chi 1 (D)	0.9	10.4	6.3	63	Medium	Minor	Minor
Skalta River River (10% of long term average mean = 0.51 m^3/s)							
Skh 1 (A)	4.2	5.3	1.5	28	Medium	Major	Major
Skh 1 (B)	3.0	6	2.2	37	Medium	Medium	Moderate
Skh 1 (C)	4.1	6.5	2.7	42	Medium	Medium	Moderate
Adjaristsqali River River (10% of long term average mean = 0 *environmental flow provided by Diakonidze)							
Downstream Didachara dam up to confluence with Skalta River							
Adj 7 (A)	9.7	8.3	1.5	19	Medium	Major	Major
Downstream Skalta River up to confluence with Chirukhistsqali River							
Adj 7 (B)	9.1	15.9	5.4	34	Medium	Medium	Moderate
Downstream Chirukhistsqali River up to Power House inflow							
Adj 7 (C)	3.5	26.9	12.7	47	Medium	Minor	Minor

Figure 8.6: Shuakhevi Scheme Impact Assessment of Affected Reaches

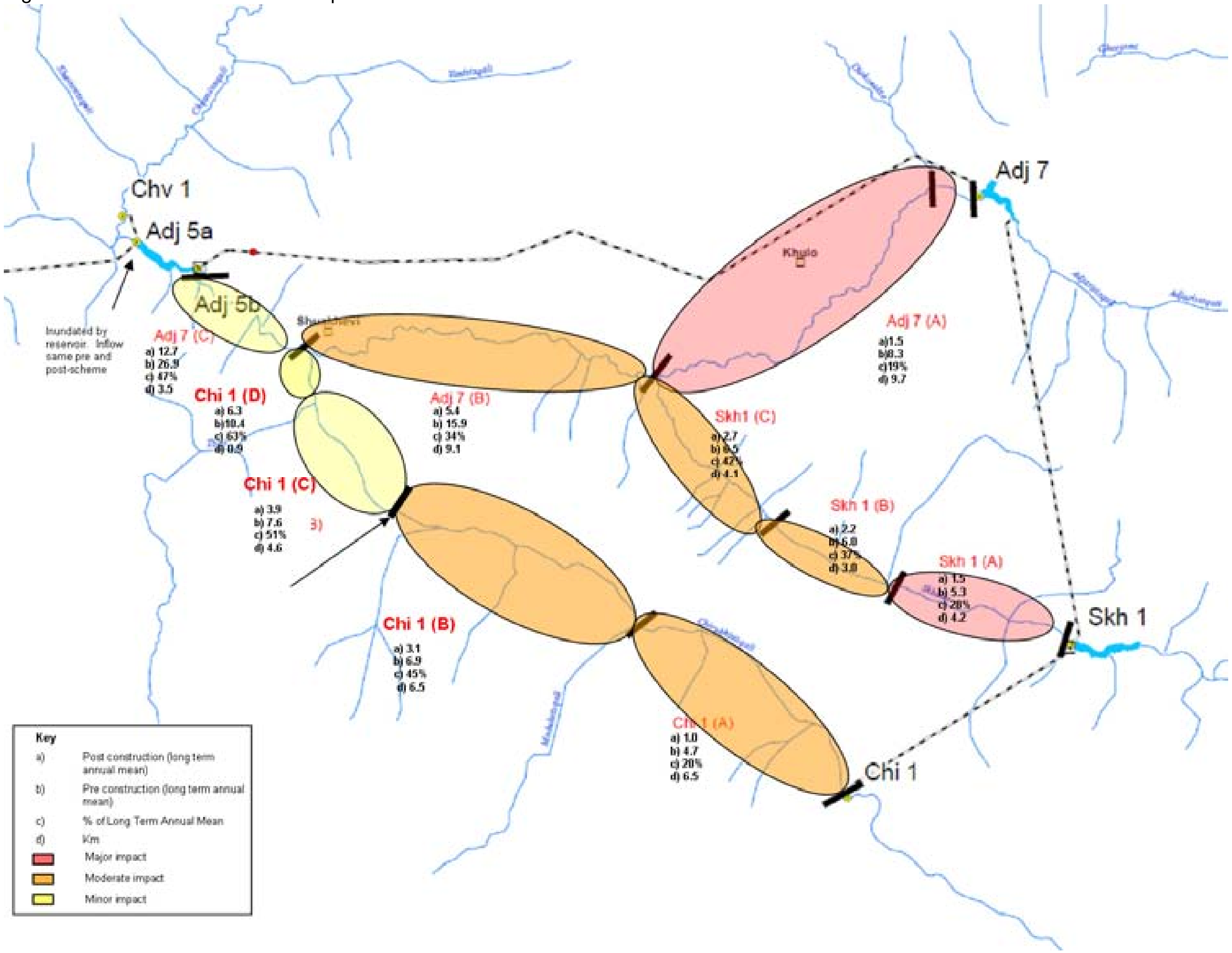
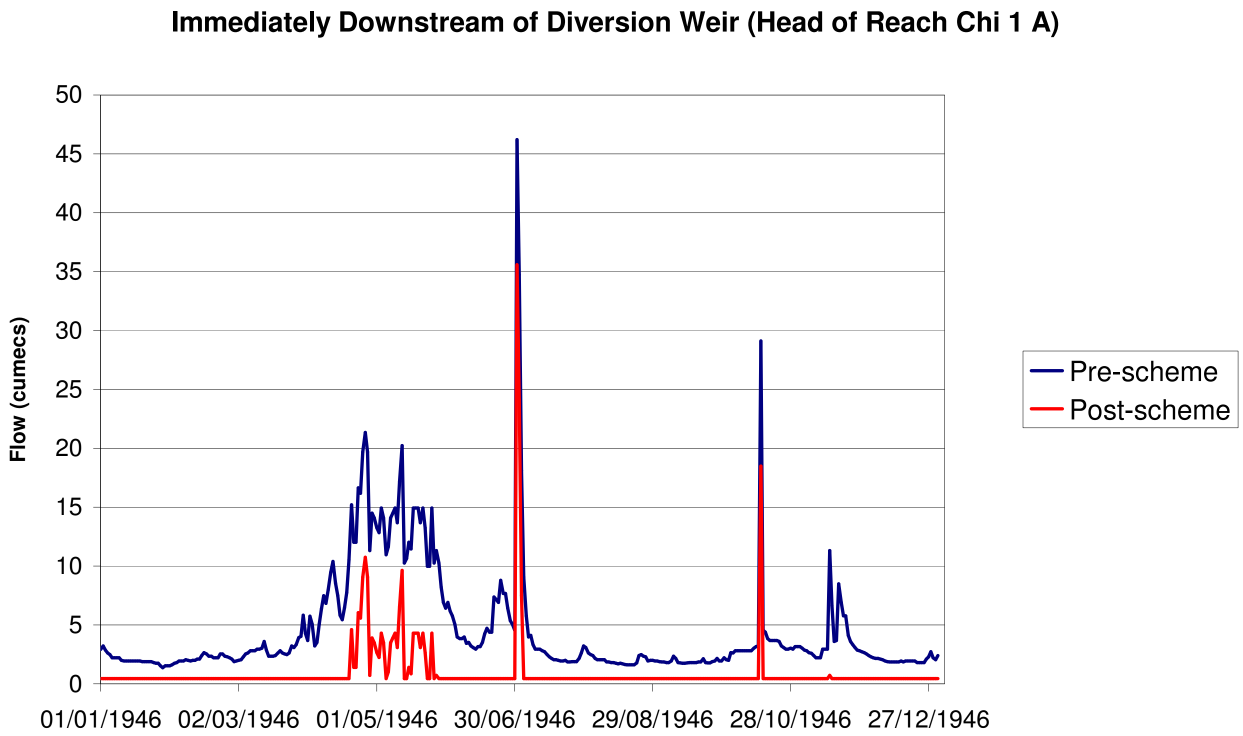
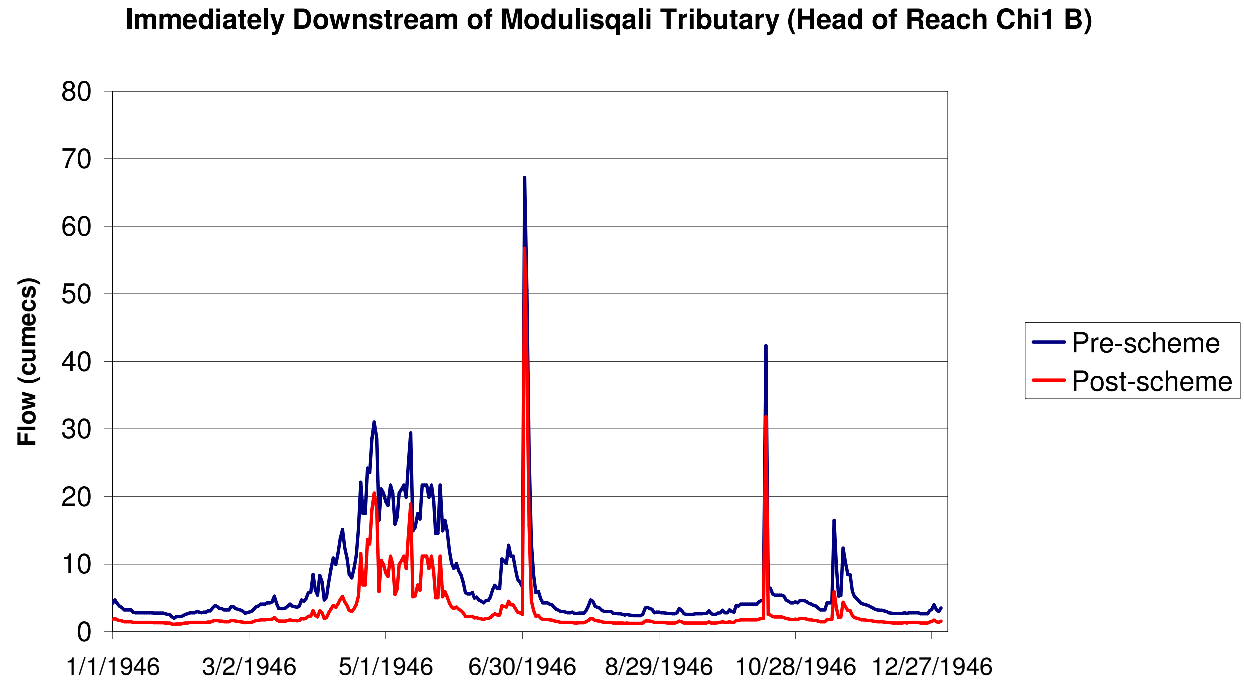


Figure 8.7: Daily Flow Series Pre and Post Scheme for Chirukhistsqali River





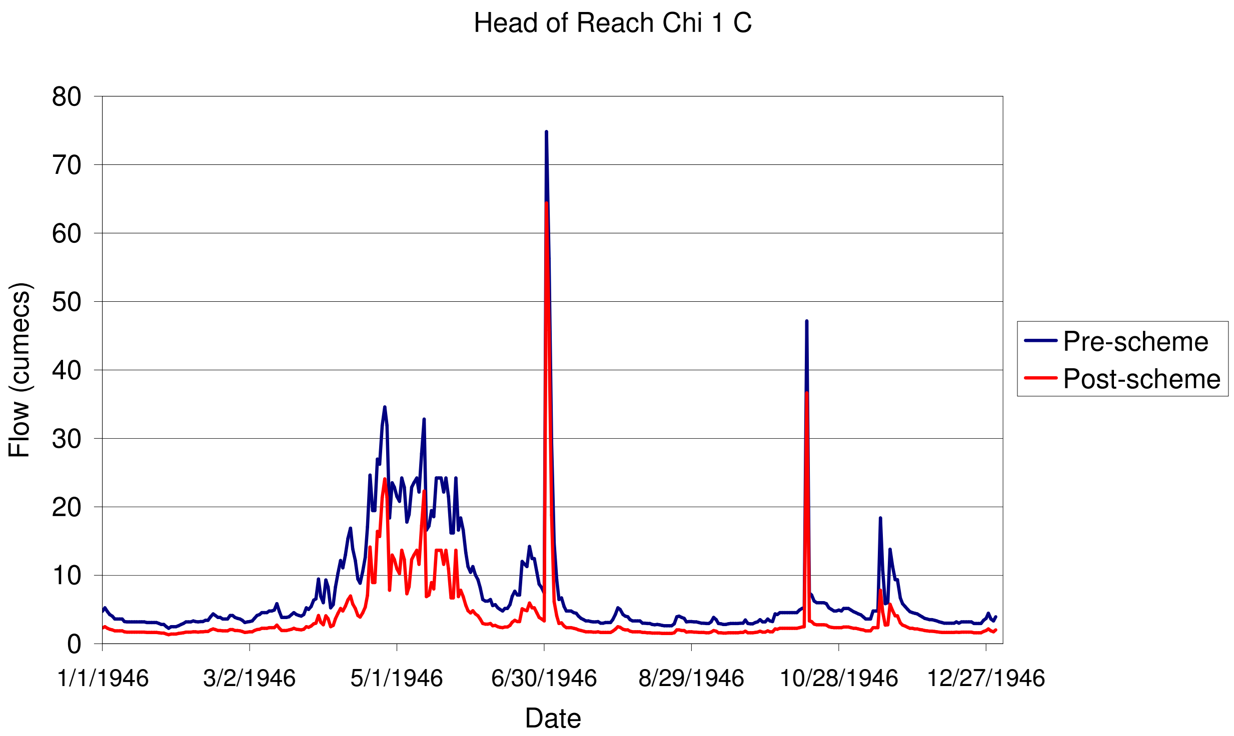
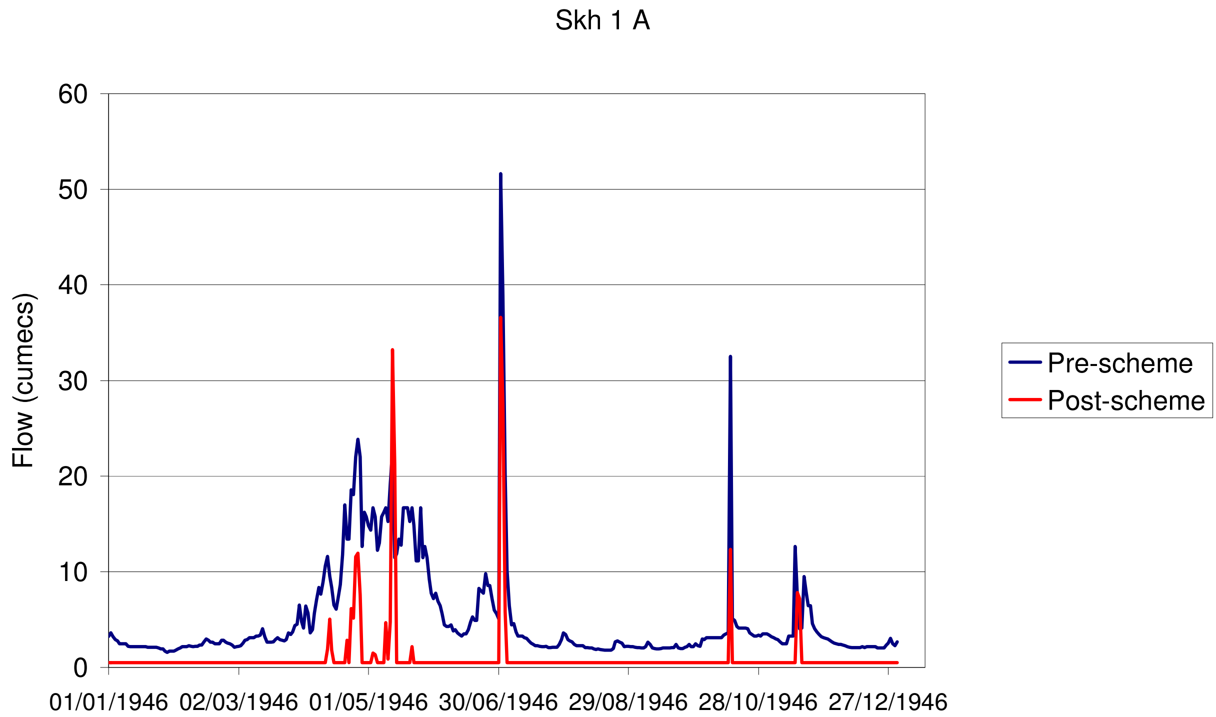
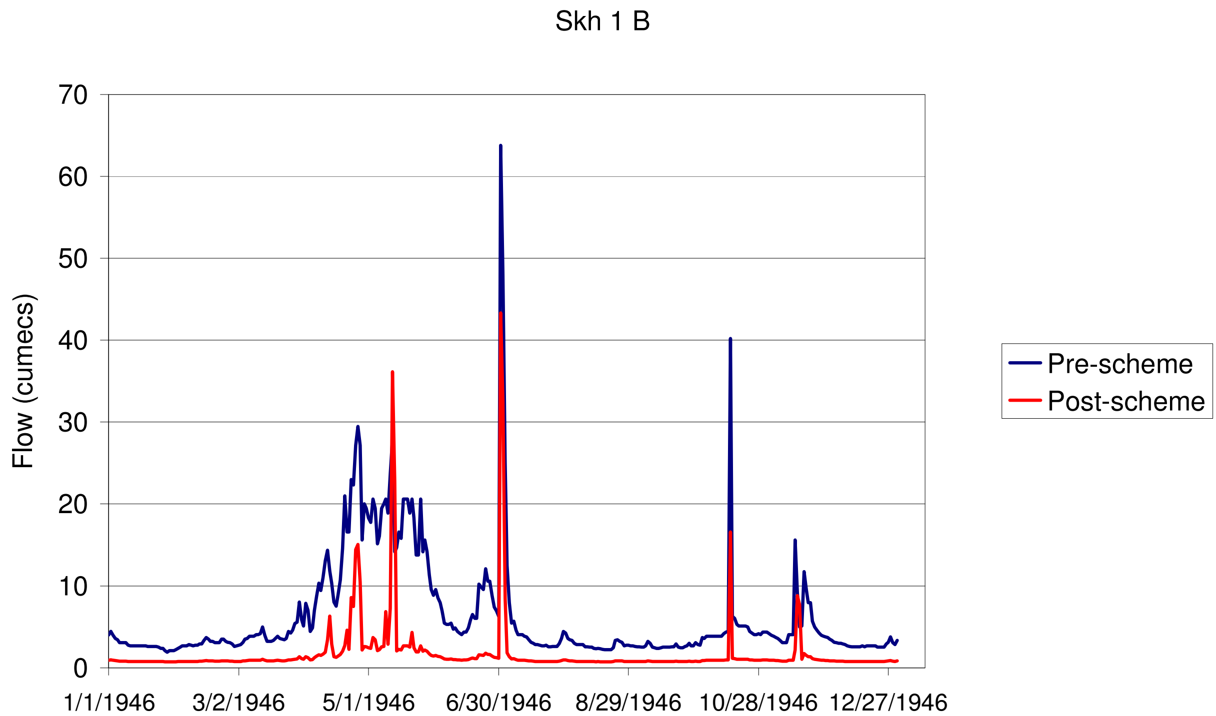

Head of Reach Chi 1 C
Flow (cumecs)
0
10
20
30
40
50
60
70
80
1/1/1946
3/2/1946
5/1/1946
6/30/1946
8/29/1946
10/28/1946
12/27/1946
Date
Pre-scheme
Post-scheme

Figure 8.8: Daily Flow Series Pre and Post Scheme for the Skhalta River





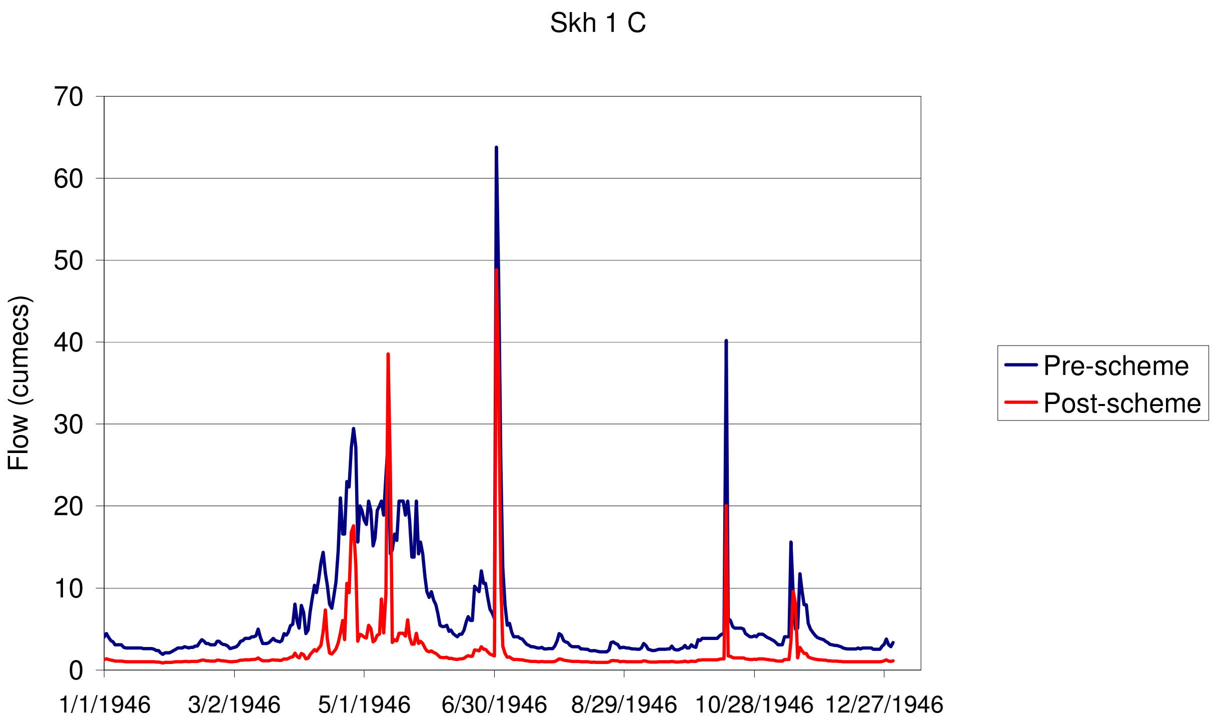
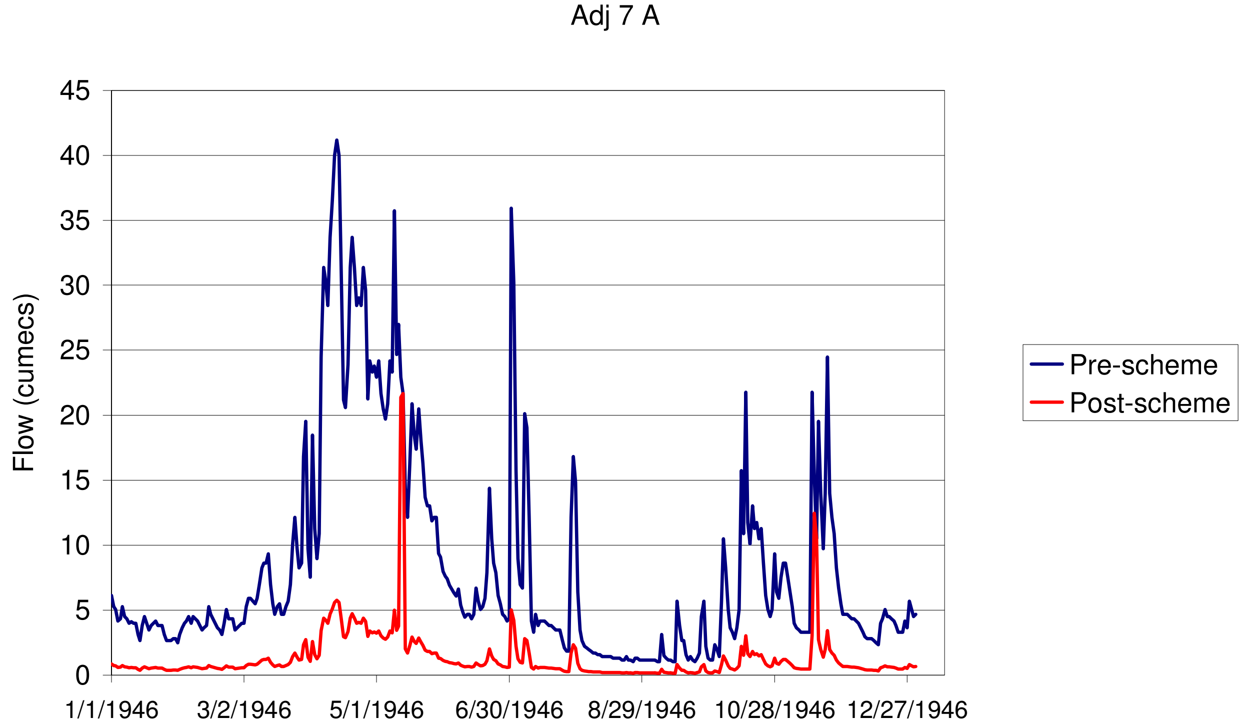
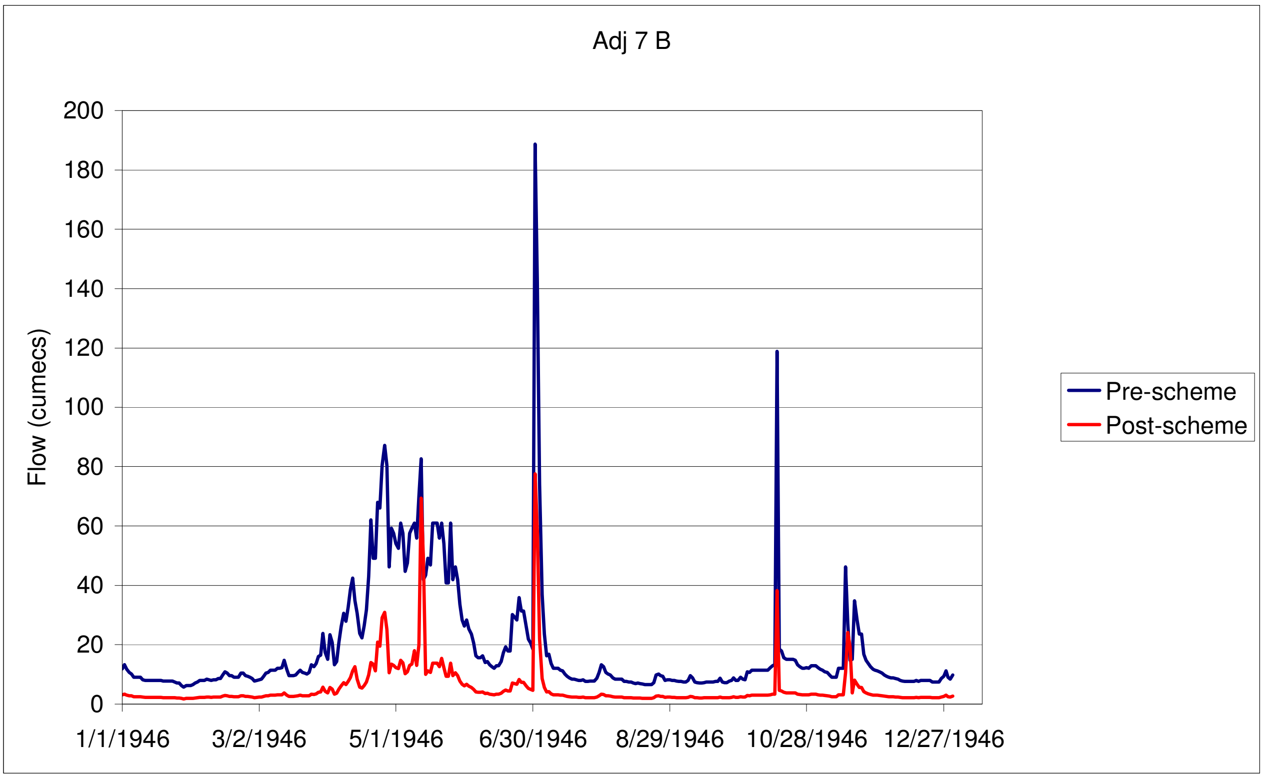
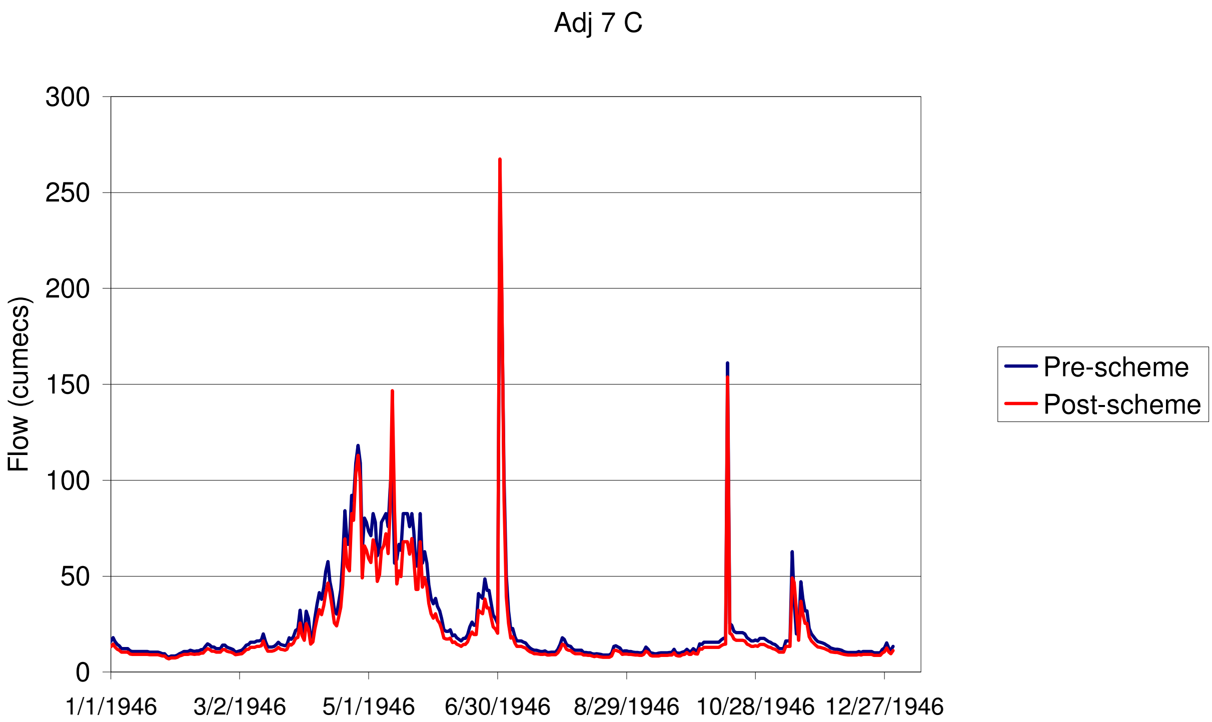

Skh 1 C
Flow (cumecs)
70
60
50
40
30
20
10
0
1/1/1946
3/2/1946
5/1/1946
6/30/1946
8/29/1946
10/28/1946
12/27/1946
Pre-scheme
Post-scheme

Figure 8.9: Daily Flows Series Pre and Post Scheme for the Adjaristsqali River






Adj 7 C
300
250
200
150
100
50
0
Flow (cumecs)
1/1/1946
3/2/1946
5/1/1946
6/30/1946
8/29/1946
10/28/1946
12/27/1946
Pre-scheme
Post-scheme

Koromkheti Scheme - Chvanistsqali River

Chv1

On the Chvanistsqali River (Chv1) the dam with diurnal storage and sediment trap will have a major negative impact on the hydrological conditions downstream (up to a distance of 1 km downstream) and major impact on the riverine habitats. With this part of the river being identified as being a spawning habitat, the impact on the fish populations and aquatic ecology are likely to a major negative. Potential impacts on the hydrological regime from the intake in the Chvanistsqali River are considered together with the impacts from the operation of the Khichauri dam in the Adjarisqali River, in the following section.

Koromkheti Scheme - Adjaristsqali River

Adj 5 (A)

Sensitivity criteria are the same in all length of the Adjarisqali River and include:
- Presence of suitable feeding habitat for cyprinid species; and
- Adjaristsqali River is important as a migratory route for some reophilic species and flows must not be reduced so much that it would prevent the fish from moving up and down the main river and consequently isolating populations in the tributaries.

Impacts from the operation of the dams (in Chvanistsqali River and Khichauri dam) and subsequent effects on the river ecology in this reach are likely to include the following:
- Loss of riverine habitat from a reduction in flow downstream, although the river at this location does not show the presence of significant vegetation;
- Dam acting as an obstruction to fish movement and the loss of aquatic habitats; and
- Loss of important feeding habitat.

Flows in the Adjarisqali River downstream the confluence with the Chvanistsqali (a 4.7km reach, up to the next important tributaries) are estimated to be approximately 23% of the annual average and therefore higher than the proposed environmental flows which are 2.82 cumecs.

This value (23%) is estimated for the top end of this reach and is expected to gradually increase along the reach due to the presence of several other tributaries. Figure 8.10 shows that the post-scheme flow pattern is significantly altered, compared with the pre-scheme flow conditions at top end of this reach. During August, when the lowest flows are recorded, flows are expected to always be 3.6 cumecs with no alteration through time during the operation of the scheme, which is significantly below what is verified in natural conditions when flows can range between 10 and 37.0 cumecs. The magnitude and period length of higher flow events are also significantly affected which could have consequences on the flushing of the Adjarisqali River and channel form.

The section of the Chvanistsqali River that will be impacted as well as the Adjarisqali River are considered of moderate sensitivity due to the presence of important feeding habitat but the magnitude of the hydrological change is considered major, and therefore it is considered that the impact will be **major adverse**.

Adj 5 (B and C)

Impacts from the operation of the dams (in Chvanistsqali River and Khichauri dam) and subsequent effects on the river ecology in this reach are likely to include the following:

- Loss of riverine habitat from a reduction in flow downstream, although the river at this location does not show the presence of significant vegetation;
- Dam acting as an obstruction to fish movement and the loss of aquatic habitats; and
- Loss of important feeding habitat.

The proposed environmental flows at this location are the same as for the upstream reach (2.82 cumecs). However, due to the presence of some tributaries in these reach the change verified in the pos-scheme situation is expected to be between 25% and 31% of the annual average flow.

This value is estimated for the top end of this reach and is expected to gradually improve along the reach due to the presence of several others tributaries. Figure 8.10 shows that the post-scheme flow pattern is still significantly altered, compared with the pre-scheme flow conditions at the top end of this reach. During August when the lowest flows are recorded flows are expected to range within 5.6 and 8.0 cumecs during the operation of the scheme as is compared with the pre-scheme flows of between 12 and 25.5 cumecs. However the higher flows in August are due to a peak which does not occur every year and is consequence of inter-annual variation, and not considered critical to exist at this time of the year. The high flow season are also reduced in time from March to June to a high flows occurring in April and May. Similarly high flow events in October and November are also much reduced with high flows limited to a few days each month.

The section of the Chvanistsqali River is considered of moderate sensitivity due to the presence of important feeding habitat but the magnitude of the hydrological change is considered moderate, and therefore it is considered that the impact will be **moderate adverse**.

Adj 5 (D)

Impacts in this reach (approximately 4.5km long) are likely to be similar to the upstream reaches and include the following:

- Loss of riverine habitat from a reduction in flow downstream, although the river at this location does not show the presence of significant vegetation, however impacts are likely to be reduced downstream due to the presence of several tributaries including the Akraveta
- Potential loss of important feeding habitat.

This section is just downstream the confluence with Akraveta River and has flows in between 31% and 33% of the annual average flow. Figure 8.10 indicates that post-scheme, during August in an average year, flows would range between 9.6 and 10.3 cumecs (not taking in consideration the high flows, recorded in the beginning of the month, in 1946) which are below what would be in pre-scheme conditions (flows ranging between 18.5 and 29 cumecs. As in the upstream section high flow would also be recorded for a shorter length of time.

The section of the Chvanistsqali River is considered of moderate sensitivity due to the presence of important feeding habitat but the magnitude of the hydrological change is considered moderate, and therefore it is considered that the impact will be **moderate adverse**.

Koromkheti Scheme - Akavreta River

Aka 2 (A)

On the Akavreta River (Aka2) with the tyrolean weir, sediment trap and intake, similar potential impacts and effects as described previously for the weirs in Shuakhevi Scheme are envisaged. These are:

- Reduction in flow downstream and consequent reduction in riverine habitats (including spawning areas) on the Akarevta.
- Impacts are likely to be reduced further downstream due to the presence of a tributary on the left side bank; and
- Additional impact whereby newly hatched fry, located near or upstream of the proposed weirs, could be drawn into the grates of the weirs when they move downstream into the Adjaristsqali to feed.

The following features based on the baseline information have been considered when defining the ecological sensitivity of this reach:

- The potential for suitable cyprinid spawning habitat was identified from the baseline along all the length of the Akraveta River, for this reason all different sections in this river are considered to be of moderate sensitivity.
- The river is subject to frequent landslides and river morphology is frequently changing as a result and characterised by very wide river bed with meandering channel.

This reach is approximately 3.4km long, the proposed environmental flows (10% of the long term average) is 0.63 cumecs. The actual flows once the scheme is in operation are likely to be just 14% of the long term annual average. Figure 8.11 indicates that at this location the post-scheme expected flows are very reduced from the pre-scheme conditions. In fact from July to March flows recorded in the river would be just the proposed environmental flow apart from a small high flow event in November. This would mean that every year the river in this reach would be under drought conditions for the most part of the year, every year.

The magnitude of hydrological impacts in this reach of the Akavreta River is likely to be major, and consequently the impacts on the aquatic ecology and fisheries (considered as medium sensitivity) significant and a **major adverse**.

Aka 2 (B)

The habitat sensitivity for this reach is considered as medium due to the presence of the same characteristics in the upstream reach. Changes in flows in this section of Akraveta, downstream of a tributary on the left side bank are much increased from the previous section. Annual average post-scheme flow is estimated to be between 30% and 33% of the annual average flow. In the low flow months the post-scheme flows are expected to be within 3.0 and 1.3 cumecs compared with the pre-scheme flows (2.6 and 4.4 cumecs). High flows are expected to occur at the same time of the year but to be much reduced.

The magnitude of hydrological impacts in this reach of the Akavreta River is likely to be moderate, and consequently the impacts on the aquatic ecology and fisheries significant and **moderate adverse**.

Koromkheti powerhouse

Similarly to Adj 5a, the release of a large volume of water at Adj 2a could also pose an obstruction to movement of fish. The velocity is currently estimated to be 4-5 m/s which may cause an obstruction to fish movement; however, this depends on how quickly the velocity will dissipate in the receiving water course and local and seasonal hydrological conditions.

Summary

The overall hydrological impacts of the Koromkheti Scheme are likely to be of a major magnitude, and while fish populations and the aquatic ecology of these river systems are relatively resilient to hydrological changes, without mitigation, the impact of the Scheme is likely to be major. With the fish populations along the river being of medium conservation value the significance is likely to be **major adverse**.

Table 8.16: Summary of Potential Impacts from the Khoromkheti Scheme

	Distance (km)	Pre-scheme Annual average (m3/s)	Pos-scheme Annual average (m3/s)	% of annual average (post-scheme)	Sensitivity	Magnitude	Significance
Adjarisqali River (10% of long term average mean = 2.82 m3/s)							
Adj 5 (A)	4.7	36.3	8.3	23	Medium	Major	Major
Adj 5 (B)	9.9	37.3	9.3	25	Medium	Medium	Moderate
Adj 5 (C)	7.7	40.5	12.4	31	Medium	Medium	Moderate
Adj 5 (D)	4.5	49.3	16.3	33	Medium	Medium	Moderate
Akavreta River River (10% of long term average mean = 0.63 m3/s)							
Aka 2 (A)	3.4	5.8	0.8	14	Medium	Major	Major
Aka 2 (B)	3.8	7.1	2.1	30	Medium	Medium	Moderate

Figure 8.10: Khoromkheti Scheme Impact Assessment

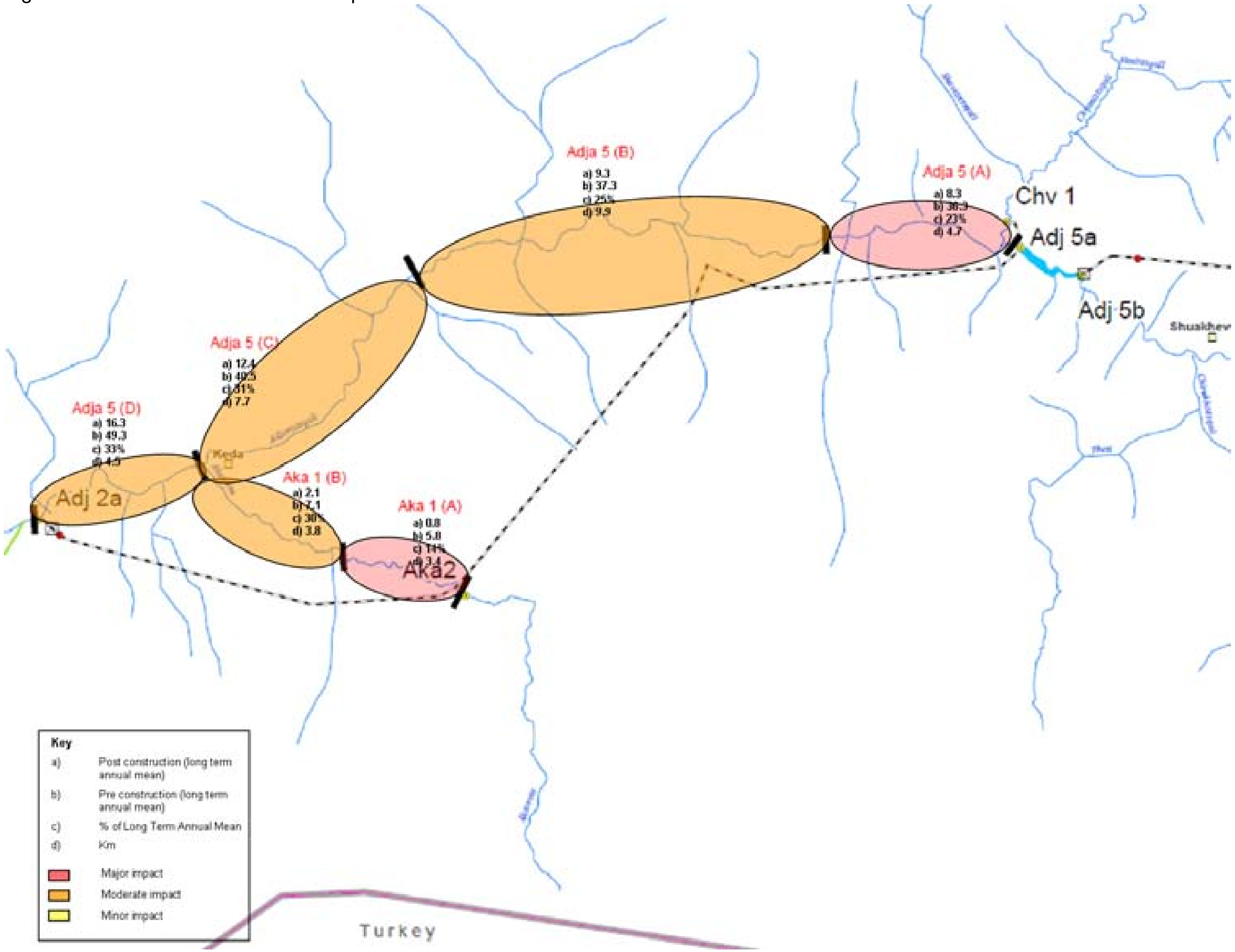
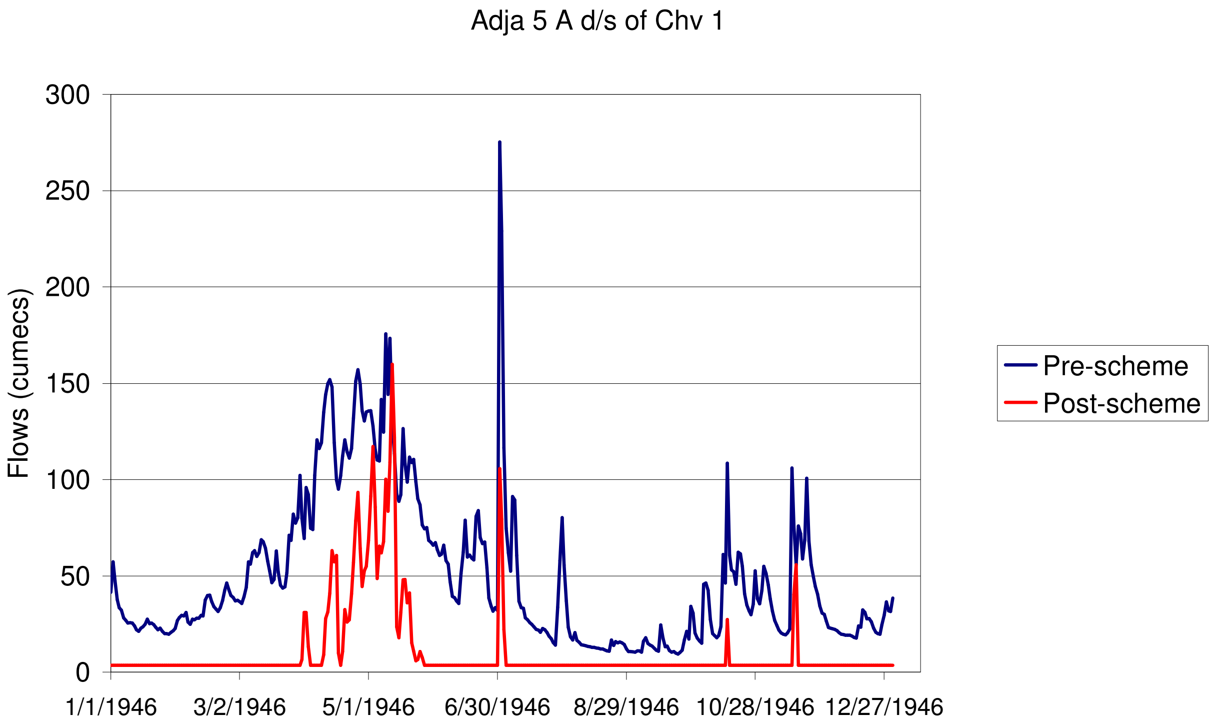
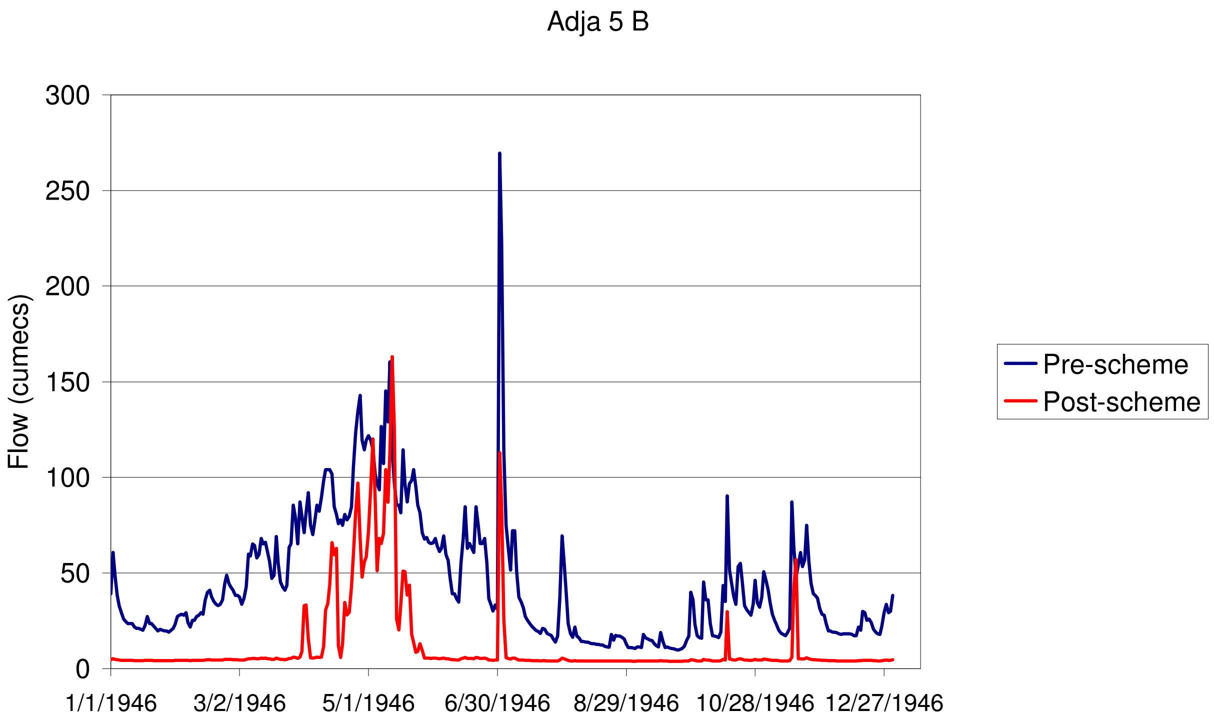
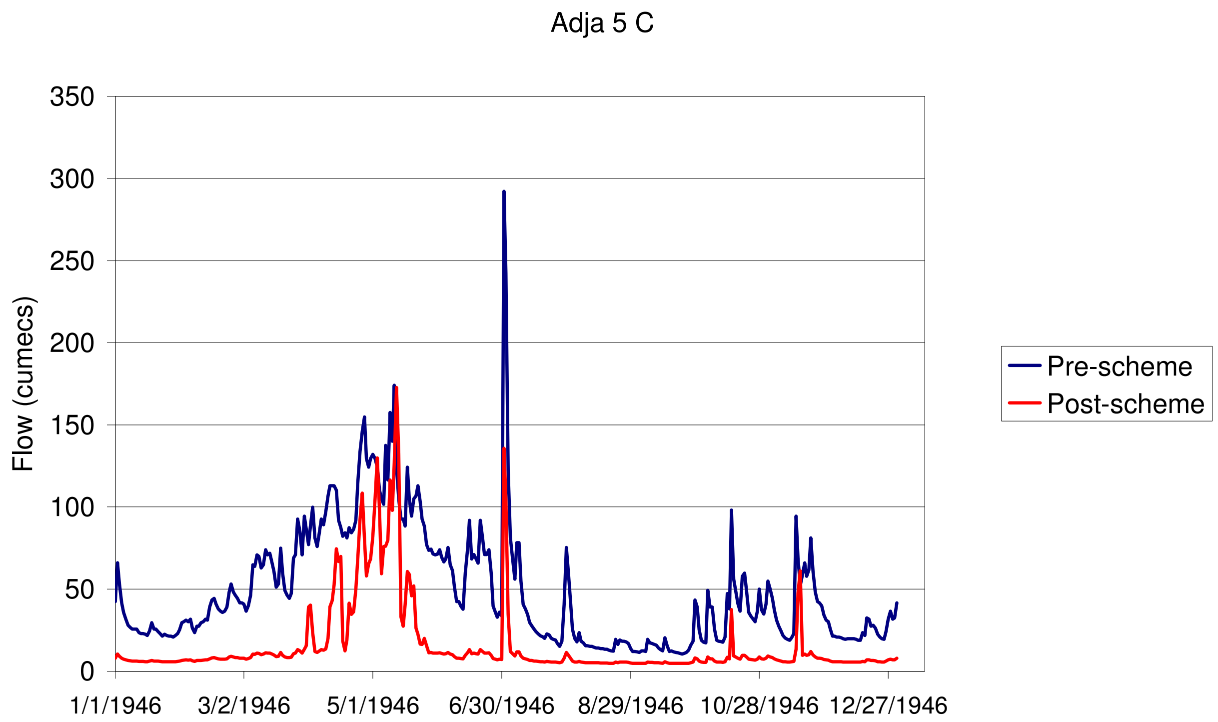


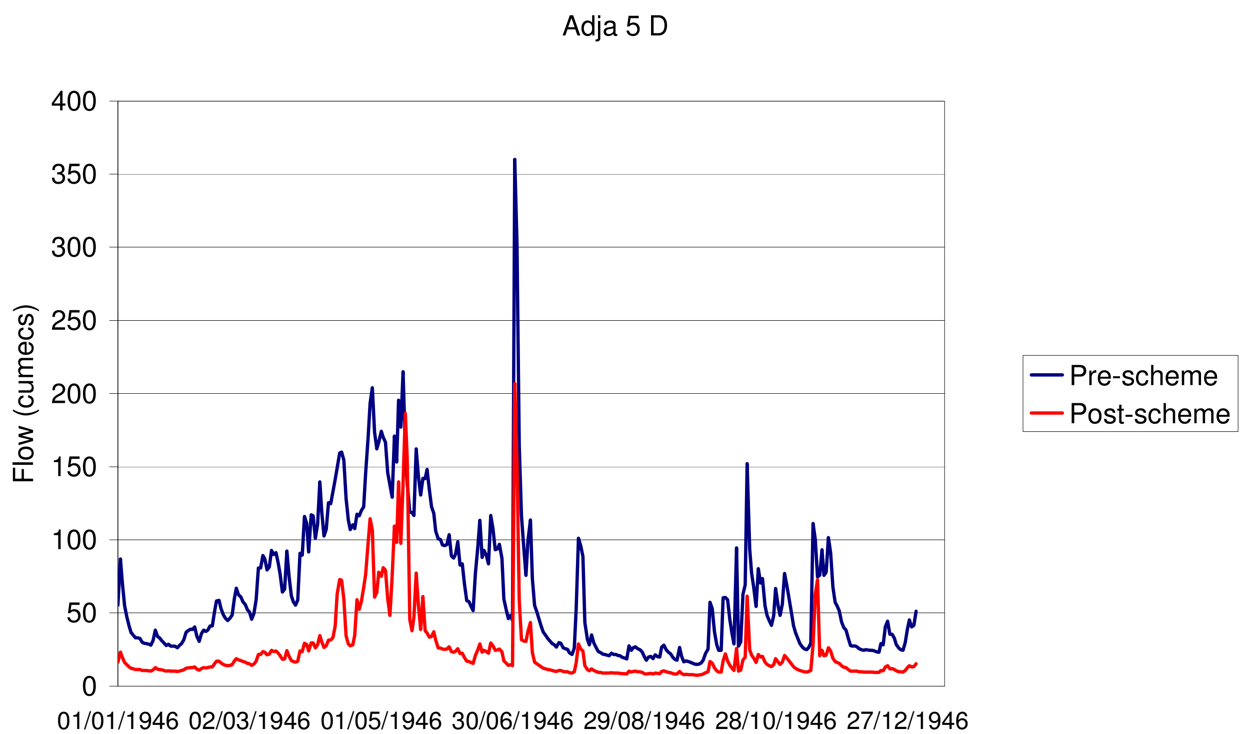
Figure 8.11: Daily Flows Pre and Post Scheme for Adjaristsqali River





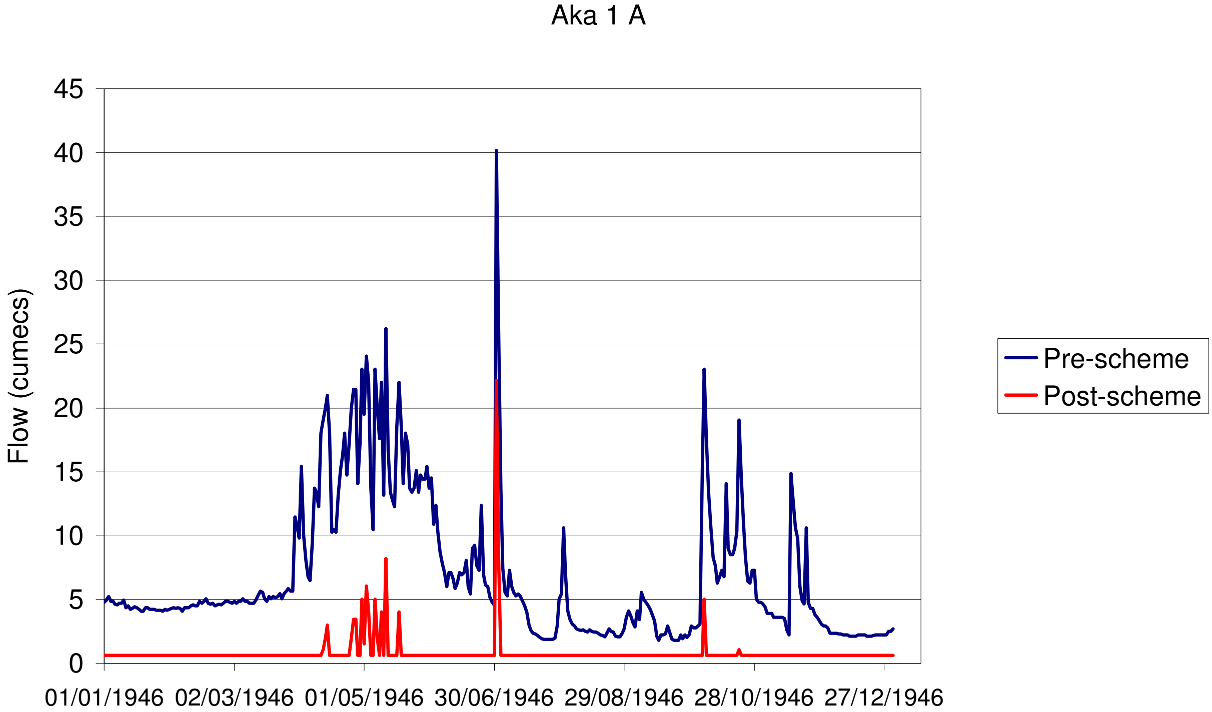


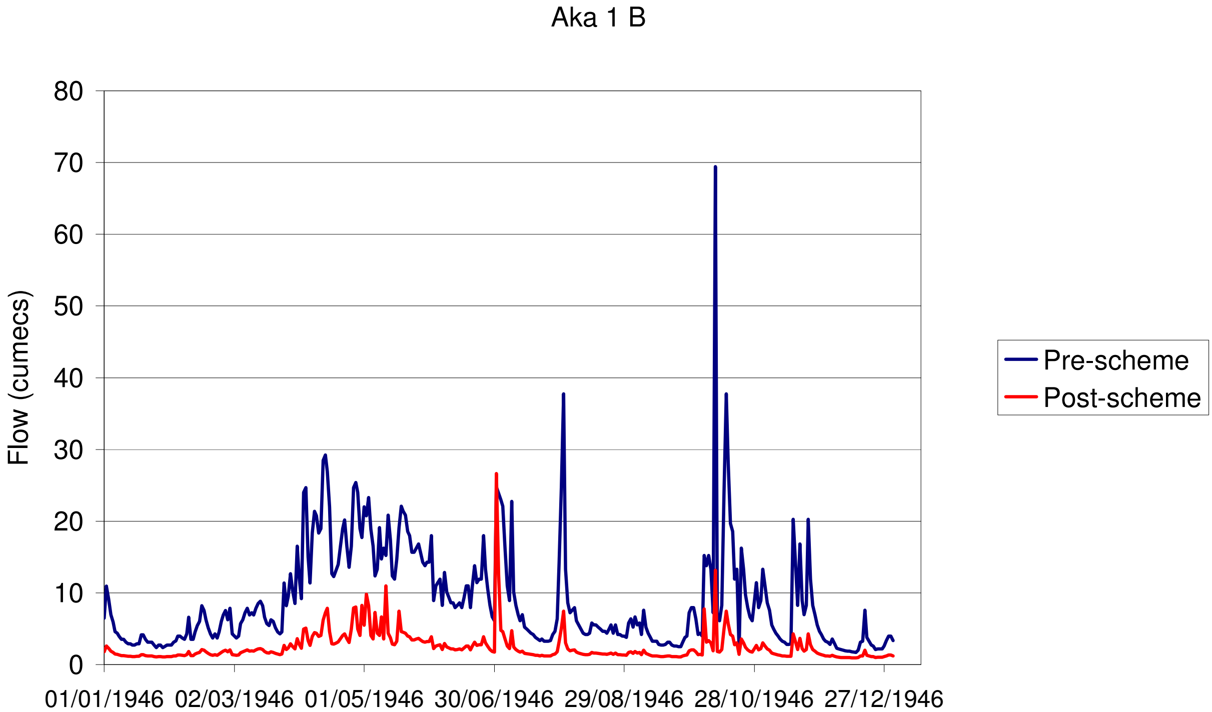
Adja 5 C
350
300
250
200
150
100
50
0
Flow (cumecs)
1/1/1946
3/2/1946
5/1/1946
6/30/1946
8/29/1946
10/28/1946
12/27/1946
Pre-scheme
Post-scheme



Adja 5 D
400
350
300
250
200
150
100
50
0
Flow (cumecs)
01/01/1946
02/03/1946
01/05/1946
30/06/1946
29/08/1946
28/10/1946
27/12/1946
Pre-scheme
Post-scheme

Figure 8.12: Daily Flows Pre and Post Scheme for Akavreta River





Khertvisi Scheme - Adjarisqali River

Adj 2 (A)

Sensitivity criteria are the same in all length of the Adjarisqali River and include:

- Presence of suitable feeding habitat for cyprinid species; and
- Adjaristsqali River is important as a migratory route for some reophilic species and flows must not be reduced as much that would prevent the fish from moving up and down the main river and consequently isolating populations in the tributaries.

Upstream the Khertvisi barrage (Adj1), just downstream the Power House inflows equal the natural flows (as shown in Figure 8.12) and therefore impacts on the aquatic ecology due to changes in flows are considered minor. Impacts are mostly limited to changes in the hydrological regime just upstream the Khertvisi barrage with the creation of a reservoir and considered to be **minor adverse**.

Fig 8.12 shows a number of inconsistent days when post-scheme flows are apparently higher than pre-scheme flows - these are all in periods of higher flow when the ecological impacts being considered are less critical (the apparent inconsistencies at this location are related to the particular gauges used to estimate the pre-scheme and post scheme flows and problems in estimating peak flows at different gauges).

Adj1 (A)

At the Khertvisi barrage (Adj1), the proposed environmental flows are 2.82 cumecs. The potential impacts on the fisheries are likely to be similar as described previously:

- Reduction in flow and subsequent reduction in riverine habitats;
- Presence of another barrage in this reach; and
- No spawning areas were identified downstream of Khertvisi and the aquatic ecology of the river systems are already partly impacted by the existing HPP scheme.

Annual average flow post-scheme is estimated to be 25%of the long term annual average. In the low flow months, during an average year (Figure 8.13), the post-scheme flows are expected to be much lower than the pre-scheme conditions even during an average year. Flows are expected to remain equal to 5.2 cumecs for most months (from June to March) with only small flood events. In addition Spring high flow are also limited to May and therefore reducing the high flow season significantly. Although the 5.2 cumecs is almost twice the proposed environmental flows it is considered that the flow variability recorded in natural conditions pre-scheme would be very much changed with potential significant adverse impacts on the river ecology

The hydrological impacts are likely to be major in this reach and therefore, with the sensitivity of the fish population being medium, the impact at this location is likely to be a **major adverse**.

Khertvisi Scheme - Machakhlistsqali River

Mac 1 (A)

On the Machakhlistsqali (Mac 1), the run of river weir with diurnal storage, sediment trap and intake is likely to have similar potential impacts and effects with a significant reduction in flow downstream and reduction in riverine habitats with major impacts on hydrology and riverine habitats. This will in turn have an impact on spawning areas and loss of fry through the weir grates for the lower reaches of the Machakhistsqali. Black sea salmon are within the Chorokhi River, and likely to migrate into and up the Machakhlistsqali. Therefore, maintaining flow conditions in the Chorokhi River is important as upstream migration of the black sea salmon may occur along this stretch. Upstream migration is triggered by coastal sea temperatures of around 8-8.5^{o}C and the end of the upstream migration period occurs when sea water temperatures are around 20-24^{o}C. A sharp increase in seawater temperature urges the salmon into the rivers and fish migration upstream usually ends in May, although in case of a cold spring this can occur in June and July. Massive migration of salmon into the river is mostly related to the summer high –water period. Most of the spawners are present in the whirlpools which are rich in food from April to September, choosing rocky inaccessible areas.

In Georgian rivers salmon migrate upstream mostly at night, during high water and flash flood periods, when the water is muddy. When the river water temperature starts to fall, at the first signal they move rapidly upstream to the spawning areas where they spawn. This is in part triggered by a change in the natural flow. The black sea salmon is known to migrate up the Machakhistsqali and the Chorokhi to the upland streams and can form resident populations in the upper most reaches. This species has a homing ability and will return to its place of birth, which will be in the upper reaches where there is cold clear fast flowing water and they will spawn on a stone / gravel substrate. The large rivers originating from high mountains, with more than 1500 km^2 catchment area, average annual flow exceeding 100 m/sec (eg. Chorokhi River) and the medium rivers with catchment area 1,000-1,500 km^2, average annual flow 5-50 m/sec (e.g. Machakhela river) are important to maintain for the existence and reproduction of salmon. The small rivers with catchments area 50-100 km^2, average annual flow 5 m/sec (eg. Dgamishi, Korolistskali, Tkhilnaristskali, Jochostskali and Boloko rivers) are important for reproduction, feeding the fry, silvering and movement to the sea.

In relation to the loss of fry through the weir grates, it is only likely to occur for those species that spawn in the lower reaches. It is unlikely that this would affect the protected fish species as spawning occurs in the upper most reaches (with the exception of eels, which occurs in the Sargasso) and the young will also remain in the upper reaches. For black sea salmon, it will be two to four years before they smoltify and migrate back to sea or mature in freshwater so they will be less vulnerable to being drawn into the weir grate and are more likely to be drawn into the fish pass.

In summary the impacts in this section are likely to be:
- Significant reduction in flow downstream and reduction in riverine habitats;
- Potential reduction in spawning areas;
- Loss of fry through the weir grates for the lower reaches of the Machakhistsqali;
- Black sea salmon are within the Chorokhi River, and likely to migrate into and up the Machakhlistsqali where suitable sensitive habitat exist; and
- Barrier to upstream and downstream migration, critical for the black sea salmon

On the Machakhlistsqali there would be major hydrological impacts, which are likely to result in major negative impacts on the fish populations, without mitigations. For the Black sea salmon, which are of high conservation value, the impact significance is likely to be **moderate to major adverse**, and for the European eel which is of very high conservation value the impact significance is likely to be **major adverse**.

Mac 1 (B)

The potential hydrological change at this location is not possible to estimate due to the lack of flow data in the Choroki River. In addition there is the presence of a few dams in this river located upstream the confluence with the Machakhistsqali River. The operation of these dams is unknown and therefore the imposed changes in the hydrological regime in the Choroki River unknown as well.

Therefore it is not possible to identify the potential changes in the Choroki River hydrological regime downstream the confluence Machakhistsqali River once the scheme is in operation. As the sensitivity of this section is considered high due to the presence of an internationally protected species a precautionary approach needs to taken and the impacts considered to be **major adverse**.

Khertvisi powerhouse

At the Adjaristsqali/Chorokhi confluence there will be no adverse effect on the flow, and the water release from the Khertvisi powerhouse is unlikely to create a significant barrier to fish movement along the Adjaristsqali due to the existing high flows at the location on the river. Therefore, any impact on the fish populations and aquatic ecology at this location are likely to be **negligible**.

Table 8.17: Summary of Impacts of Khertvisi Scheme

	Distance (km)	Pre-scheme Annual average*	Pos-scheme Annual average	Percentage of annual average (pos-scheme)	Sensitivity	Magnitude	Significance
Adjarisqali River (10% of long term average mean = 5.24 cumecs)							
Adj2 (A)	4.5	51.1	51.1	100	Medium	Minor	Minor
Adj 1 (A)	12.8	52.7	13.1	25	Medium	Major	Major
Machakhistsqali River (10% of long term average mean = 2.03cumecs)							
Mac1 (A)	6.6	20.0	3.2	16	Major	Major	Major
Mac1 (B)1	2.9	21.2	4.3	20	Major	Unknown	Major

Note 1 – values just before the confluence with the Choroki River. Hydrological impacts on the Chroroki reach downstream the confluence are not possible to assess as there is no data available on the Choroki hydrological regime.

Figure 8.13: Khertvisi Scheme Impact Assessment

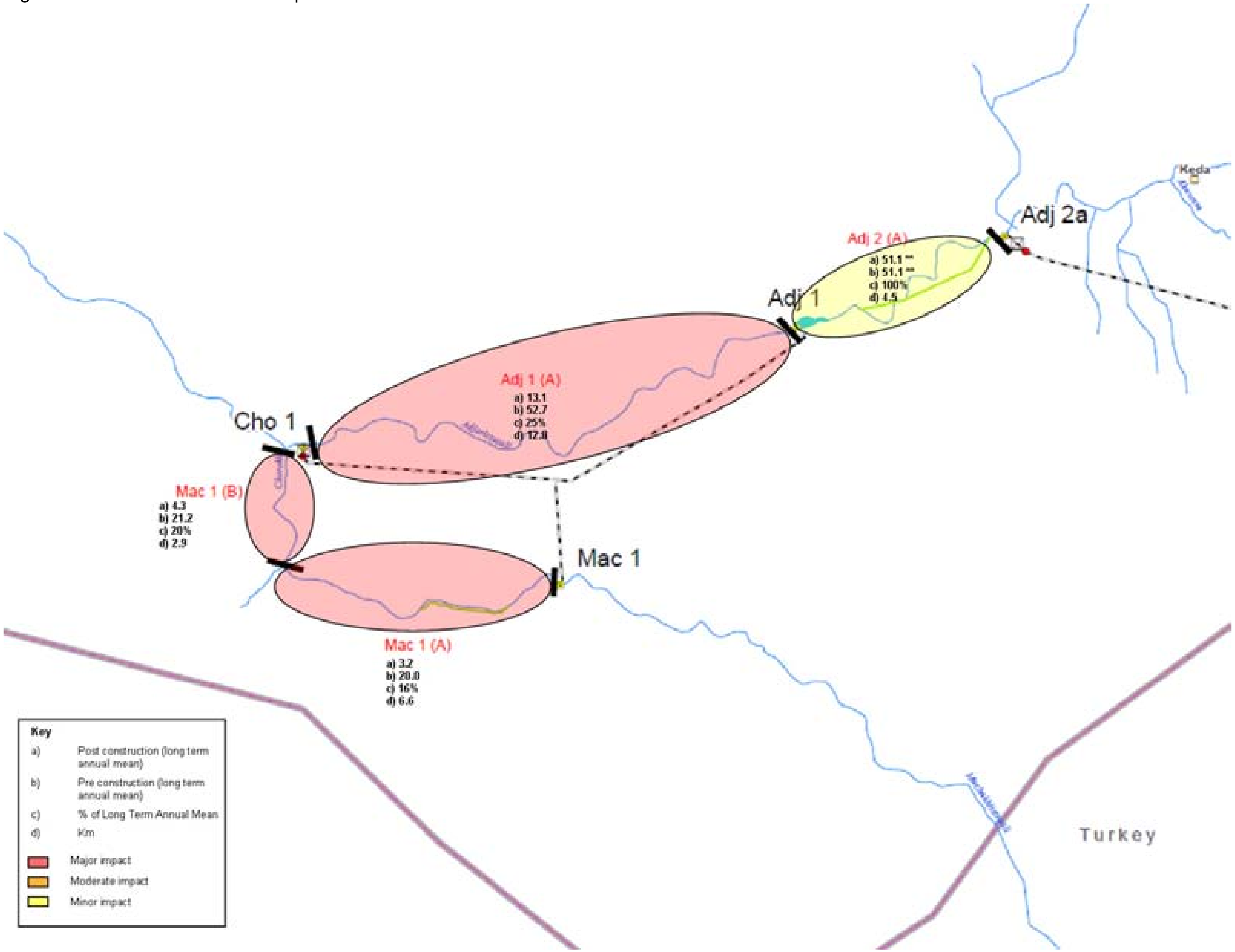
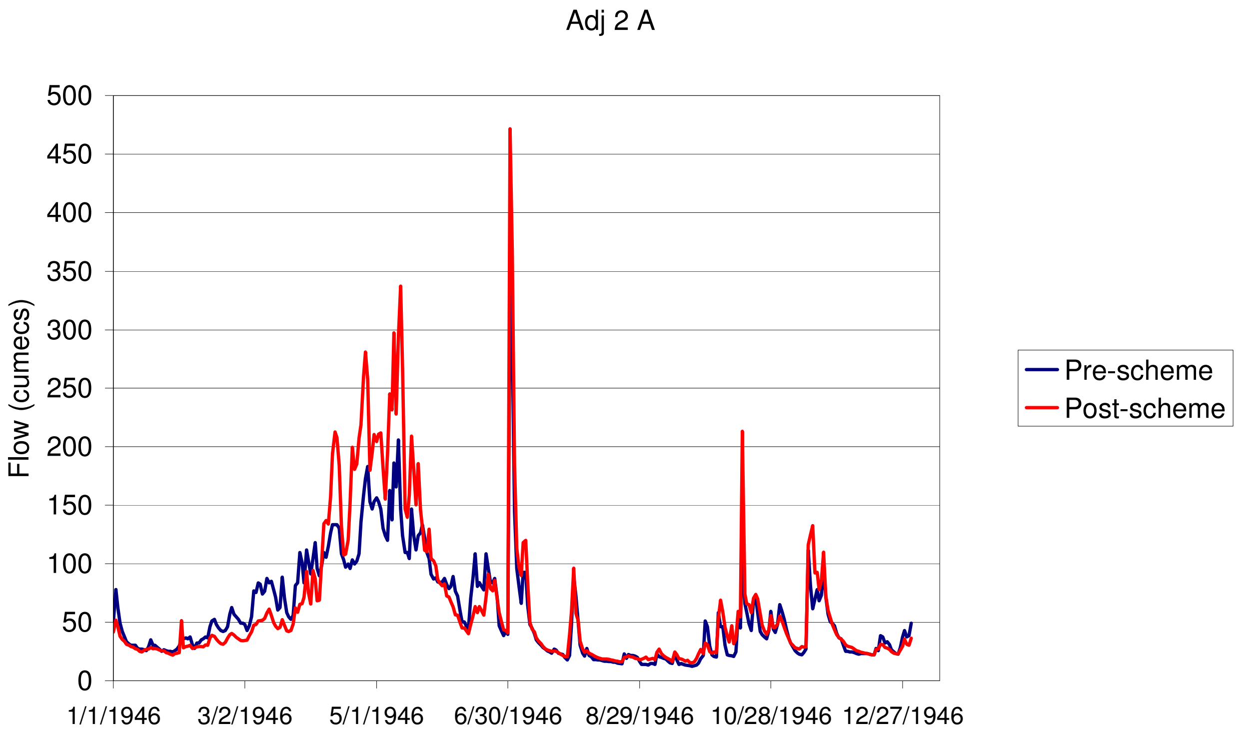


Figure 8.14: Daily Flows Pre and Post Scheme for Adjaristsqali River



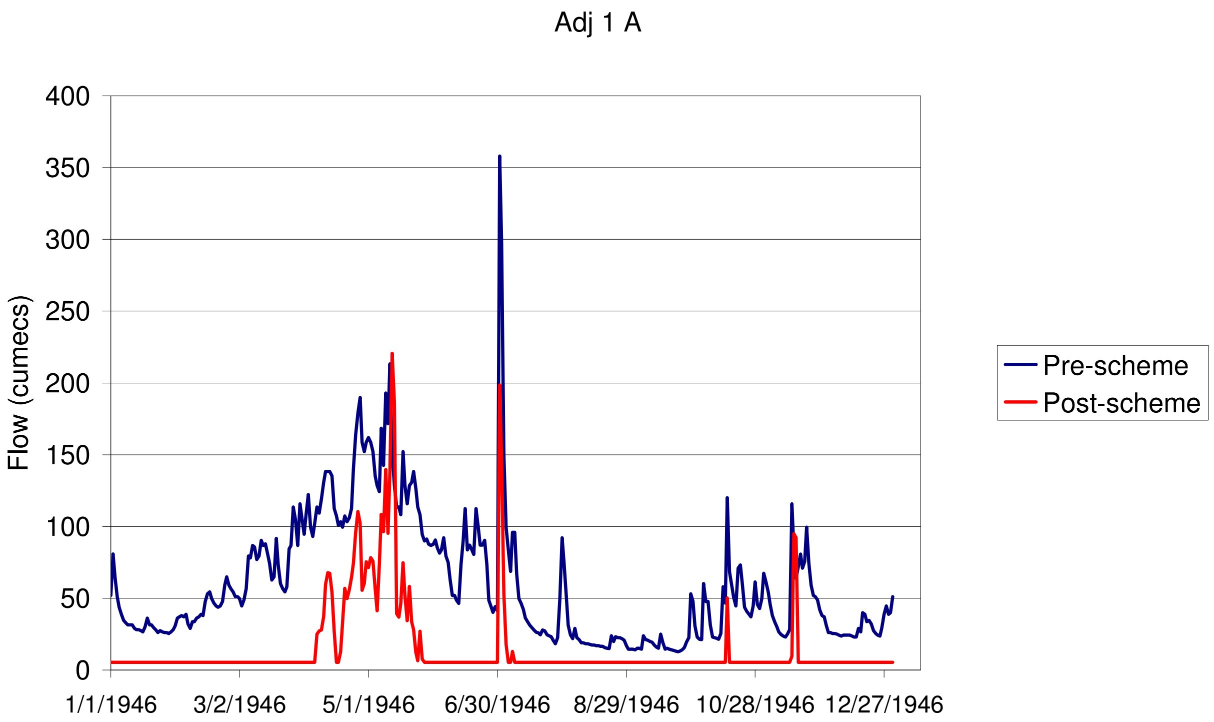
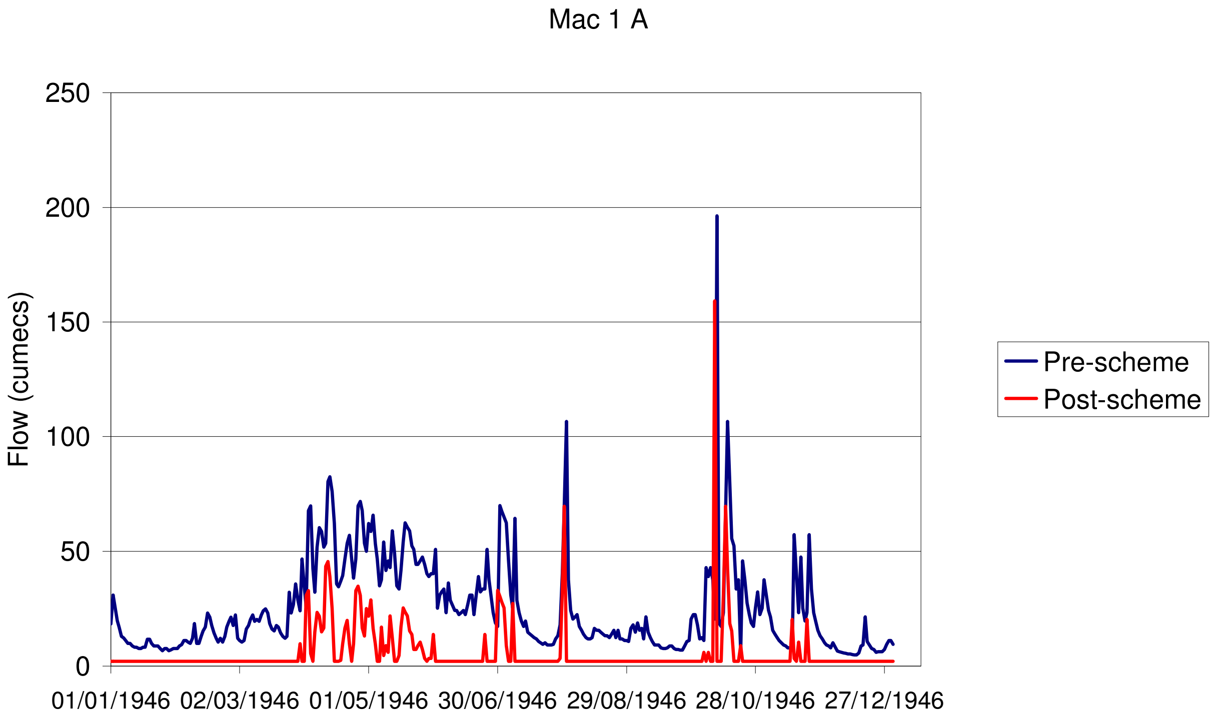
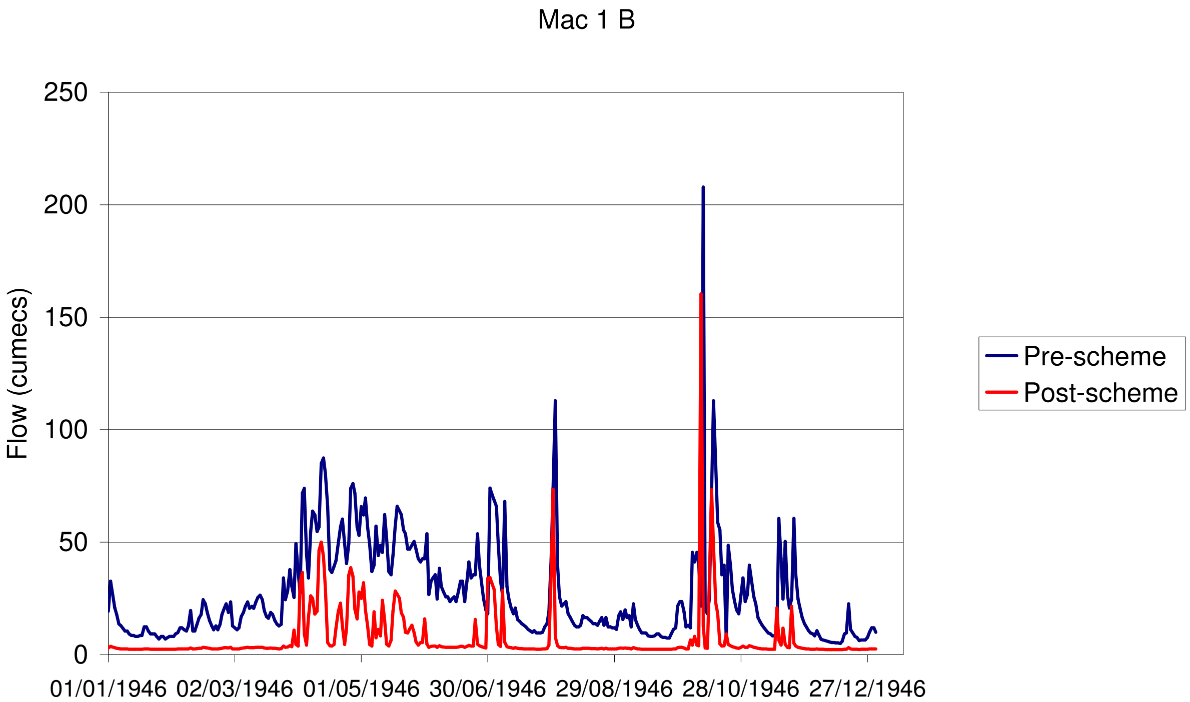


Figure 8.15: Daily Flows Pre and Post Scheme for Machakhlistsqali River





8.6 Ecosystem Services

8.6.1 Introduction

In accordance with IFC Performance Standard 6, where a project is likely to adversely impact on ecosystem services, it is necessary to conduct a systematic review to identify the priority ecosystem services, to avoid impacts on these services and where impacts cannot to avoided to minimise the impacts and implement measures that aim to maintain the value and functionality of priority services. The following Sections describe these priority services and the potential impacts. Mitigation measures associated with these ecosystem services are described as part of the Impact Assessment in Section 8.8.

8.6.2 Provisioning Services

8.6.2.1 Overview

The provisioning services used by local communities which occur within the Project area of influence (AoI) include:

- Fisheries, predominantly local fish farms and recreational fishing
- Water for local subsistence agriculture use, irrigation and household sanitation
- Wild foods and other non-timber forest products, including medicinal plants collected from the natural deciduous forest habitats
- Plant genetic resources, notably within the natural deciduous forest which are of high conservation value due to the presence of relic species and genetic origins on domestic tree crop species, such as walnut and pear
- Timber for fuel and local house building from the coniferous and deciduous forest habitats
- Sand and gravel from the river beds (local use and commercial extraction)
- Livestock grazing along the riverside grassland terraces.

The two provisioning services which have the potential to be significantly affected by the Project are fisheries and local water use, which are described in more detail below.

8.6.2.2 Fisheries

There are a large number of small rainbow trout fish farms that rely on a clean and an adequate supply of water within the Project AoI. These are mapped in Figure 9.5 of Chapter 9. A majority of these trout farms are local, small, and provide subsistence to local people. These farms are reliant on a minimum flow to provide a steady water supply and in addition trout are sensitive to changes in water quality and temperature. If the water becomes warmer, then fewer fish can be stocked and a greater flow of water is required because the solubility of oxygen in water decreases with increasing temperature. Ideally, oxygen levels should be around 7 mg/l or greater. The flow of the water source will in part determine the stocking level. While artificial aeration can be used to increase oxygen levels a sufficient water flow is still needed to remove waste produced by the fish. Further details are provided in Chapter 10. A vast majority of the fish farm occur on the small tributaries off the Adjaristsqali, and would not therefore occur within the Project AoI. While no fish farms would be directly impacted, there are however a number of fish farms within the Project AoI, and these could, prior to mitigation, be significantly affected by reduced water availability and water quality with a moderate negative impact.

Local amateur fishing occurs in the lower reaches of the Adjaristsqali, and while the Project is unlikely to have any major significant negative impacts, there could be change in the species caught with a move from rheophillic to limnophillic species. The impact on these local fishing activities is therefore regarded as being minor to moderate negative. During construction, fishing activities are likely to increase as the local communities provide fish for the construction work force, and while this would have economic benefits to the local fishermen it is likely to have an additional impact on the fish populations within the river system.

8.6.2.3 Existing Irrigation/Agricultural Use

Throughout the Adjaristsqali and its tributaries water is diverted from rivers for irrigation of corn, beans and vegetables and orchards, vineyards and pasture. Irrigation requirements are generally taken as 700 m^3/ha per crop season. The diversions are informal or "wild" intakes where boulders in the channel are aligned to direct flow into some form of conveyance channel (earth channel, hollowed log, pipe etc). There is no form of hydraulic control structure on the river and in many cases no control structures within the conveyance system. Water flows into the conveyance system and returns to the river through leakage or excess runoff from the cultivated land.

Most of the intakes are on upper tributaries using gravity where the topography is suitable for small agricultural areas; they are therefore generally obtaining water at higher elevations than the proposed diversions under the Project and therefore would not be impacted by the Project.

Typical Traditional Irrigation Intake Arrangements: Chvanistsqali Head

Source: GEG June 2011

Typical Traditional Irrigation Intake Arrangements: Zermovarjanauli Head, Vanistsqali River

Source: GEG June 2011

8.6.3 Regulating Services

The regulating services which are important for ecosystem function which occur with the Project AoI include:

- Water regulation relating to the hydrological functions of the catchment and river system
- Air quality and local climate regulations from the forest systems
- Erosion regulation provided by natural and plantation forests along the river gorges, with clear evidence of soil erosion and landslip where areas of forest have been cleared for agricultural purposes
- Natural habitats, notably the deciduous forests, across the area provide important refugia for pollinators of agricultural crops.

The Project is likely to have a minor negative impact on the water regulation, air quality/local climate regulation and pollination regulating services due to forest habitat loss and changes in the hydrological conditions along river. The impact on the erosion regulating services are assessed as having the potential for a moderate to major impact due to habitat loss associated with both direct and indirect effects from construction and operational activities, especially because of the thin soil covering base rocks along the sides of the river gorges.

8.6.4 Cultural Services

The cultural services which are important for the local communities which occur with the Project AoI are relatively limited at present. There are no indigenous people within the Project AoI, and so the spiritual or religious value is negligible. Ecotourism within the area has not yet been developed, although there could be potential indirect benefits through improved infrastructure and access. The only notably recreational service associated with the Adjaristsqali is fishing by local people.

The Adjaristsqali and its tributaries do have, however, high visual, amenity and aesthetic value for both the local people and visitors. While there is unlikely to be any negative impacts on the amenity and aesthetic values during operational activities, there is likely to be a significant moderate negative impact during construction, largely due to the large number of vehicle movements and noise disturbance. Landscape and visual impact assessment is provided in Chapter 18.

8.6.5 Supporting Services

Soil formation, nutrient and water cycling processes within the Adjaristsqali are all important supporting services provided by the riverine and forest ecosystem functions which occur with the Project AoI. While these ecosystems are likely to be affect by the Project, these cycling processes are unlikely to be impacted. The water balance across the catchment, for instance, would not be significantly impacted by the Projects; the hydro scheme will only be affecting water flow and local hydrological conditions.

8.7 Decommissioning Impacts

The ecological impacts related to decommissioning would depend on the generate approach and how much of the infrastructure is removed. During decommissioning it is likely that there would be localised and temporary, moderate negative impacts on the ecological features within the Project AoI. But once fully decommissioned and the habitats recovered from disturbance, the long-term impact is likely to be a moderate positive with river flows returned to its near natural pre-construction flow condition.

8.8 Cumulative Impacts

There are a number of other projects and proposed developments which are likely to have a cumulative impact on the ecology and biodiversity within the Adjaristsqali river system and further downstream. The main activities and development include:

- The current Asti HPP hydro scheme
- The Chorokhi hydropower cascade project in Turkey (Deriner Dam)
- The Achara Energy project currently under construction non the Chorokhi River both upstream and downstream of the Adjaristsqali River confluence
- Extraction of sand and gravel from the river-bed of the Chorokhi River
- Potential agricultural expansion leading to increased deforestation and soil erosion due to increase economic growth, access and urbanisation into the catchment
- A general increase in urbanisation and increased disturbance from local business activities.

The general development throughout the catchment, of which this Project contributes by opening up access and improving infrastructure, is likely to lead to significant additional cumulative impacts on ecology and biodiversity, notably on the natural forest habitats and fisheries. Fisheries are likely to be impacted from gradual changes and deterioration in water quality, as well as increased fishing activities and forest habitats from agricultural expansion along the river gorge and increased use of timber from the forests. The impact is of significance because of the high conservation value across the entire catchment, as described in Section 8.3.1.

The construction of the large Deriner Dam in Turkey and the extraction of sand and gravel from the Chorokhi river-bed in Georgia (following licences given by the Government of Georgia) have significantly reduced the amount of sediments which reach the Chorokhi Delta. Besides, the erosion caused by the Black Sea affects many coastal areas in Adjara including the Chorokhi Delta. The Black Sea's erosion on the Chorokhi Delta is significant and very large areas of the delta could be lost in the following years if no action is taken. Chorokhi Delta is a very important area for breeding and migratory birds, and for nurseries of threatened and endemic fish.

8.9 Mitigation Measures

8.9.1 Overview

The Project is a large infrastructure development with three schemes spread over a large geographical area, and hence the management of these impacts will be critical to ensuring that the impacts are minimised. The nature of the Project means that there is likely to be a significant impact on the ecohydrological conditions across the Adjaristsqali River which will have a significant impact on its biodiversity and ecosystem services. Hence the importance of mitigation and monitoring measures to reduce these impacts to acceptable levels.

8.9.2 Avoidance Measures

The Project Scheme design has been significantly modified and revised to take into consideration the environmental and ecological sensitivities and to avoid significant impacts on the areas of high conservation value, in particular:

- The original scheme design included dams and weir on a number of tributaries off the main Adjaristsqali River. The habitats, flora and fauna along these tributaries are of significantly higher conservation value, compared to the main river systems, and due to the sensitivity of the habitats the impact on biodiversity would have been major adverse. If it were not for the removal of these dams and weirs from the Project; and
- Working practices have been significantly modified, notably the areas of working reduced to avoid significant impacts on sensitive habitats (such as access road routes). The locations for spoil deposits, quarrying areas, substations, hostel; bridges etc have all been selected based on the minimum likely environmental impacts.

8.9.3 Generic Mitigation Measures

The following generic mitigation measures will be applied throughout the Project:

- All construction and operational working areas will be kept to the minimum which is required to reduce the areas of habitat loss;
- Access routes for construction and operational activities will be kept to a minimum. All off-road access will be prohibited or allowed along pre-defined routes that limit the extent of off-road activity. Plans will

be implemented to minimise all construction traffic activities. These actions will significantly reduce potential impacts on habitats and disturbance to species;
- Night time illumination of construction sites will be limited as much as possible to minimise the potential disturbance to nocturnal mammals;
- Noise disturbance and vibration will be kept to a minimum through measures such as ensuring proper maintenance of construction machinery and equipment and complying with national standards;
- Measures, such as water sprays, will be implemented for reduction of dust during the working period;
- All construction and operational activities will comply with the international guidelines on the prevention and management of alien plant and animal species across the Project. A Community Wildlife Officer will be appointed to monitor the construction activities to ensure compliance with such guidelines. Details will be provided in the CESMP with regard to the responsibility of the Community Wildlife Officer;
- Prior to construction activities in ecologically sensitive areas and in habitats of high conservation value, checks will be undertaken for protected reptiles and amphibians. Any reptiles or amphibians found will be removed by a qualified ecologists and relocated to a safe refugia;
- All pits, trenches and excavations will be fenced to avoid animal falling in. Alternatively at night time long boards and wooden logs must be laid in trenches and pits to allow small animals to escape. Pits and trenches must be checked prior to refilling; and
- All workers engaged in the Project will be made aware of the environmental and ecological sensitivities of the region, the Project site and their own actions. The Community Wildlife Officer will compile information in this regard in the construction site induction and incorporate outreach works on the importance of preserving habitats of animals and prevention of poaching.

8.9.4 Habitat Creation and Reinstatement Measures

The forest habitats within the Project AoI are of significant botanical interest, with a large diversity and number of relic species, including tree species which are wild relatives of modern cultivars (e.g. walnut and pear) and are therefore of high genetic conservation value. Due to this importance a range of mitigation measures are required

A Habitat Removal and Reinstatement Plan will be produced that will set out the minimum requirements in relation to the clearance and re-instatement of natural forest habitats. The Plan will form part of the Construction Environmental and Social Management Plan (CESMP). The habitat reinstatement plan will include the following practices:
- Prior to the removal of any natural forest habitat, the areas to be removed will be subjected to botanical surveys and checked for protected and rare plant species. A detailed inventory of the plant communities and species will be undertaken and records provided to the Ministry of Environmental Protection, as required by the Forest Code of Georgia;
- An inventory of all tree species felled as part of the Project will be kept, and for each tree removed two trees of the same species and cultivar will be planted (as part of the habitat reinstatement); and
- All species used in the habitat reinstatement and landscape planting will be native. No introduction of non-native plant species should be allowed.

Additional mitigation measures will include:
- Where possible, plant species of medium or higher conservation value will be translocated to new forest areas prior to the clearance of natural forests; and
- Seeds and live plants (if possible) will be collected before construction and translocated to conservation centres. As the translocation of plants is always associated with high risk, seed propagation should be used as well to increase chances of success and propagate enough seedlings for consequent reintroduction.

Due to the loss of natural forest habitats of high conservation value and a priority ecosystem service, largely from the road construction and inundation from the reservoirs, offsetting through the creation of similar habitats is required to reduce the residual impacts. While there will be a delay before the new habitats become of equal conservation value, this will be an important component in mitigating for the impacts of the Project on biodiversity. The scheme will include the creation/planting of 52,000 m^2 of new mixed species forest habitats to compensate for the 52,000 m^2 of high conservation value forest habitat which will be lost from the operational and construction activities of the Project.

Details on methodologies to be used for these mitigations will be provided in the Habitat Removal and Reinstatement Plan and the Biodiversity Action Plan.

8.9.5 Protected and Notable Fauna Species

Protected and notable fauna are likely to be impacted by the Project, and therefore additional mitigation measures are required:

- Birds are protected by Georgian and EU legislation and to minimise the potential impact to all breeding bird species, vegetation clearance should be undertaken outside of the bird nesting period, with clearance undertaken after early August and completed before early March. Where vegetation clearance during this period is not possible, the areas to be cleared will be checked for breeding birds prior to the clearance and if nesting birds found appropriate mitigation measures undertaken. As all birds' nests are protected by the law, any nest found during construction must be registered and shall remain untouched until nesting activity at the nest finishes;
- Prior to any works which are undertaken during the bird breeding season, the location of nests species of high conservation value, especially those of large raptor species, will be identified within the AoI. If any nests are found then the local Ministry must be informed and the appropriate mitigation measures agreed;
- Bats are protected by Georgian and EU legislation and if during construction, including tree removal, bats or bat roosts are found then the works will stop and the local authorities notified. As all coverts for bat species are protected by law they must be registered with the Ministry of Environmental Protection;
- Prior to any tunnelling activities, any large crevices or caves which occur within the footprint of the works must be inspected before commencement of works for bats, if any bat roosts are found then the local Ministry must be informed and the appropriate mitigation measures put in place (such as the removal of the bats by a qualified bat ecologist);
- Prior to any works which are undertaken between May and July and occur in the riverine habitats, including the river banks and river edge habitats will be checked for otter holts (breeding sites). If any sites are found then the local Ministry must be informed and the appropriate mitigation measures agreed (such as the phased removal of the holts under supervision of a qualified ecologist); and
- Hunting and poaching of fish, birds and mammals of all species will be prohibited. All staff of construction and service organizations will be under obligation not to undertake poaching or hunting throughout the whole Project area. Signage will be installed illustrating the hunting ban throughout the Project area. This requirement will form part of the construction camp and settlement code of conduct. A key responsibility of the Community Wildlife Officer shall be enforcement of the hunting ban, raising awareness of the need not to hunt and to raise awareness in the local communities about the importance of nature conservation.

8.9.6 Fisheries Measures

The following mitigation measures will be introduced to reduce the impact on the fisheries:

- The introduction of fish passes into the Chirukhistsqali, Chvanistsqali, Machakhlistsqali, Khichauri and Khertvisi dams which will be specifically designed to effectively entice fish of all sizes into the appropriate channel. The design of the fish pass will allow for upstream passage of fish but also consider measures for the safe passage of fish downstream;
- During construction sediment control procedures, including sediment traps, will be adopted that minimise mobilisation of sediments downstream, especially during the main spawning period from April to August;
- Construction of the infrastructure on the Machakhlistsqali will not occur during the migratory period of black sea salmon (between early April and early September); and
- Users of the river (especially fish farms) will be informed of when the dam gates will be opened and the subsequent release of sediment, so that they can plan accordingly.

8.9.7 Environmental Flows Measures

The single most significant impact on the ecology and biodiversity within the Project AoI will be the reduction in river flows. Typically hydro-schemes, in Georgia, have been using an environmental flow of 10% of the mean annual flow; however, this rarely reflects the annual changes in hydrological conditions which are important in mimicking environmental conditions of the river and protecting the functional value of flow events. As part of this Project, a two tier approach has been used to assess environmental flows for the project; Phase I where environmental flow were set at a level assumed to be 10% of the mean annual flow, in line with what has been used in the past for other schemes, and a Phase II which will be implemented from spring/summer 2012. Phase II is detailed in Chapter 10 of this ESIA and will use a different method to refine assessment of environmental flows. This method will be strongly based on further data collection which will identify sensitive sections of the affected rivers and will determine more accurately specific environmental flows for each river. This will allow determination of a flow which more accurately reflects the hydrological conditions and ecological requirements of the river system, this is critical in reducing the potentially significant impacts of the Project on biodiversity and ecosystem services.

The key measures which will be introduced to the Project to reduce the ecological impacts will be:
- Production of adjusted environmental flows which will take into consideration the specific ecological requirement for specific reaches based on Phase II assessment; and/or
- Habitat enhancement measures and opportunities for improving quality of habitats identified in Phase II.

8.9.8 Biodiversity Offsetting & Enhancements

After the introduction of the mitigation measures outlined in the previous Sections, there is still likely to be a significant impact on the ecological features within the Project AoI, and hence further offsetting measures are required to reduce these likely impacts further:
- A Community Wildlife Officer will be appointed for the lifetime of the Project. The Officer will be responsible for the implementation and monitoring of all ecological mitigation and offsetting measures as detailed in the ESIA, CEMP and Biodiversity Action Plan (BAP).
- The installation of 100 bat and 100 bird boxes for each of the three schemes as an offset for the loss of bird nesting sites and bat roosting sites resulting from habitat loss and inundation.
- The creation of new recreational fishing areas around the reservoirs and the stocking of the reservoirs and rivers with native fish species.

Further to the mitigation measures and due to the likely significant impacts on ecology and ecosystem services associated with the Adjaristsqali River and forest habitats, a Biodiversity Action Plan will be developed and implemented to ensure the biodiversity within the Project areas is protected and enhanced.

8.9.8.1 Adjaristsqali Biodiversity Action Plan

The aim of the Adjaristsqali BAP will be to protect and enhance the biodiversity within the Project AoI and surrounding areas. A draft Adjaristsqali BAP will be produced for consultation with stakeholders within 4 months of the start of construction. The final BAP will be implemented before the end of construction of the first scheme. The BAP will include details of all mitigation, offsetting and enhancement measures which will be implemented during the whole life of the Project, while the CEMP will cover all mitigation and offset measures associated with the construction activities of the Project. The Adjaristsqali BAP will include actions for all three schemes.

The Adjaristsqali BAP will include specific conservation actions for the following habitats and species:

- Natural forest habitats of high conservation value
- Riverine/aquatic habitats
- Protected and notable plant species
- Protected and threatened mammals including all bats, otters, carnivorous mammals
- Protected birds and birds of high conservation value
- Protected and threatened fish species, including Black Sea salmon, brown trout, European eel, Colchic khramulya

The specific actions for the conservation and management of these habitats and species will be documented within the BAP. Actions, subject to stakeholder consultation, will include habitat management activities to the benefits of the specific species, habitat creation, actions to increase food resources (such as increasing fish stocks for otters), and actions to control negative impacts such as controlling discharges into the water systems, reduce use of pesticides, etc.

The BAP will also include educational awareness programmes to increase local community understanding of the importance to the regions biodiversity.

Table 8.18: Summary of Terrestrial Ecological Mitigation & Offsetting Measures of the Project

Type of Mitigation	Provisions to Address Ecological Impacts & Effects
Embedded mitigations (avoidance measures)	- Reduced scheme design, with the removal of weirs and infrastructure on smaller tributaries of higher conservation value and high sensitivity - Site location based on the least likely areas to cause ecological impacts.
Mitigations of non-significant effects	- Measure to control the potential spread of alien, invasive plant and animal species - Habitat clearance and working areas kept to a minimum - Illumination of construction sites at night should be limited to avoid disturbance to mammals, notably bats - Noise disturbance and vibration level kept to below national standards - All Project workers to be made aware of the ecological sensitivities and works to stop if any rare or protected species (notably mammals, including bats, birds, reptiles and amphibians) found and a qualified ecologist consults and mitigations applied.
Mitigations of significant effects	- Tree and rare plant inventories prior to removal of high conservation value forest. Translocation of species, where possible. Replacing each lost tree with two trees of the same species and native origin - Production and implementation of Habitat Removal and Reinstatement Plan - Habitat clearance, where possible outside the bird nesting period. Checks for nesting bird, bats, otters, reptile and amphibians prior to clearance of habitats - Ban on all hunting and fishing by Project workers - Introduction of fish passes on the Adjaristsqali River and downstream tributaries - Minimisation of sediment release from the construction and operational activities, especially during spawning periods - No in-river construction activities on the Mackakhistsqali during the peak Black Sea salmon migration, to be re-evaluated prior to construction if suitable mitigation measures are available. - Phase II assessment of environmental flows and development of adaptive management plan and habitat enhancement measures in most significantly impacted reaches. .
Offsetting & enhancement measures	- Production and implementation of a BAP, focusing on the conservation and management of key habitats and species - Development of Habitat Reinstatement Plan and replacement of lost 52,000 m^2 of lost forest. - Appointment of a Community Wildlife Office to oversee all ecology mitigation and offsetting measures and to co-ordinate and implement the BAP - Creation of recreational fishing areas and stocking of reservoirs - Support to a Black Sea Salmon in situ conservation programme - Installation of bird and bat boxes.

8.9.9 Proposed Monitoring

8.9.9.1 Introduction

To verify that the proposed mitigation and offsetting measures are successful and meet the objective of reducing the ecological impacts of the Project, a series of monitoring activities will be undertaken during and after construction. Full details will be formulated and included in the CEMP and BAP but a summary of the proposed monitoring measures are set out below.

Further consultation will be undertaken with the fish farms to ensure an adequate supply of water will be provided for their farms to continue to operate;

8.9.9.2 Monitoring of Terrestrial Systems

Annual monitoring will be carried out to check the conditions of the faunal diversity (birds, reptiles and otter). Monitoring will take place a year before commencement of construction works and shall be continued during 10 years after completion of civil works. Five years after completion of construction phase, the condition of target species will be reviewed and if species are regarded to be in decline and their decline attributed to the operation activities of the Project then further offsetting measures may be needed. Target species will need to be identified as part of the BAP.

The success of habitat reinstatement will be monitored, with the condition of all habitat areas reinstated checked annually, measuring the health and mortality of replanted trees. Details to be agreed with the Forestry Department and details will be provided as part of the Habitat Reinstatement Plan.

During construction checks will be undertaken for the accidental introduction or spread of alien, invasive species, especially plant species which may be brought into the areas from construction activities (on vehicles, in any imported materials). Checks by a qualified ecologist will be undertaken around all major working areas and site compounds every other month. Measures to remove/eradicate any species introduced, if found, will be discussed with the Ministry of Environmental Protection prior to execution.

8.9.9.3 Monitoring of Aquatic Systems

An environmental monitoring system will be established as part of the operational activities and as part of the hydrological monitoring. This system will also be used to monitor the aquatic systems with permanent survey sites with six survey sites along the Adjaristsqali, and two survey sites on the Skhalta, Chirukhistsqali, Akavreta and Machakhlistsqali. At each of these sites, annual monitoring of the following will be undertaken for the lifetime of the Project:

- Fish populations surveys
- Water flow and heights
- Water quality, including sediment loads.

In addition to the annual monitoring, water quality measurements undertaken during the timed releases and at regular intervals during the year to ensure that dissolved oxygen levels do not fall below the natural variation in dissolved oxygen throughout the year.

Table 8.19: Monitoring Requirements

Activity	Project Stages	Parameters	Locations	Frequency	Implementing Responsibility	Supervision/ Reporting
Faunal diversity	Construction and operations	Population size/numbers for specific key biodiversity indicator species, to be determined as part of the Adjaristsqali BAP	To be determined as part of the Adjaristsqali BAP	Annual surveys during optimum time of year for specific species, up to 5 years post construction	Adjaristsqali Georgia LLC (AGL)	Reporting to Ministry for Environmental Protection
Habitat	Operations (post	Condition and health of habitats after	At all locations	Annual, for up to	AGL	Report to the Forestry

Activity	Project Stages	Parameters	Locations	Frequency	Implementing Responsibility	Supervision/ Reporting
condition	construction)	reinstatement	where significant habitat re-instatement has occurred	10 years post construction .		Department and Ministry for Environmental Protection
Invasive species	Construction	Presence and spread of alien invasive species	All working areas	Monthly	Contractors	Report to AGL and Ministry for Environmental Protection
Fish populations	Construction and operations	Population size	To be determined in accordance with Phase II	Annual in September/ October during low flows for lifetime of the Project.	AGL	Reporting to Ministry for Environmental Protection
River flows and water quality	Construction and operations	As per determinant	To be determined in accordanc with Phase II	Annual in September/ October for lifetime of the Project.	AGL	Fisheries Department and the Ministry of Environmental Protection

8.10 Summary of Impacts, Mitigation and Residual Significance

8.10.1 Residual Impacts

The Adjaristsqali River system, within which the Project is to be developed, is of high biodiversity interest with a diversity of habitats and species characteristic of the region. Without mitigation the Project would have a large and very significant impact on the biodiversity and ecosystem services, but these impacts will be significantly reduced through the responsible implementation of the proposed mitigation, offsetting and enhancement measures, in particular:

- The production and implementation of CESMPs. These plans will detail exactly how and when the mitigation and offsetting measures summarised below will be undertaken;
- The production of a BAP for the Project, which will detail specific actions needed during the whole life and operations of the Project to protect and enhance the biodiversity across the Adjara;
- The implementation of a Habitat Creation Scheme which will ensure that there will be no net loss in natural forest habitats;
- Creation of a Community Foresty Scheme to ensure the long-term protection and conservation of forests and their ecosystem function and services;
- A Catchment Management Scheme to ensure a long-term and sustainable water supply to ensure water users and ensure ecosystem functioning; and
- Appointment of a Community Wildlife Officer who will be responsible for ensuring the delivery of the ecological aspects of the EMPs and BAP, the associated mitigation measures and environmental awareness raising amongst the local communities and businesses.

With the introduction of these measures, in the short to medium term, the residual impacts will include:

- Minor adverse impacts on natural forest habitats of high conservation value
- Moderate adverse impacts on the riverine/aquatic habitats due the significant hydrological changes
- Minor adverse impacts on specific protected, endemic and relic plant species, notably the European Hop-hornbeam

- Minor adverse impacts of Black Sea salmon and European eel populations in and around the Machakhlistsqali/Chorokhi
- Minor to moderate adverse impacts on otters.

However, in the long-term, once the biodiversity has adapted to the changes in the hydrological conditions and the offset measure start taking effect, the overall impact on biodiversity is likely to be neutral and in some cases beneficial.

8.10.2 Summary for the Shuakhevi Scheme

A table summarising the impacts of the Project on the key ecological features which occur within the AoI is provided below.

Table 8.20: Summary of Key Significant Impacts on Ecological Features during Construction Activities

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
Oak forest – Quercus petraea ssp. dschorochensis	Habitat loss and felling for road access, work compounds.	High	Minor	Moderate adverse	Avoidance measures, minimum working areas, habitat reinstatement, plant genetic conservation.	**Minor adverse**
Liana-rich mixed deciduous forest with spruce – *Picea orientalis, Carpinus caucasica, Alnus barbata, Salix caprea*	Habitat loss and felling for road access, work compounds.	Medium	Moderate	Moderate adverse	Avoidance measures, minimum working areas, habitat reinstatement, plant genetic conservation.	**Minor adverse**:
Degraded spruce (Picea orientalis) forest with deciduous species – *Quercus petraea ssp. dshorochensis, Fagus orientalis, Ulmus glabra, Carpinus caucasica*	Habitat loss and felling for road access, work compounds.	Medium	Moderate	Moderate adverse	Avoidance measures, minimum working areas, habitat reinstatement.	**Minor adverse**:
Riparian forest – Alnus barbata dominant	Habitat loss and felling for road access, work compounds.	Low	Moderate	Minor adverse	Avoidance measures, minimum working areas, habitat reinstatement	**Insignificant**
Walnut plantation – Juglans regia, Alnus barbata, Picea orientalis	Habitat loss and felling for road access, work compounds.	Low	Moderate	Minor adverse	Avoidance measures, minimum working areas, habitat reinstatement.	**Insignificant**
Riverine forest & scrub – Salix alba, Robinia pseudoacacia, Alnus barbata	Habitat loss and felling for road access, work compounds.	Low	Moderate	Minor adverse	Avoidance measures, minimum working areas, habitat reinstatement.	**Insignificant**
Pontic rhododendron scrub	Habitat loss and felling for road access, work compounds.	High	Minor	Moderate adverse	Avoidance measures, minimum working areas, habitat reinstatement, plant genetic conservation.	**Minor adverse**:
Bare rock, cervices and riverside deposits	Deposition of tunnelling waste, drilling activities, habitat loss	Low	Minor	Insignificant	None	**Insignificant**

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
Hartvisian oak	Habitat loss and felling for road access, work compounds.	Medium	Moderate	Moderate adverse	Avoidance measures, minimum working areas, tree planting or translocation, plant genetic conservation.	**Minor adverse**
Cyclamen	Habitat loss and felling for road access, work compounds.	Medium	Moderate	Moderate adverse	Avoidance measures, minimum working areas, species translocation, plant genetic conservation.	**Minor adverse**
Assemblage of notable plant species	Habitat loss and felling for road access, work compounds.	Low-Medium	Minor	Minor adverse	Avoidance measures, minimum working areas, species translocation.	**Insignificant**
European otter	Barriers during construction, noise disturbance, food shortage, sediment release, habitat loss	High	Moderate	Major adverse	Minimum working areas, sediment control and	**Moderate adverse**
Brown bear	Habitat loss, noise disturbance, hunting	Medium	Moderate	Moderate adverse	Avoidance of natural habitat loss, hunting ban, good working practices	**Minor adverse**
European lynx	Habitat loss, noise disturbance, hunting	Medium	Moderate	Moderate adverse	Avoidance of natural habitat loss, hunting ban, good working practices	**Minor adverse**
Caucasian squirrel	Habitat loss & noise disturbance	Medium	Minor	Minor adverse	Avoidance of natural habitat loss, hunting ban, good working practices, habitat instatement	**Insignificant**
Golden jackal	Habitat loss, noise disturbance, hunting	Low	Moderate	Minor adverse	Avoidance of natural habitat loss, hunting ban, good working practices, habitat instatement	**Insignificant**
Common wild boar	Habitat loss, noise disturbance, hunting	Low	Moderate	Minor adverse	Avoidance of natural habitat loss, hunting	**Insignificant**

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
					ban, good working practices, habitat instatement	
Wildcat	Habitat loss, noise disturbance, hunting	Medium	Moderate	Moderate adverse	Avoidance of natural habitat loss, hunting ban, good working practices, habitat instatement	**Minor adverse**
Bats (all species)	Habitat loss, light and noise disturbance.	High	Moderate	Major adverse	Avoidance of natural habitat loss, habitat instatement	**Moderate adverse**
Notable bird species	Habitat loss, light and noise disturbance, hunting	High	Moderate	Moderate adverse	Minimise habitat loss and potentially disturbing activities, ban on hunting, pre-construction checks for nesting birds	**Minor adverse**
General bird assemblages	Habitat loss, light and noise disturbance, hunting	Low-Medium	Moderate	Minor-moderate adverse	Minimise habitat loss, ban on hunting, pre-construction checks for nesting birds	**Minor adverse**
Clark's lizard	Habitat loss, accidental killing and injury	Very high	Minor	Moderate adverse	Minimise area of habitat loss, pre-construction checks in sensitive areas/suitable habitats, relocation of animals if found, staff awareness	**Minor adverse**
Caucasus viper	Habitat loss, accidental killing and injury	Very high	Minor	Moderate adverse	Minimise area of habitat loss, pre-construction checks in sensitive areas/suitable habitats, relocation of animals if found, staff awareness	**Minor adverse**
Caucasian salamander	Habitat loss, accidental killing and injury, degradation of habitats	High	Minor	Moderate adverse	Minimise area of habitat loss, pre-construction checks in sensitive areas/suitable habitats, relocation of animals if found, staff awareness	**Minor adverse**

Table 8.21: Summary of Key Significant Impacts on Ecological Features during Operational Activities for Shuakhevi

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
Oak forest – *Quercus petraea ssp. dschorochensis*	Permanent habitat loss from inundation and infrastructure	High	Minor	Moderate adverse	Reduced operating area & reforestation scheme, including habitat creation	**Minor adverse**
Liana-rich mixed deciduous forest with spruce – *Picea orientalis, Carpinus caucasica, Alnus barbata, Salix caprea*	Permanent habitat loss from inundation and infrastructure	Medium	Minor	Minor adverse	Reduced operating area & reforestation scheme	**Insignificant**
Degraded spruce (Picea orientalis) forest with deciduous species – *Quercus petraea ssp. dshorochensis, Fagus orientalis, Ulmus glabra, Carpinus caucasica*	Permanent habitat loss from inundation and infrastructure	Medium	Moderate	Moderate adverse	Reduced operating area & reforestation scheme	**Minor adverse**
Riparian forest – *Alnus barbata* dominant	Permanent habitat loss from inundation and infrastructure	Low	Moderate	Minor adverse	Reduced operating area & reforestation scheme	**Insignificant**
Walnut plantation – *Juglans regia, Alnus barbata, Picea orientalis*	Permanent habitat loss from inundation and infrastructure	Low	Minor	Insignificant	Reduced operating area & reforestation scheme	**Minor beneficial**.
Riverine forest & scrub – *Salix alba, Robinia pseudoacacia, Alnus barbata*	Permanent habitat loss from inundation and infrastructure. Changes in hydrological conditions may increase as river recedes	Low	Moderate	Minor adverse	Reduced operating area & reforestation scheme	**Insignificant**
Pontic rhododendron scrub	Permanent habitat loss from inundation and infrastructure	High	Minor	Moderate adverse	Avoidance measures, reduced operating area & reforestation scheme	**Minor adverse**
Riverside grassland-river terrace typically used for	Permanent habitat loss from inundation and	Negligible	Major	Insignificant	Reduced operating area & reforestation scheme	**Insignificant**

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
agricultural/grazing purposes	infrastructure.					
Bare rock, cervices and riverside deposits	Permanent habitat loss from inundation and infrastructure	Low	Minor	Insignificant	-	**Insignificant**
Hartvisian oak	Permanent habitat loss from inundation and infrastructure	Medium	Minor	Minor adverse	Reduced operating area & reforestation scheme	**Insignificant**
Cyclamen	Permanent habitat loss from inundation and infrastructure	Medium	Moderate	Moderate adverse	Reduced operating area & plant translocation	**Minor adverse**
Assemblage of notable plant species	Permanent habitat loss from inundation and infrastructure	Low	Minor	Insignificant	Reduced operating area & plant translocation	**Minor adverse**
European otter	Physical barriers preventing movement of species, reduced riverine habitat, reduce food availability along rivers, changes in water quality, increase disturbance	High	Major	Major	Adjustment to the environmental flows, stocking of reservoirs with fish.	**Moderate adverse**
Brown bear	Habitat loss, noise disturbance, hunting	Medium	Minor	Minor to moderate adverse	Hunting ban and enforcement measures, minimise habitat loss and reinstatement where possible, staff awareness	**Minor adverse**
European lynx	Habitat loss, noise disturbance, hunting	Medium	Minor	Minor adverse	Hunting ban and enforcement measures, minimise habitat loss and reinstatement where possible, staff awareness	**Insignificant**
Caucasian squirrel	Habitat loss, noise disturbance, hunting	Medium	Minor	Minor adverse	Minimise habitat loss, habitat reinstatement	**Insignificant**
Golden jackal	Habitat loss, noise disturbance, hunting	Low	Minor	Insignificant	Hunting ban and enforcement measures,	**Insignificant**

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
					minimise habitat loss and reinstatement where possible, staff awareness	
Common wild boar	Habitat loss, noise disturbance, hunting	Low	Minor	Insignificant	Hunting ban and enforcement measures, minimise habitat loss and reinstatement where possible, staff awareness	**Insignificant**
Wildcat	Habitat loss, noise disturbance, hunting	Medium	Minor	Minor to moderate adverse	Hunting ban and enforcement measures, minimise habitat loss and reinstatement where possible, staff awareness	**Insignificant**
Bats (all species)	Habitat loss, reduced area for roosting, increased disturbance and light pollution. But open water habitats creating new foraging areas	Medium	Minor	Minor adverse	Erection of bat boxes to compensate for loss of roost sites.	**Minor adverse**
Notable bird species	Habitat loss, light and noise disturbance, hunting, creatation of open water habitats	High	Moderate	Moderate adverse	Hunting ban and enforcement measures, minimise habitat loss and reinstatement where possible, provision of safe artificial nest sites, staff awareness	**Minor adverse**
General bird assemblages	Habitat loss, light and noise disturbance, hunting, creatation of open water habitats	Low-Medium	Moderate	Minor-moderate adverse	Hunting ban and enforcement measures, minimise habitat loss and reinstatement where possible, provision of safe artificial nest sites, staff awareness	**Minor adverse**

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
Clark's lizard	Habitat loss, accidental killing and injury	Very high	Minor	Moderate adverse	Reduced operating areas, habitat creation, staff awareness of ecological issues	**Minor**
Caucasus viper	Habitat loss, accidental killing and injury	Very high	Minor	Moderate adverse	Reduced operating areas, habitat creation, staff awareness of ecological issues	**Minor**
Caucasian salamander	Habitat loss, accidental killing and injury	High	Minor	Low to Moderate adverse	Reduced operating areas, habitat creation, staff awareness of ecological issues	**Minor**

8.10.3 Summary for the Koromkheti Scheme

The following table summarises the impact of the Project on the key ecological features which occur within the AoI.

Table 8.22: Summary of Key Significant Impacts on Ecological Features during Construction Activities for Koromkheti

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
Oak forest – *Quercus petraea ssp. dschorochensis*	Habitat loss and felling for road access, work compounds.	High	Minor	Moderate adverse	Avoidance measures, minimum working areas, habitat reinstatement, plant genetic coservation.	**Minor adverse**
Oakhornbeam forest with *Carpinus caucasica, Quercus petraea ssp. dschorochensis* or *Quercus hartwissiana* Mixed, species rich deciduous forest with Colchic understorey-*Castanea sativa, Aristolochia pontica, including Quercus*	Habitat loss and felling for road access, work compounds.	High	Moderate	Major adverse	Avoidance measures, minimum working areas, habitat reinstatement, plant genetic coservation.	**Moderate adverse**
Chestnut forest with cherry-laurel – *Castanea sativa, Acer campestre, Alnus barbata*	Habitat loss and felling for road access, work compounds.	Medium	Moderate	Moderate adverse	Avoidance measures, minimum working areas, habitat reinstatement, plant genetic coservation.	**Minor adverse**
Riparian forest – *Alnus barbata* dominant Riverine forest & scrub – *Salix alba, Robinia pseudoacacia, Alnus barbata*	Habitat loss and felling for road access, work compounds.	Low	Moderate	Minor adverse	Avoidance measures, minimum working areas, habitat reinstatement	**Insignificant**
Riverside grassland-river terrace typically	Habitat loss for construction activities	Negligible	Moderate	Insignificant	Avoidance measures, minimum working areas,	**Insignificant**

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
used for agricultural/grazing purposes					habitat reinstatement, plant genetic coservation.	
Bare rock, cervices and riverside deposits	Deposition of tunnelling waste, drilling activities, habitat loss	Low	Minor	Insignificant	None	**Insignificant**
Aquatic/riverine habitats of the Adjarastsqali River and its tributaries	Sediment release, changes in water quality.	Very high	Moderate	Major adverse	Minimum working areas, pollution prevention measures, sediment control	**Moderate adverse**
Chestnut	Habitat loss and felling for road access, work compounds.	Medium	Moderate	Moderate adverse	Avoidance measures, minimum working areas, tree planting or translocation, plant genetic coservation.	**Minor adverse**
Walnut	Habitat loss and felling for road access, work compounds.	Medium	Moderate	Moderate adverse	Avoidance measures, minimum working areas, tree planting or translocation, plant genetic coservation.	**Minor adverse**
European hop hornbeam	Habitat loss and felling for road access, work compounds.	High	Minor	Major adverse	Avoidance measures, minimum working areas, tree planting or translocation, plant genetic coservation. Propogation scheme for nature European hop hornbeam	**Moderate adverse**
Hartvisian oak	Habitat loss and felling for road access, work compounds.	Medium	Moderate	Moderate adverse	Avoidance measures, minimum working areas, tree planting or translocation, plant genetic coservation.	**Minor adverse**
Colchic bladdernut	Habitat loss and felling for road access, work compounds.	Medium	Minor	Minor adverse	Avoidance measures, minimum working areas, species translocation, plant genetic coservation.	**Insignificant**

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
Elm	Habitat loss and felling for road access, work compounds.	Medium	Minor	Minor adverse	Avoidance measures, minimum working areas, tree planting or translocation, plant genetic coservation.	**Insignificant**
Cyclamen	Habitat loss and felling for road access, work compounds.	Medium	Moderate	Moderate adverse	Avoidance measures, minimum working areas, species translocation, plant genetic coservation.	**Minor adverse**
Assemblage of notable plant species	Habitat loss and felling for road access, work compounds.	Low-Medium	Minor	Minor adverse	Avoidance measures, minimum working areas, species translocation.	**Insignificant**
European otter	Barriers during construction, noise disturbance, food shortage, sediment release, habitat loss	High	Moderate	Major adverse	Minimum working areas, sediment control and	**Moderate adverse,** significant, but temporary and localised
Brown bear	Habitat loss, noise disturbance, hunting	Medium	Moderate	Moderate adverse	Avoidance of natural habitat loss, hunting ban, good working practices	**Minor adverse**
Caucasian squirrel	Habitat loss & noise disturbance	Medium	Minor	Sligh adverse	Avoidance of natural habitat loss, hunting ban, good working practices, habitat instatement	**Insignificant**
Golden jackal	Habitat loss, noise disturbance, hunting	Low	Moderate	Minor adverse	Avoidance of natural habitat loss, hunting ban, good working practices, habitat instatement	**Insignificant**
Common wild boar	Habitat loss, noise disturbance, hunting	Low	Moderate	Minor adverse	Avoidance of natural habitat loss, hunting ban, good working practices, habitat instatement	**Insignificant**

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
Bats (all species)	Habitat loss, light and noise disturbance.	High	Moderate	Major adverse	Avoidance of natural habitat loss, habitat instatement	**Moderate adverse**
Notable bird species	Habitat loss, light and noise disturbance, hunting	High	Moderate	Moderate adverse	Minimise habitat loss and potentially disturbing activities, ban on hunting, pre-construction checks for nesting birds	**Minor adverse**
General bird assemblages	Habitat loss, light and noise disturbance, hunting	Low-Medium	Moderate	Minor-moderate adverse	Minimise habitat loss, ban on hunting, pre-construction checks for nesting birds	**Minor adverse**
Caucasian toad	Habitat loss	Medium	Minor	Minor adverse	Minimise area of habitat loss, pre-construction checks in sensitive areas/suitable habitats, relocation of animals if found, staff awareness	**Insignificant**
Clark's lizard	Habitat loss, accidential killing and injury	Very high	Minor	Moderate adverse	Minimise area of habitat loss, pre-construction checks in sensitive areas/suitable habitats, relocation of animals if found, staff awareness	**Minor adverse**
Caucasus viper	Habitat loss, accidential killing and injury	Very high	Minor	Moderate adverse	Minimise area of habitat loss, pre-construction checks in sensitive areas/suitable habitats, relocation of animals if found, staff awareness	**Minor adverse**
Caucasian salamander	Habitat loss, accidential killing and injury, degradation of habitats	High	Minor	Moderate adverse	Minimise area of habitat loss, pre-construction checks in sensitive areas/suitable habitats, relocation of animals if found, staff awareness	**Minor adverse**, not significant, impact only localised and temporary during construction period

Table 8.23: Summary of Key Significant Impacts on Ecological Features during Operational Activities for Koromkheti

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
Oak forest – *Quercus petraea ssp. dschorochensis*	Permanent habitat loss from inundation and infrastructure	High	Minor	Moderate adverse	Reduced operating area & reforestation scheme, including habitat creation	**Minor adverse**
Oak-hornbeam forest with *Carpinus caucasica, Quercus petraea ssp. dschorochensis* or *Quercus hartwissiana*	Permanent habitat loss from inundation and infrastructure	High	Moderate	Major adverse	Reduced operating area & reforestation scheme, including habitat creation	**Moderate adverse**
Mixed, species rich deciduous forest with Colchic understorey- *Castanea sativa, Aristolochia pontica, including Quercus*	Permanent habitat loss from inundation and infrastructure	High	Moderate	Major adverse	Reduced operating area & reforestation scheme	**Moderate adverse**
Chestnut forest with cherry-laurel – *Castanea sativa, Acer campestre, Alnus barbata*	Permanent habitat loss from inundation and infrastructure	Medium	Minor	Minor adverse	Reduced operating area & reforestation scheme	**Insignificant**
Riparian forest – Alnus barbata dominant	Permanent habitat loss from inundation and infrastructure	Low	Moderate	Minor adverse	Reduced operating area & reforestation scheme	**Insignificant**
Riverine forest & scrub – *Salix alba, Robinia pseudoacacia, Alnus barbata*	Permanent habitat loss from inundation and infrastructure. Changes in hydrological conditions may increase as river recedes	Low	Moderate	Minor adverse	Reduced operating area & reforestation scheme	**Insignificant**
Riverside grassland- river terrace typically used for agricultural/grazing purposes	Permanent habitat loss from inundation and infrastructure.	Negligible	Major	Insignificant	Reduced operating area & reforestation scheme	**Insignificant**
Bare rock, cervices and	Permanent habitat loss	Low	Minor	Insignificant	-	**Insignificant**

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
riverside deposits	from inundation and infrastructure					
Chestnut	Permanent habitat loss from inundation and infrastructure	Medium	Moderate	Moderate adverse	Reduced operating area & reforestation scheme	**Minor adverse**
Walnut	Permanent habitat loss from inundation and infrastructure	Medium	Moderate	Moderate adverse	Reduced operating area & reforestation scheme	**Minor adverse**
European hop hornbeam	Permanent habitat loss from inundation and infrastructure	High	Moderate	Large adverse	Reduced operating area & reforestation scheme	**Moderate adverse**
Hartvisian oak	Permanent habitat loss from inundation and infrastructure	Medium	Minor	Minor adverse	Reduced operating area & reforestation scheme	**Minor adverse**
Colchic bladdernut	Permanent habitat loss from inundation and infrastructure	Medium	Minor	Minor adverse	Reduced operating area & plant translocations	**Minor adverse**
Elm	Permanent habitat loss from inundation and infrastructure	Medium	Minor	Minor adverse	Reduced operating area & reforestation scheme	**Minor adverse**
Cyclamen	Permanent habitat loss from inundation and infrastructure	Medium	Moderate	Moderate adverse	Reduced operating area & plant translocation	**Minor adverse**
Assemblage of notable plant species	Permanent habitat loss from inundation and infrastructure	Low	Minor	Insignificant	Reduced operating area & plant translocation	**Minor adverse**
European otter	Physical barriers preventing movement of species, reduced riverine habitat, reduce food availability along rivers, changes in water quality, increase disturbance	High	Major	Large adverse	Adjustment to the environmental flows, stocking of reservoirs with fish.	**Moderate adverse**
Brown bear	Habitat loss, noise disturbance, hunting	Medium	Minor	Minor to moderate adverse	Hunting ban and enforcement measures, minimise habitat loss	**Minor adverse**

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
					and reinstatement where possible, staff awareness	
Caucasian squirrel	Habitat loss, noise disturbance, hunting	Medium	Minor	Minor adverse	Minimise habitat loss, habitat reinstatement	**Insignificant**
Golden jackal	Habitat loss, noise disturbance, hunting	Low	Minor	Minor adverse	Hunting ban and enforcement measures, minimise habitat loss and reinstatement where possible, staff awareness	**Insignificant**
Common wild boar	Habitat loss, noise disturbance, hunting	Low	Minor	Minor adverse	Hunting ban and enforcement measures, minimise habitat loss and reinstatement where possible, staff awareness	**Insignificant**
Bats (all species)	Habitat loss, reduced area for roosting, increased disturbance and light pollution. But open water habitats creating new foraging areas	Medium	Minor	Minor adverse	Erection of bat boxes to compensate for loss of roost sites.	**Minor adverse**
Notable bird species	Habitat loss, light and noise disturbance, hunting, creatation of open water habitats	High	Moderate	Moderate adverse	Hunting ban and enforcement measures, minimise habitat loss and reinstatement where possible, provision of safe artificial nest sites, staff awareness	**Minor adverse**
General bird assemblages	Habitat loss, light and noise disturbance, hunting, creatation of open water habitats	Low-Medium	Moderate	Minor-moderate adverse	Hunting ban and enforcement measures, minimise habitat loss and reinstatement where possible, provision of safe artificial nest sites, staff	**Minor adverse**

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
					awareness	
Caucasian toad	Habitat loss along river margins	Medium	Minor	Minor adverse	-	**Minor adverse**
Clark's lizard	Habitat loss, accidential killing and injury	Very high	Minor	Moderate adverse	Reduced operating areas, habitat creation, staff awareness of ecological issues	**Insignificant**
Caucasus viper	Habitat loss, accidential killing and injury	Very high	Minor	Moderate adverse	Reduced operating areas, habitat creation, staff awareness of ecological issues	**Insignificant**

8.10.4 Summary for the Khertvisi Scheme

The following table summarises the impact of the Project on the key ecological features which occur within the AoI.

Table 8.24: Summary of Key Significant Impacts on Ecological Features during Construction Activities for Khertvisi

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
Machakhela National Park	Habitat loss, sediment release and water quality changes due to construction activities	High	Minor	Moderate adverse	Minimise working areas, habitat reinstatement.	**Minor adverse**, temporary and localised, not significant.
Hornbeam-chestnut forest – *Castanea sativa, Carpinus caucasica*	Habitat loss and felling for road access, work compounds.	High	Minor	Moderate adverse	Avoidance measures, minimum working areas, habitat reinstatement, plant genetic conservation.	**Minor adverse**
Riparian forest – Alnus barbata dominant	Habitat loss and felling for road access, work compounds.	Low	Moderate	Minor adverse	Avoidance measures, minimum working areas, habitat reinstatement	**Insignificant**
Riverine forest & scrub – *Salix alba, Robinia pseudoacacia, Alnus barbata*	Habitat loss and felling for road access, work compounds.	Low	Moderate	Minor adverse	Avoidance measures, minimum working areas, habitat reinstatement.	**Insignificant**
Riverside grassland-	Habitat loss for	Negligible	Moderate	Insignificant	Avoidance measures,	**Insignificant**

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
river terrace typically used for agricultural/grazing purposes	construction activities				minimum working areas, habitat reinstatement, plant genetic conservation.	
Bare rock, cervices and riverside deposits	Deposition of tunnelling waste, drilling activities, habitat loss	Low	Minor	Insignificant	None	**Insignificant**
Aquatic/riverine habitats of the Adjaristsqali River and its tributaries	Sediment release, changes in water quality.	Very high	Moderate	Major adverse	Minimum working areas, pollution prevention measures, sediment control	**Moderate adverse**
Chestnut	Habitat loss and felling for road access, work compounds.	Medium	Moderate	Moderate adverse	Avoidance measures, minimum working areas, tree planting or translocation, plant genetic conservation.	**Minor adverse**
Walnut	Habitat loss and felling for road access, work compounds.	Medium	Moderate	Moderate adverse	Avoidance measures, minimum working areas, tree planting or translocation, plant genetic conservation.	**Minor adverse**
Elm	Habitat loss and felling for road access, work compounds.	Medium	Minor	Minor adverse	Avoidance measures, minimum working areas, tree planting or translocation, plant genetic conservation.	**Insignificant**
Cyclamen	Habitat loss and felling for road access, work compounds.	Medium	Moderate	Moderate adverse	Avoidance measures, minimum working areas, species translocation, plant genetic conservation.	**Minor adverse**
Assemblage of notable plant species	Habitat loss and felling for road access, work compounds.	Low-Medium	Minor	Minor adverse	Avoidance measures, minimum working areas, species translocation.	**Insignificant**
European otter	Barriers during construction, noise disturbance, food shortage, sediment	High	Moderate	Major adverse	Minimum working areas, sediment control and	**Moderate adverse,** significant, but temporary and localised

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
	release, habitat loss					
Brown bear	Habitat loss, noise disturbance, hunting	Medium	Moderate	Moderate adverse	Avoidance of natural habitat loss, hunting ban, good working practices	**Minor adverse**
Caucasian squirrel	Habitat loss & noise disturbance	Medium	Minor	Minor adverse	Avoidance of natural habitat loss, hunting ban, good working practices, habitat instatement	**Insignificant**
Bats (all species)	Habitat loss, light and noise disturbance.	High	Moderate	Major adverse	Avoidance of natural habitat loss, habitat instatement	**Moderate adverse**
Notable bird species	Habitat loss, light and noise disturbance, hunting	High	Moderate	Moderate adverse	Minimise habitat loss and potentially disturbing activities, ban on hunting, pre-construction checks for nesting birds	**Minor adverse**
General bird assemblages	Habitat loss, light and noise disturbance, hunting	Low-Medium	Moderate	Minor-moderate adverse	Minimise habitat loss, ban on hunting, pre-construction checks for nesting birds	**Minor adverse**
Caucasian toad	Habitat loss	Medium	Minor	Minor adverse	Minimise area of habitat loss, pre-construction checks in sensitive areas/suitable habitats, relocation of animals if found, staff awareness	**Insignificant**
Clark's lizard	Habitat loss, accidental killing and injury	Very high	Minor	Moderate adverse	Minimise area of habitat loss, pre-construction checks in sensitive areas/suitable habitats, relocation of animals if found, staff awareness	**Minor adverse**
Caucasus viper	Habitat loss, accidental killing and injury	Very high	Minor	Moderate adverse	Minimise area of habitat loss, pre-construction checks in sensitive	**Minor adverse**

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
					areas/suitable habitats, relocation of animals if found, staff awareness	
Caucasian salamander	Habitat loss, accidental killing and injury, degradation of habitats	High	Minor	Moderate adverse	Minimise area of habitat loss, pre-construction checks in sensitive areas/suitable habitats, relocation of animals if found, staff awareness	**Minor adverse**

Table 8.25: Summary of Key Significant Impacts on Ecological Features during Operational Activities for Khertvisi

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
Machakhela National Park	Reduced flows, potential barrier to movement of some species	High	Minor	Moderate adverse	Reduced operating area, improved environmental flow during spring and autumn	**Minor adverse**
Hornbeam-chestnut forest – *Castanea sativa, Carpinus caucasica*	Permanent habitat loss from inundation and infrastructure	High	Moderate	Major advere	Reduced operating area & reforestation scheme, including habitat creation	**Moderate adverse**
Alder forest – Alnus barbara dominant	Permanent habitat loss from inundation and infrastructure	Low	Moderate	Minor adverse	Reduced operating area & reforestation scheme	**Insignificant**
Riverine forest & scrub – *Salix alba, Robinia pseudoacacia, Alnus barbata*	Permanent habitat loss from inundation and infrastructure. Changes in hydrological conditions may increase as river receeds	Low	Moderate	Minor adverse	Reduced operating area & reforestation scheme	**Insignificant**
Riverside grassland-river terrace typically used for agricultural/grazing purposes	Permanent habitat loss from inundation and infrastructure.	Negligible	Major	Insignificant	Reduced operating area & reforestation scheme	**Insignificant**
Bare rock, cervices and riverside deposits	Permanent habitat loss from inundation and infrastructure	Low	Minor	Insignificant	-	**Insignificant**
Chestnut	Permanent habitat loss from inundation and infrastructure	Medium	Moderate	Moderate adverse	Reduced operating area & reforestation scheme	**Minor adverse**
Walnut	Permanent habitat loss from inundation and infrastructure	Medium	Moderate	Moderate adverse	Reduced operating area & reforestation scheme	**Minor adverse**
Cyclamen	Permanent habitat loss from inundation and infrastructure	Medium	Major	Moderate adverse	Reduced operating area & plant translocation	**Minor adverse**
Assemblage of notable	Permanent habitat loss	Low	Minor	Insiginficant	-	**insignifcant**

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
plant species	from inundation and infrastructure					
European otter	Physical barriers preventing movement of species, reduced riverine habitat, reduce food availability along rivers, changes in water quality, increase disturbance	High	Moderate	Major adverse	Habitat enhancement and Phase II assessment of flow in significantly impacted reaches, stocking of reservoirs with fish.	**Moderate to Minor adverse**
Brown bear	Habitat loss, noise disturbance, hunting	Medium	Minor	Minor to moderate adverse	Hunting ban and enforcement measures, mimimise habitat loss and reinstatement where possible, staff awareness	**Minor adverse**
Caucasian squirrel	Habitat loss, noise disturbance, hunting	Medium	Minor	Minor adverse	Minimise habitat loss, habitat reinstatement	**Insigificant**
Bats (all species)	Habitat loss, reduced area for roosting, increased disturbance and light pollution. But open water habitats creating new foraging areas	Medium	Minor	Minor adverse	Erection of bat boxes to compensate for loss of roost sites.	**Insignificant**
Notable bird species	Habitat loss, light and noise disturbance, hunting, creatation of open water habitats	High	Moderate	Moderate adverse	Hunting ban and enforcement measures, minimise habitat loss and reinstatement where possible, provision of safe artificial nest sites, staff awareness	**Minor adverse**
General bird assemblages	Habitat loss, light and noise disturbance, hunting, creatation of open water habitats	Low-Medium	Moderate	Minor-moderate adverse	Hunting ban and enforcement measures, minimise habitat loss and reinstatement where possible, provision of safe artificial nest sites, staff	**Minor adverse**

Features	Key Impacts	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual significance
					awareness	
Caucasian toad	Habitat loss along river margins	Medium	Minor	Minor adverse	-	**Minor adverse**
Clark's lizard	Habitat loss, accidential killing and injury	Very high	Minor	Moderate adverse	Reduced operating areas, habitat creation, staff awareness of ecological issues	**Insignificant** in the long-term due habitat creation
Caucasus viper	Habitat loss, accidential killing and injury	Very high	Minor	Moderate adverse	Reduced operating areas, habitat creation, staff awareness of ecological issues	**Insignificant** in the long-term due habitat creation

Table 8.26: Summary of Ecosystem Services Impacts[31] and Mitigations

Priority Services	Likely Impacts during construction	Likely Impacts during operations	Significance of the impacts	Mitigations	Residual Effects
Provisioning					
Fisheries	Moderate	Moderate	Adverse impact without mitigations due to fundamental change in hydrological conditions	Habitat enahncement, fish passes and implementation of BAP and associated offsetting measures	**Minor to moderate adverse**
Water irrigation & agricultural use	Minor	Moderate	No significant impacts as water for irrigation from sources above the areas being impacted. Reduced flows downstream likely to affect local community use	Compensation to local users. A catchment management scheme to ensure long-term water supply to users.	**Insignificant**
Plant genetic resources	Moderate	Moderate to Major	Habitat loss could have significant impact on genetic diversity	Habitat removal and reinstatement plan to include species translocation and transfer of stock to ex-situ centres. Habitat creation and BAP to include habitat management activities	**Minor adverse**
Timber	Moderate	Negligible	Moderate adverse but likely to be localised as construction work force may use local timber for personal/domestic use. No deforestation for timber for the project construction.	Habitat creation and reinstatement plans. Improvement management of natural habitats through the BAP	**Insignificant**
Livestock grazing	Moderate	Minor	Land currently used by local farmers will be used for construction activities and some area lost as part of operations. Moderate adverse impact.	Compensation to farmers due to loss of land.	**Minor adverse**
Regulating					

[31] Impact assessment for Ecosystem services covers all three schemes.

Priority Services	Likely Impacts during construction	Likely Impacts during operations	Significance of the impacts	Mitigations	Residual Effects
Water regulation	Negligible	Minor	Change in hydrological conditions may result localised water regulation changes, but unlikely to be significant	A catchment management scheme to ensure long-term water supply to users	**Insignificant**
Air quality and local climatic conditions	Minor	Minor	Loss of habitat and changes in hydrological conditions affecting local climatic conditions. Minor adverse	Habitat creation and re-instatement, environmental flows	**Insignificant**
Erosion regulation	Moderate	Moderate	Habitat loss and construction work likely to lead to local soil erosion problems, moderate adverse. Existing erosion and land slippage from agricultural activities.	Habitat reinstatement and creation. Community Forest scheme to replant areas already under erosion and planting new areas. Catchment management scheme & BAP also to look at habitat management across the area	Long-term **minor beneficial** effects from forest planting and improved management.
Refugia for pollinators	Minor	Minor	Localised habitat loss may lead to reduced abundance of pollinators for local crops. Minor adverse	Habitat reinstatement and creation, plus Community Forest scheme for native tree planting around agricultural areas	**Insignificant**
Cultural					
Amenity value	Moderate negative	Negligible or Minor positive	Minor adverse during construction due to disturbance from construction activities	Stocking of reservoirs and rivers for fishing, potential for ecotourism developments	Potential **minor beneficial** with potential recreational use on and around the reservoirs.
Aesthetic value	Moderate negative	Negligible	Moderate adverse during construction, minor negative during operations, and changes in landscape character.	-	**Insignificant**
Recreational value	Moderate negative	Minor positive	Minor adverse impact during construction and beneficial in the longer term	-	Potential **minor beneficial** with potential recreational use on and around the reservoirs.

Priority Services	Likely Impacts during construction	Likely Impacts during operations	Significance of the impacts	Mitigations	Residual Effects
Supporting					
Soil formation, nutrient an water cycling processes	Negligible	Negligible	Insignificant	None required	**Insignificant**

8.11 Statement of Significance and Compliance

8.11.1 Statement of Significance

The Adjaristsqali Hydropower Cascade Project is a large and complicated development in an area of high biodiversity interest with priority ecosystem services. Prior to mitigation, the Project would have a large and very significant impact on biodiversity and ecosystem services. A complex array of mitigation, compensation and enhancement measures will be introduced which will be delivered. Through the effective implementation of the CEMP and BAP the overall impact of the Project will be significantly reduced but due to the nature of the Project a significant impact on the aquatic system will remain. Yet long-term significant beneficial effects on biodiversity are predicted to be achieved.

8.11.2 National legislation compliance

By undertaking the necessary mitigation and compensation measures as outlined in this Environmental Statement and implemented through the CEMP and BAP this Project is in compliance with national legislative requirements of Georgia.

8.11.3 IFC compliance

Table 8.27 presents a summary of the Project ecological impacts in the form of a Habitat Decision Framework against the requirement of IFC Performance Standard 6, Biodiversity, Conservation and Sustainable Natural Resource Management.

Table 8.27: IFC Habitat Decision Framework – Summary of Significant & Cumulative Effects

IFC PS6 compliance requirement	Significance of the Project and IFC compliance with the Performance Standard	Cumulative Effects
Will the project impact on a site legally protected or proposed for protection?	No impact on a legally protected site. There is potential for some minor influence to the borders of the Machakhela National Park, but the project is not within the designated area, therefore any disturbance impacts are likely to be minor to insignificant.	None
Will the project impact on critical habitats?	No Critical habitat as defined under IFC PS6 will be affected by the project, while some protected species and areas of important Natural habitat are present within a wider modified environment. Impacts on these species of high conservation value have been highlighted in the assessment and specific mitigation measures recommended to minimise any impact, in the long-term and with mitigation and offsetting measures the impact is unlikely to be significant.	There could be significant cumulative impacts on the biodiversity and ecosystem services within the Adjaristsqali river system. However with introduction of a Biodiversity Action Plan, and ensuring that the objectives and actions of the BAP are applied to other developments within the catchment, significant impacts would be avoided.
Will the project reduce populations of any recognised critically endangered or endangered species?	The introduction and implementation of mitigation and offsetting measures will reduce the impact on endangered species and any long-term significant adverse effect compensated for.	Potentially yes, in particular potential impact on European eel and Black Sea salmon in the Chorokhi and Machakhlistsqali river systems. However this will be investigated further as part Phase II aquatic biodiversity assessment.

IFC PS6 compliance requirement	Significance of the Project and IFC compliance with the Performance Standard	Cumulative Effects
Will there be measurable adverse impacts on the habitats ability to support its high value species and functions?	The impact on the river system will be significant in the short-term until mitigation and compensation measures become established and the biodiversity adapts to the changed hydrological conditions. During this period, (estimated at between 4 – 10 years) the reductions in flow and changes in hydrological condition are likely to affect species dependent on the river system and its functions.	Depends on the potential impacts of other developments within the river, notably along the Machakhlistsqali.
Will the project impact on modified or natural habitats?	Modified and natural habitats will be impacted, but with the implementation of the BAP, the impacts in the medium to long-term may be beneficial.	Depends on the potential impacts of other developments, notably on the high conservation value forest habitats. But with adherence to the proposed BAP by this Project and other major developments, the cumulative effects are unlikely to be significant.
Will the project lead to significant conversion or degradation of natural habitats?	The river systems, by the nature of the Project, will be significant degraded in certain reaches due to the significant reduction in river flows. However not all reaches significantly affected are unmodified/natural reaches. Phase II assessment will undertake to define specific mitigation measures to minimise impacts on reaches which will experience significant impact.	Depends on the potential impacts of other developments within the river, notably along the Machakhlistsqali and Chorokhi River.
Will the project lead to potential significant impacts on ecosystem services?	The most significant impacts would be on the Adjara river systems and natural forests. Due to this, a Biodiversity Action Plan will be prepared for all three schemes. The BAP measures will ensure that there is no long-term impact on the ecosystem services.	Cumulative effects on ecosystem services are likely, and therefore any future major developments will need to comply with the BAP proposed under this Project to avoid any significant impacts.
Are there technical and financially feasible alternatives?	Other technical and financially feasible alternatives have been considered, and the currently proposed scheme design is the design which would have the lowest impact on biodiversity and ecosystem services. This is because alternative scheme have included significant infrastructure works on the smaller tributaries which are of significant higher conservation value.	-
Do the overall benefits to biodiversity outweigh costs?	Yes	-
Can any significant conversion or degradation be mitigated to acceptable levels?	Yes, through the implementation of the CESMP and BAP, this includes habitat creation, habitat reinstatement, community forest management, and long-term catchment management plans.	Yes, by ensure that the BAP and its different schemes are applied to all other major developments within the Adjaristsqali.

Note: Table adapted from the Habitat Decision Framework, Annex B of the IFC Guidance Note

9. Water Reources and Water Quality

9.1 Introduction

This Chapter considers the potential impacts on water (surface and groundwater, quantity and quality, and flood risk) associated with construction, operation and decommissioning of the Adjaristsqali Hydropower Cascade Project (hereafter referred to as “the Project”). The Project has several components: construction and operation of four new dams/weirs and three weirs on the Adjaristsqali River and its tributaries; construction and operation of transfer tunnels and three hydropower stations, and construction of temporary and permanent access roads to support construction, maintenance and operational activities connected with main infrastructure works.

This Chapter identifies the relevant framework of legislation, and identifies and assesses potential significant adverse impacts on the river regime and water users, before defining appropriate mitigation, compensation and enhancement measures that will be implemented as part of the Project. This Chapter should be read in conjunction with Chapter 8 specifically those sections relating to aquatic ecology, and Chapter 10. Together these three chapters fully address the issues of protecting the river ecosystem and community water use.

This is in accordance with the Scoping Study prepared for the project (Mott MacDonald, August 2011).

9.1.1 General Approach

9.1.1.1 Spatial scope

The water resources study area is shown in Figure 9.1; it covers the full catchment of the Adjaristsqali River and the Chorokhi River within Georgia. The Area of Influence (AoI) is that part of the study area downstream of any abstraction point incorporated within the Project (as shown in Figures 2.1 – 2.3 in Chapter 2).

The Adjaristsqali River originates from the western part of the Arsiani mountain range, 2435 m above sea level. The total length of the river is 90 km, total fall – 2,397 m, average inclination – 26.6%. The catchment area is 1,540 km^2, average elevation is 1,400 m. The river joins the River Chorokhi from the right side some 17 km upstream of the outfall of the Chorokhi River into the Black Sea.

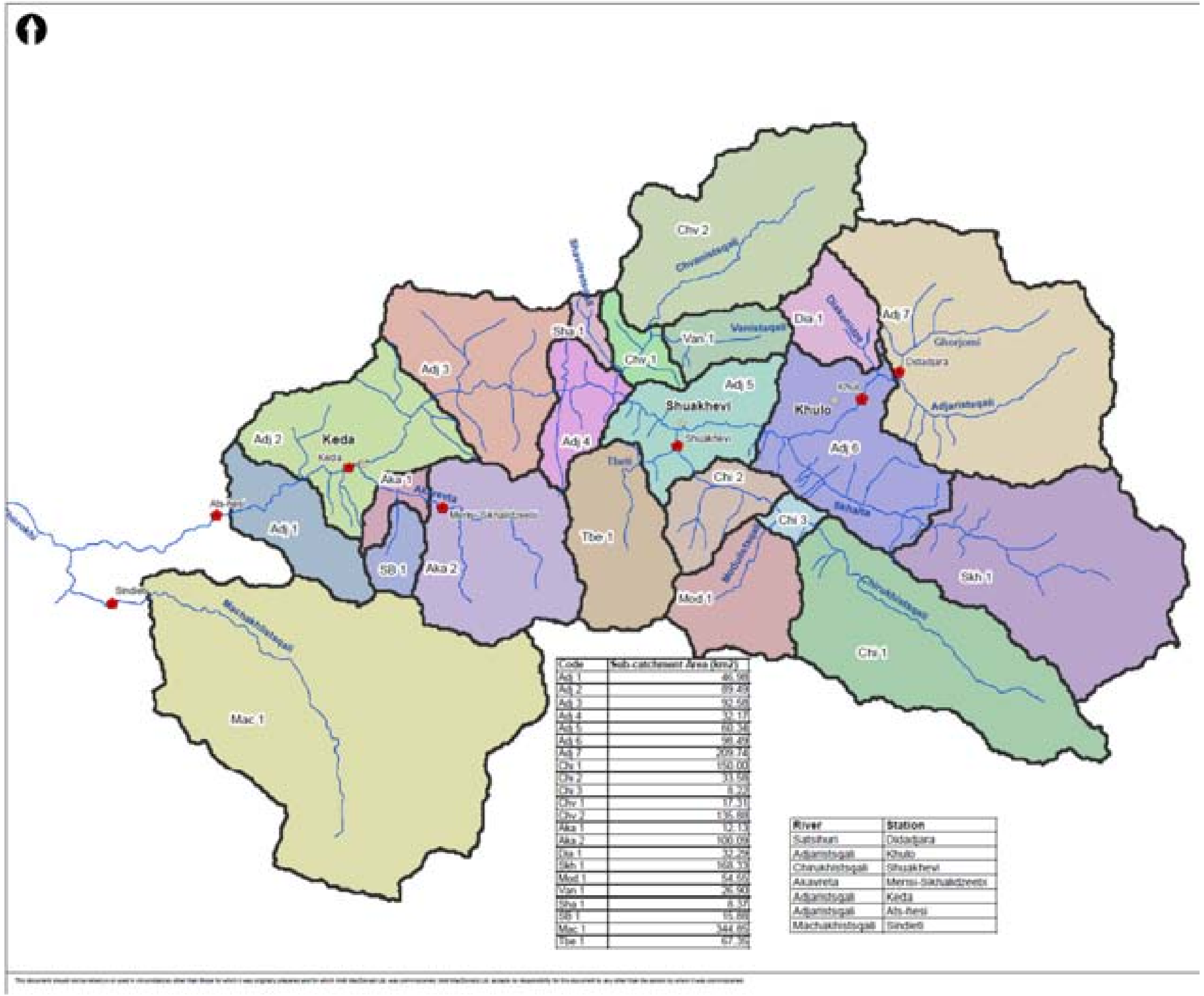
Most of the Adjaristsqali catchment area is covered by forests. In the downstream area, at 1,000-1,200 m elevation, deciduous forest dominates, whereas at higher elevations, 1,200-2,000 m, conifer forest is present. About 15-20% of total basin area is above the treeline and has alpine conditions.

9.1.1.2 Temporal scope

The assessment commenced in 2011 with an overview of the existing baseline conditions. The initial site visits were conducted in May 2011. Field work was undertaken in August 2011 to assess low flow situation and subsequent measurements were undertaken monthly.

The construction period is estimated to commence in 2013 and would be constructed in a phased approach as described in Chapter 2. Decommissioning impacts have been assessed qualitatively in relation to the potential impacts that may occur at that time.

Figure 9.1: Water Resources Study Area



Source: Mott MacDonald Ltd

9.2 Methodology and Assessment Criteria

9.2.1 Overview

Given the nature of the Project, the construction activities and subsequent operation of the project infrastructure (powerhouses, headworks, tunnels, and access roads), the scheme has the potential to impact water resources within the project AoI. The water resources assessment will cover the potential impacts on groundwater and surface waters.

A key aspect will be the determination of demands for downstream water use, both environmental and human at each of the proposed intakes in order to determine the necessary environmental flow to be maintained during the operational phase of the Project. Assessment and derivation of appropriate environmental flows has specifically been addressed in Chapter 10. Water resource requirements generally have seasonal variations and therefore consideration must be given to this.

The assessment of hydrological impacts is structured around the consideration of potential impacts upon the following sensitive receptors:
- Surface water features (hydrological regime, water quality and function of watercourses)
- Water resources
- Groundwater resources

9.2.2 Hydrological Regime, Water Quality and Function

Hydropower schemes are a non-consumptive use of water resources but they still have the potential for impacts on hydrological regime, water quality and function.

Potential impacts on surface watercourses include:
- Alteration of volume and seasonal pattern of runoff
- Loss of reach connectivity in low flow periods
- Alteration in range of flows to maintain channel morphology
- Alteration of volume and seasonal patterns of sediment erosion, transport and deposition
- Alteration of drainage paths (temporary or permanent)
- Changes to local flow dynamics and erosion including causing flooding where temporary or permanent works are required in the channel
- Increased erosion and sediment loads
- Contamination during site clearance and construction works (e.g. pesticide runoff during vegetation clearance, oil contamination, concrete wash-out / runoff)
- Changes to flood conveyance capacity of the channel (temporary or permanent) caused by spoil placement, vegetation encroachment due to lower flows, etc.

Rainfall is often intense and flooding and soil erosion are significant concerns so that construction activities need to be planned and managed to minimise potential impacts on watercourses and springs during the wetter months.

9.2.3 Water Resources

The construction and subsequent use of the project infrastructure has the potential to compete for water resources with existing users especially during low flow periods in mid-summer/early autumn and in winter.

Existing users include: urban water supplies, village water supplies, formal irrigation, small holder irrigation, livestock watering, hydropower plants, and use by wildlife. Water resource issues should be considered at every location where it is proposed to abstract for the Project or dispose of waste to a watercourse.

Potential impacts on surface water resources include:
- Alteration of volume and seasonal pattern of runoff no longer matches requirements of other users
- Reduced water available, unable to meet the needs of other users in low flow periods
- Alteration in range of flows to maintain channel morphology may lead to problems for other users' abstraction
- Alteration of volume and seasonal patterns of sediment erosion, transport and deposition may lead to problems for other users' abstraction including poor water quality
- Alteration in water quality.

Project water needs include potable supplies for the temporary or permanent workforce and water for use in construction (during earthworks, dust control etc).

9.2.4 Groundwater

Potential impacts on groundwater include:
- Water resources for drinking, irrigation and household use could be lost in areas where tunnels are dug underneath groundwater supplies
- Contamination during tunnel construction
- Spills or leakage during construction
- Work camp waste water (domestic waste)
- Competition for water resources with existing local users.

9.2.5 Legislative Framework

9.2.5.1 National

The main legislative framework for regulation of water resources in Georgian is the Law of Georgia on Water. The Law regulates the major general legal relationships with respect to Georgia's water resources as follows:
- Between the State and physical/legal entities in the field of water protection, study and consumption
- State and physical/legal entities involved in water protection, study and use on land, underground, continental shelf, territorial water and especially active economic zones;
- State and physical/legal entities involved in commercial water production and international trade in water
- Defines the competences of autonomous republics, local government and self-government for water related issues
- State and physical/legal entities involved in groundwater protection, study and use consistent with requirements of the law of Georgia on "Natural Resources"
- State and physical/legal entities involved in the protection of aquatic life, study, reproduction and use, in compliance with the law of Georgia on Fauna
- Regarding the use and/or consumption of fauna, flora, forest, land and other natural resources whilst utilising water.

Consistent with the legislation, water within the territory of Georgia is owned by the State can be abstracted only for consumption. Any actions directly or indirectly violating the State ownership rights for water are prohibited.

Other laws that are indirectly relevant in relation to minimising risk of pollution include;
- Law of Soil Protection
- Law on Hazardous Chemicals.

9.2.5.2 International

The following international guidelines and standards are relevant to the Project:
- Equator Principles 2006
- International Finance Corporation (IFC): Policy and Performance Standards on Social and Environmental Sustainability 2012
  - IFC Performance Standard 3 on Pollution Prevention and Abatement
  - IFC Performance Standard 4 on Community Health, Safety and Security
  - IFC Performance Standard 6 on Biodiversity Conservation and Sustainable Natural Resource Management
- IFC Environment Health and Safety (EHS) General Guidelines (2007)
- IFC EHS Guidelines for Electric Power Transmission and Distribution (2007)
- World Commission on Dams (WCD) – the criteria checklists and guidance in Chapter 9 of their final report 'Dams and Development: A Framework for Decision Making' (2001)
- International Hydropower Association Hydropower Sustainability Assessment Protocol (2011).

9.2.6 Consultation

Full details of consultations are provided in Chapter 6. Issues raised in relation to hydrology, hydrogeology, water quality and flood risk have been taken into consideration in this assessment.

9.2.7 Desk Study

A desk study was undertaken to obtain relevant baseline hydrological and hydrogeological information. The data made available for this chapter are summarised in Table 9.1.

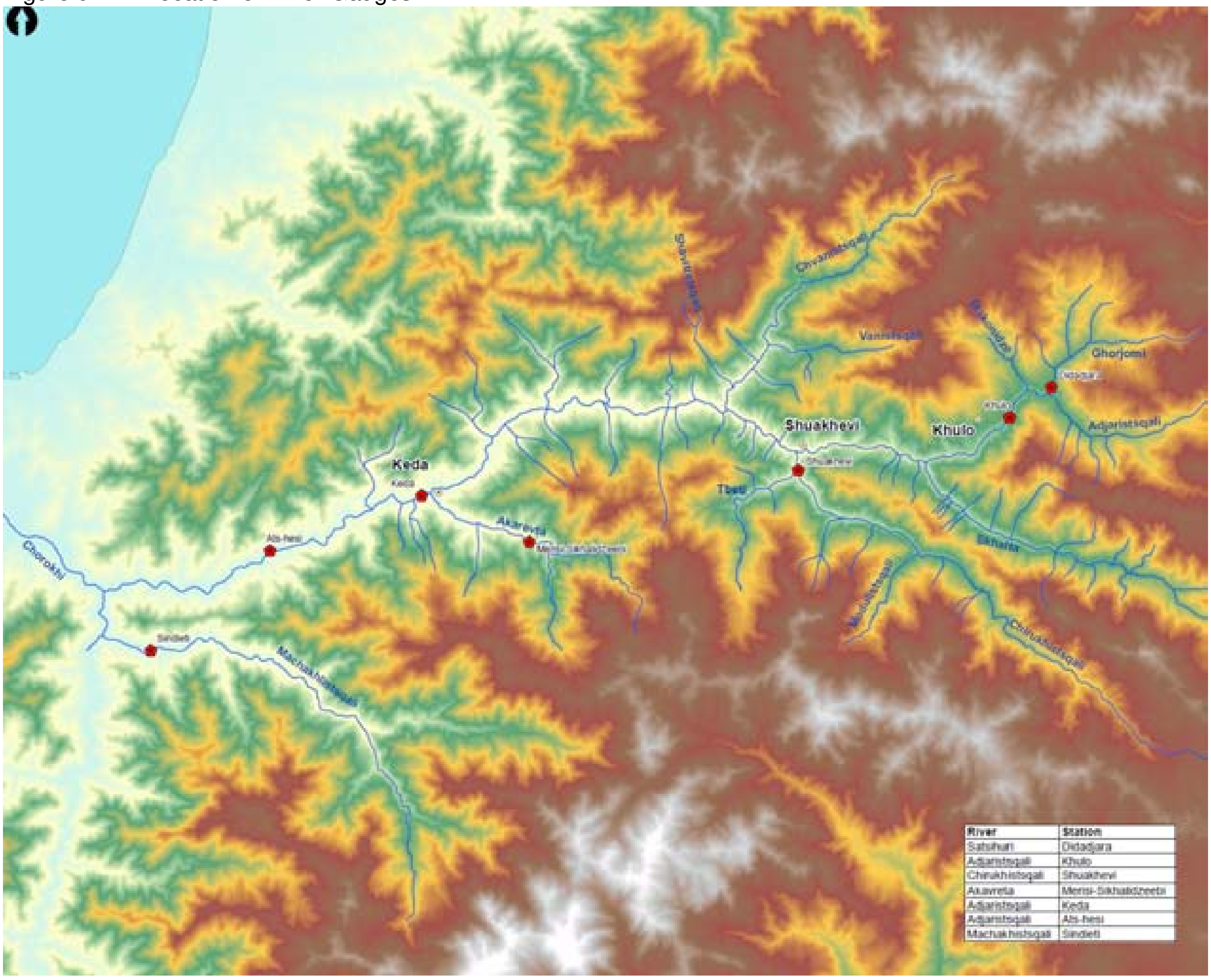
Table 9.1: Available Data and Data Sources

Source	Description	Period
Hydrometric Agency of Former Soviet Union	Hydrometric Year Books	Up to 1992
National Environment Agency	Unpublished hydrometric data post 1992	Mixed, some to 2005
Georgian State Institute "SakSakhTsqalProekti"	Hydro reclamation map of Georgia	

The desk study information sources included the following documents:
- Findings from the specialists site visit, 2011
- LANDSAT imagery.

At present there is no active hydrometric measurement being undertaken anywhere in the Adjaristsqali catchment by the National Environment Agency (NEA) through its regional department in Batumi. The last records appear to have been water level records at Keda up to December 2009. There are hardly any river flow data for the period after 1992. Before 1992 however the catchment was relatively well served by river gauging stations which covered both the Adjaristsqali River and its main tributaries. Records are available for river flows at seven sites in the catchment with over 48 years of daily data as shown in Figure 9.3, locations are shown in Figure 9.2.

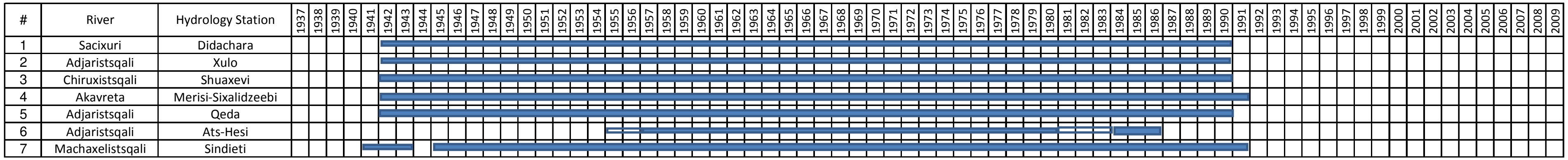
Figure 9.2: Location of River Gauges



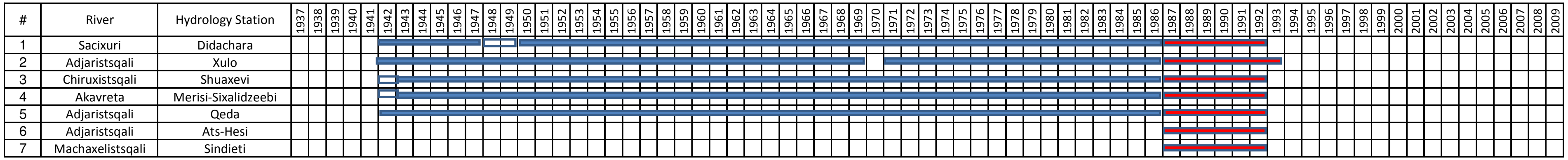
Source: Mott Macdonald Ltd

Figure 9.3: Historical Flow Records for the Adjaristsqali River and Tributaries

Discharge Monthly m3/s



Discharge Daily m3/s



Source: NEA

9.2.8 Field Reconnaissance

An initial fieldwork programme was completed which aimed at providing information to:

- confirm empirical relationships derived from the historical records
- checking the flow estimates prepared using catchment area factors
- serve engineering design purposes (e.g. sedimentation of planned reservoirs)
- establish a baseline situation for the environmental and social impact assessment (ESIA)
- inform the assessment of environmental flow requirements.

The short term monitoring survey (August 2011 – June 2012) integrated river monitoring for engineering and environmental purposes. Due to the overall Governent of Georgia project delivery timescales the initial fieldwork was commenced after signing of the implementation agreement in June 2011. Consequently low flow surverys were undertaken during August 2011, with additional monitoring then continued into summer of 2012 to capture spring season and provide a year's worth of monitoring data on which to support ongoing assessment.

The fieldwork programme incorporated three monitoring campaigns to support immediate work:

- August (low flow period). The low flow period fieldwork covered measurement of river flow, in-situ bed sampling and preparation works for high flow season field survey
- Routine monthly survey commenced in October (2011) and to be completed in June (2012). Regular suspended bed load sampling campaign and monthly reading of river level data from logger that was installed in low flow season
- High flow periods (autumn wet period and spring snow melt flood). Part of this work has been undertaken, with additional surveys to be undertaken in the Spring. The high flow period fieldwork will cover: suspended sediment sampling (mainly hardness) and flow measurements.

A survey of water users was undertaken which combined data requests to municipalities with site visits to a sample of schemes.

9.2.9 Assessment of Impact Significance

9.2.9.1 Determining Sensitivity and Magnitude

An appraisal of the water features has been undertaken through desk study and by reference to fieldwork reports to provide information against which to predict levels of potential impact and assess significance of such impacts.

The water features which are likely to be affected by the scheme have been evaluated in terms of the short and long-term consequences to help assess the relative significance of the development (see Table 9.2 below). The magnitude of impact and the likely significance of any effects of the Project on water features of the area have been assessed using the criteria in Table 9.3.

Table 9.2: Water Feature Sensitivity Criteria

Sensitivity	Typical Characteristics	Example of features/ areas
High	Surface water or groundwater body with little or no capacity to absorb proposed changes or minimal opportunities for mitigation. Receptor at high risk of depletion (surface waters levels falling or drying out; groundwater levels / yields falling) Receptor at high risk of pollution Receptor provides vital ecosystem services (fishery, flood conveyance capacity, sediment transport) Receptor provides urban water supplies, major industrial abstraction or large irrigation supplies	Pristine reach of river with natural flow, sediment and water quality regime Spawning areas for important fishery Springs vital for urban water supply Water supply serving major industry or irrigation use River reach receiving wastewater from urban area.
Medium	Surface water or groundwater body with some capacity to absorb proposed changes or limited opportunities for mitigation. Receptor at medium risk of depletion (surface waters levels falling or drying out; groundwater levels / yields falling) Receptor at medium risk of pollution Receptor provides important ecosystem services (fishery, flood conveyance capacity, sediment transport) Receptor used for local village water supply source, small industrial abstraction or minor irrigation scheme	River reach or spring/well serving village, local industry or small irrigation user Village wastewater disposal River reach supporting local fishery.
Low	Surface water or groundwater body with some capacity to absorb proposed changes or moderate opportunities for mitigation. Receptor already significantly modified from some aspect of natural condition Receptor provides ecosystem services (fishery, flood conveyance capacity, sediment transport) Receptor used for water supply to individual dwellings or farms	River reach in a modified state due to existing use (eg existing dam/weir, gravel extraction) Minor water use Isolated wastewater disposal
Negligible	Surface water or groundwater body with considerable capacity to absorb proposed changes and/or good opportunities for mitigation. Receptor already significantly modified from natural condition	Aquifer that is confined where project works occur River reach severely impacted by upstream dam.

Table 9.3: Magnitude of Impacts on Water Features

Magnitude Parameters	Typical impacts
Major Adverse / Beneficial	Fundamental change to the specific environmental conditions assessed, resulting in long term or permanent change, typically widespread in nature. Would require significant intervention to return to baseline; exceed national standards and limits.
Moderate Adverse / Beneficial	Detectable change to the specific environmental conditions assessed, resulting in non-fundamental temporary or permanent change
Minor Adverse / Beneficial	Detectable but minor change to the specific environmental conditions assessed
Negligible	No perceptible change to the specific environmental conditions assessed

9.2.9.2 Assigning Significance

The significance has been determined by the interaction between the magnitude of impacts and the sensitivity of receptors affected, as depicted in the significance matrix shown in Table 5.4 in Chapter 5.

The magnitude of impact and value of water environment attribute "sensitivity criteria" are combined to determine the likely significance of potential effects. Only impacts of moderate or greater significance have been considered to be significant. If the impact is negative then the effect is adverse; if the impact is positive then the effect is beneficial. Professional judgement was used to vary the predicted effect where appropriate for example where an impact of major magnitude on a highly sensitive receptor may not be of critical significance if it is considered unlikely to occur.

9.2.10 Data Limitations

In undertaking the water resources and quality impact assessment the following data limitations have been identified:

- No published hydrometric data after 1990, limited climatological data available for more recent years but no flow data. This is a significant limitation on the assessment of trends in runoff which might be attributable to climate change or indeed other water developments.
- Little information on the water use of existing schemes in the river basin, in particular the operation of the existing Atsi run of river hydropower plant on the lower section of the river. The operator was approached but declined to make commercially sensitive information on flows/power generation available.
- Project implementation agreement was signed (and approved by Cabinet of Ministers Georgia) in June 2011 which limited available time to complete additional long term monitoring data and meet the overall project timeline including contract tendering, construction and start operation by January 2016. As a consequence long term monitoring surveys are on-going and expected to be completed during summer 2012. This additional monitoring data will be used to review the findings of this assessment and refine the mitigation measures to be adopted if required.

9.3 Baseline Description

9.3.1 General

The Chorokhi River basin can be subdivided into three key areas:

- The headwaters of the Adjaristsqali River and its tributaries upstream of the proposed Khichauri Dam
- Lower catchment of the Adjaristsqali River from the proposed Khichauri Dam downstream to the confluence with the Chorokhi River
- Downstream of the confluence of the River Adjaristsqali and the Chorokhi River and the eventual outfall of the Chorokhi River into the Black Sea.

The primary focus of the baseline is the Adjaristsqali River but the final section of the Chorokhi River to the Black Sea must be considered in the assessment of impacts downstream of the cascade.

9.3.2 Water Resources – Current Use

9.3.2.1 Overview

The following aspects need to be considered in assessing baseline water requirements;

- Any existing hydropower schemes that maybe operating in the catchments
- Existing abstractions for irrigation and livestock purposes
- Existing abstractions for public water supply purposes

- Minimum flows required to maintain the assimilative capacity of the watercourse for pollution dispersion and dilution
- The flow and depth regime required for the fish species currently inhabiting various affected stretches of the Adjaristsqali River and its tributaries (see Chapter 10)
- Sediment transport through the schemes to the Black Sea.

9.3.2.2 Existing Hydropower Schemes

There are three currently operating hydropower plant (HPP) schemes within the Project area as detailed in Table 9.4.

Table 9.4: Existing HPP

Scheme	River	Description	Comment
Chirukhistsqali	Chirukhistsqali	Currently not in full operation	Not in Project zone of influence, immediately upstream of Chirukhistsqali diversion
Atsi	Adjaristsqali	16 MW run of river Operating since 1941 Output 75 GWh No fish pass facilities No known environmental flow rule	Key facility to be considered in developing the proposed Project, situated immediately downstream of the Koromkheti outfall. The reach impacted by this scheme is approximately 7 km long.
Machakhlistsqali	Machakhlistsqali	1.5-2 MW	On tributary of the Chorokhi River downstream of the proposed Mac1 diversion to Khertvisi scheme

Source: GEG

Atsi HPP Weir and Intake Facilities

Source: Mott MacDonald

Existing Machakhlistsqali HPP

Source: Mott MacDonald

9.3.2.3 Existing Irrigation/Agricultural Use

Water is diverted from rivers for irrigation of corn, beans and vegetables and orchards, vineyards and pasture. Irrigation requirements are generally taken as 700 m^3/ha per crop season. The diversions are informal or “wild” intakes where boulders in the channel are aligned to direct flow into some form of conveyance channel (earth channel, hollowed log, pipe etc). There is no form of hydraulic control structure on the river and in many cases no control structures within the conveyance system. Water flows into the conveyance system and returns to the river through leakage or excess runoff from the cultivated land.

Most of the intakes are on upper tributaries using gravity where the topography is suitable for small agricultural areas; they are therefore generally obtaining water at higher elevations than the proposed diversions under the Project.

Typical Traditional Irrigation Intake Arrangements: Chvanistsqali Head

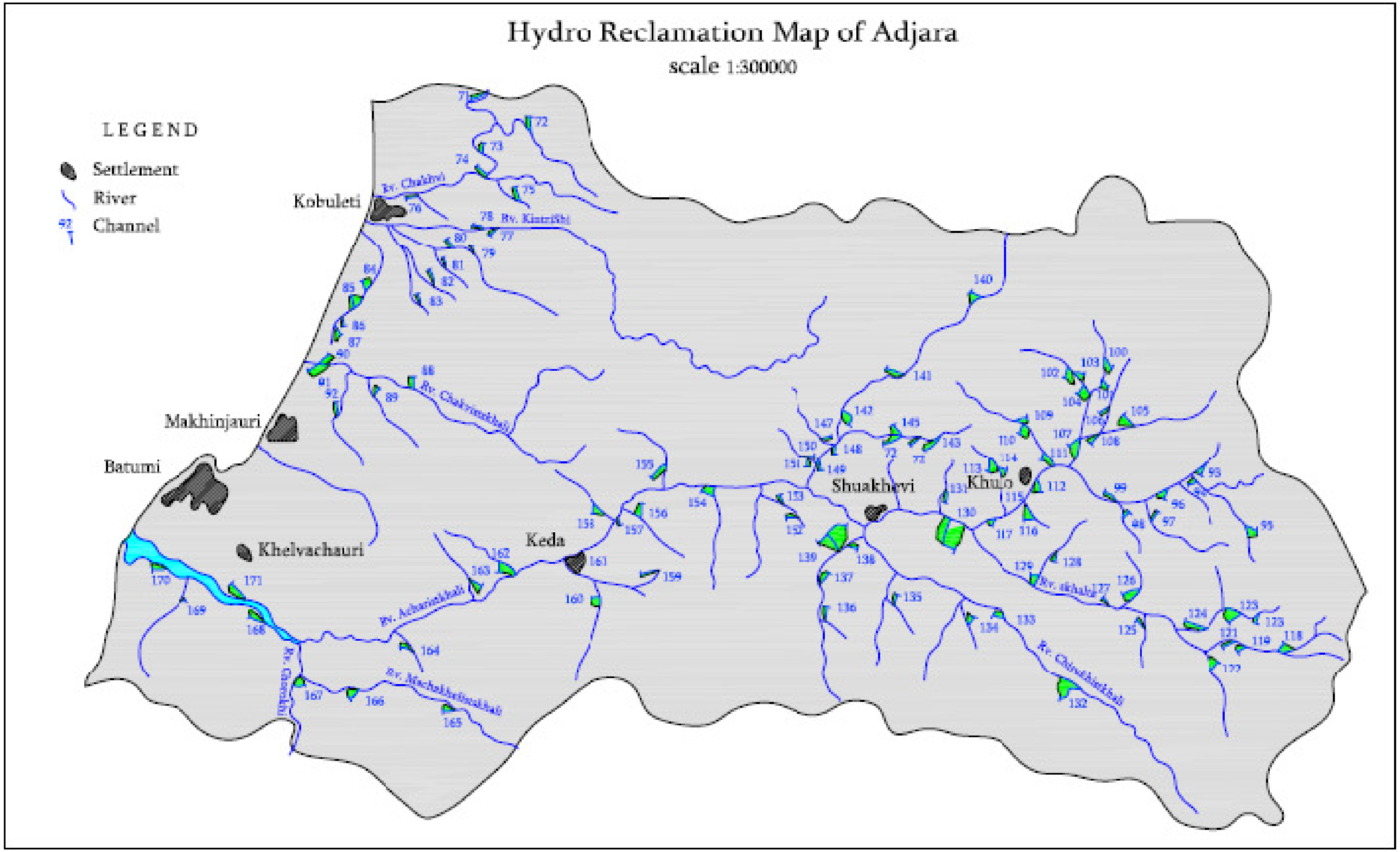
Source: GEG June 2011

Typical Traditional Irrigation Intake Arrangements: Zermovarjanauli Head, Vanistsqali River

Source: GEG June 2011

Many of these schemes are in a poor state of repair. Details of collected data including responses from the municipalities of Keda, Shuakhevi and Khulo is given in Appendix B. Figure 9.4 shows the location of irrigated areas – in subsequent sections of this chapter irrigated areas are referred to with respect to the numbering shown on this map.

Figure 9.4: Adjara Province – Irrigation and Drainage Schemes



Source: Hydro Reclamation Map of Georgia, prepared by the Georgian State Institute of "SakSakhTsqalproekti"

9.3.2.4 Public Water Supplies and Sanitation

The current water supply and sanitation arrangements for the three larger settlements in the Project area are set out in Table 9.5.

Table 9.5: Existing Water Supply and Sanitation Arrangements

Urban Centre	Sources of Supply/Waste Water Disposal	Description	Comment
Potable Water Supply			
Khulo	Groundwater	Spring(s) captured and piped to village	No complaints about quality of supply
Shuakhevi	Adjaristsqali	Intake on right bank	During floods the water supply is unsuitable for drinking and the population then makes use of springs
Keda	Groundwater	Spring(s) captured and piped to village	No complaints about quality of supply
Wastewater Disposal			
Khulo	Adjaristsqali	Small formal sewerage system in centre, direct to river	Facilities defunct no effective treatment
Shuakhevi	Adjaristsqali	Small formal sewerage system in centre, direct to river	Facilities defunct no effective treatment
Keda	Adjaristsqali	Small formal sewerage system in centre, direct to river	Facilities defunct no effective treatment

Source: Gamma

Smaller villages and farm households typically obtain their water supply from springs and small headwater tributaries. Sediment loads in the larger tributaries and the main river are generally too high for the water to be attractive as a drinking water source except for livestock.

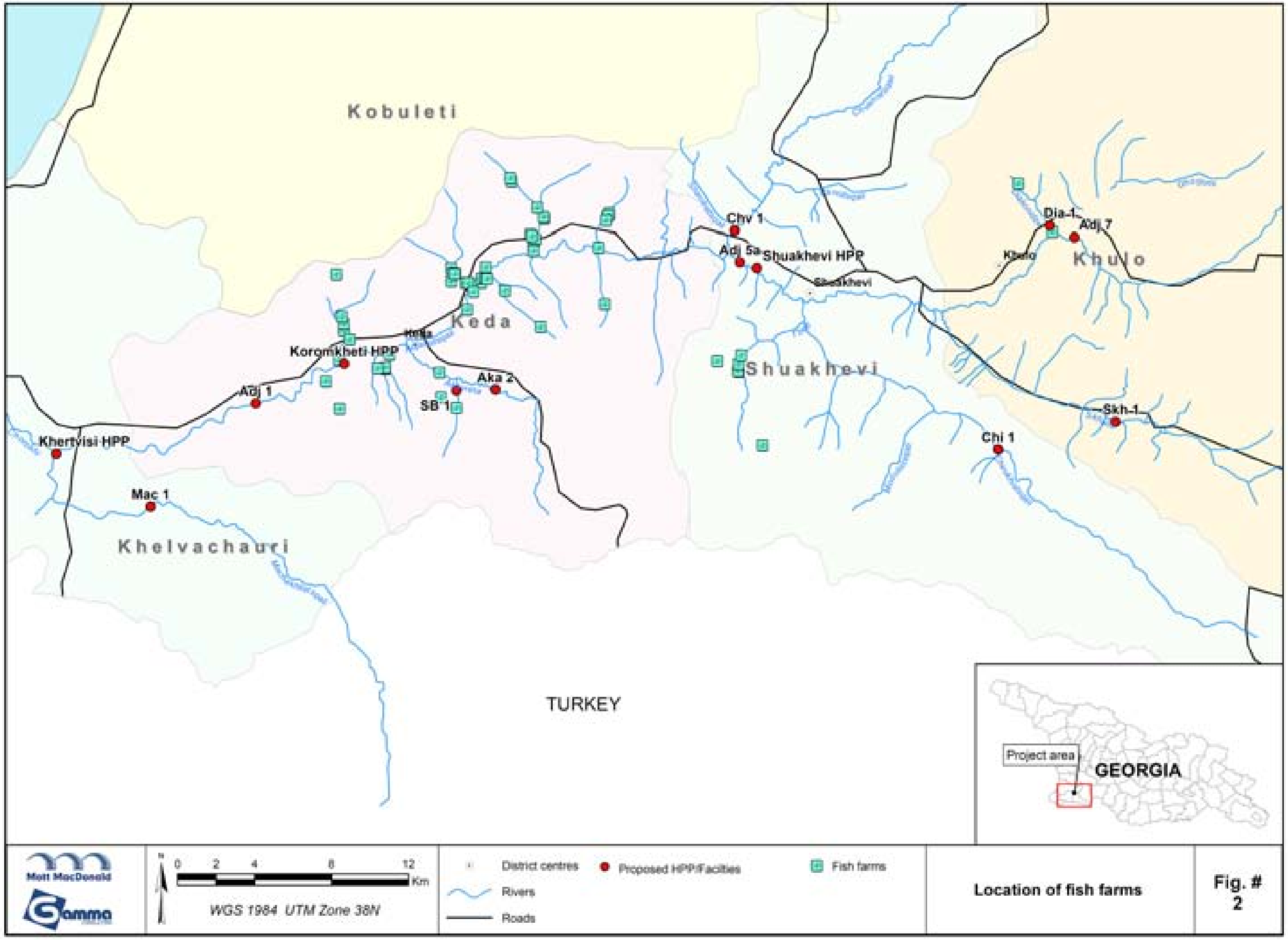
9.3.2.5 Fishery Interests

The Adjaristsqali River and Machakhlistsqali River support a wild fishery as discussed in Chapter 8.

There are a number of fish farms near Keda which produce Rainbow trout (see Figure 9.5). These are small scale enterprises which, like the small irrigators, take a limited supply by gravity channel/pipe from rivers and streams to offline tanks / ponds and dispose their wastewater back to the river.

Figure 9.5 shows that most of the fish farms take water from tributaries that will not be affected by the proposed abstractions for the Project.

Figure 9.5: Location of Fish Farms



Source: Gamma

9.3.2.6 Summary of Water Use Baseline by Scheme

Table 9.6 shows the key water users in reaches potentially affected by the proposed Project operations. Potentially affected reaches are discussed in Section 9.4.

Table 9.6 Summary of Existing Users Potentially Affected By Scheme

Type	Shuakhevi Scheme	Koromkheti Scheme	Khertvisi Scheme
Hydropower	None	Atsi HPP	Machakhlistsqali HPP
Irrigation	Scheme 133	Scheme 157	None
Public water supply	Khulo - springs Shuakhevi – part of supply from river	Keda - springs	None
Wastewater disposal	Khulo and Shuakhevi untreated	Keda untreated	None
Fish farms	None	1 farm	None
Ecology / ecosystem services	See Chapter 8	See Chapter 8	See Chapter 8

9.3.3 Water Features

9.3.3.1 Surface Water

The key features of rivers to be considered are:

- Flow regime in reaches within the AoI (inter-annual, seasonal, ranges of level and flow at key sites)
- Sediment transport regime
- Channel morphology including long profile, presence of waterfalls/rapids, braiding reaches, riffle-pool sequences
- Water quality regime
- Degree to which reach can be regarded as “pristine”
- Any special characteristics that distinguish the river or section of river e.g. recognised tourist attraction.

9.3.3.2 Groundwater

The key features to be considered for groundwater are:

- Flow regime at springs within the AoI (inter-annual, seasonal)
- Water level regime in aquifers within the AoI (inter-annual, seasonal variation observed in wells/boreholes)
- Water quality regime
- Any special characteristics that distinguish the spring/aquifer e.g. recognised quality for drinking.

9.3.4 International Water Issues

The Adjaristsqali catchment is entirely within the Republic of Georgia however it joins the Chorokhi River which rises in Turkey and drains into the Black Sea. Concerns have been voiced that sediment supply has been reduced by the construction of the Murtli Dam and Tortum Dam in Turkey and that further planned dams on the Chorokhi River (a total of 13 hydro-electric dams are planned as part of the Chorokhi River Development Plan) will affect sediment supply further.

9.3.5 Surface Water Baseline

9.3.5.1 Introduction

River Adjaristsqali inflows are provided by snow, rain and groundwater. The primary input is rainfall which is the main source of river water inflow (44%) with groundwater and snow respectively making up 30% and 26% of the inflow. There are no glaciers in the catchment.

Melting of winter snows feeds a major period of higher flows in spring through to early summer. A second period of higher flows occurs in late autumn driven by rain storms – this flooding season is shorter than the melt driven flood period. The main characteristics of the hydrological regime are therefore flooding in spring and autumn, with shallow water in summer and winter.

Upper Adjaristsqali in August (proposed Didachara Site)

Source: Gamma August 2011

Skhalta at Proposed Dam Site (August)

Source: Gamma August 2011

Adjaristsqali at Shuakhevi in flood (October)

Lower Adjaristsqali in October

Source: Mott MacDonald October 2011

Source: Mott MacDonald October 2011

The baseline hydrological regime is based on an analysis of the historical records at the stations shown in Table 9.7. These stations also have records of suspended sediment.

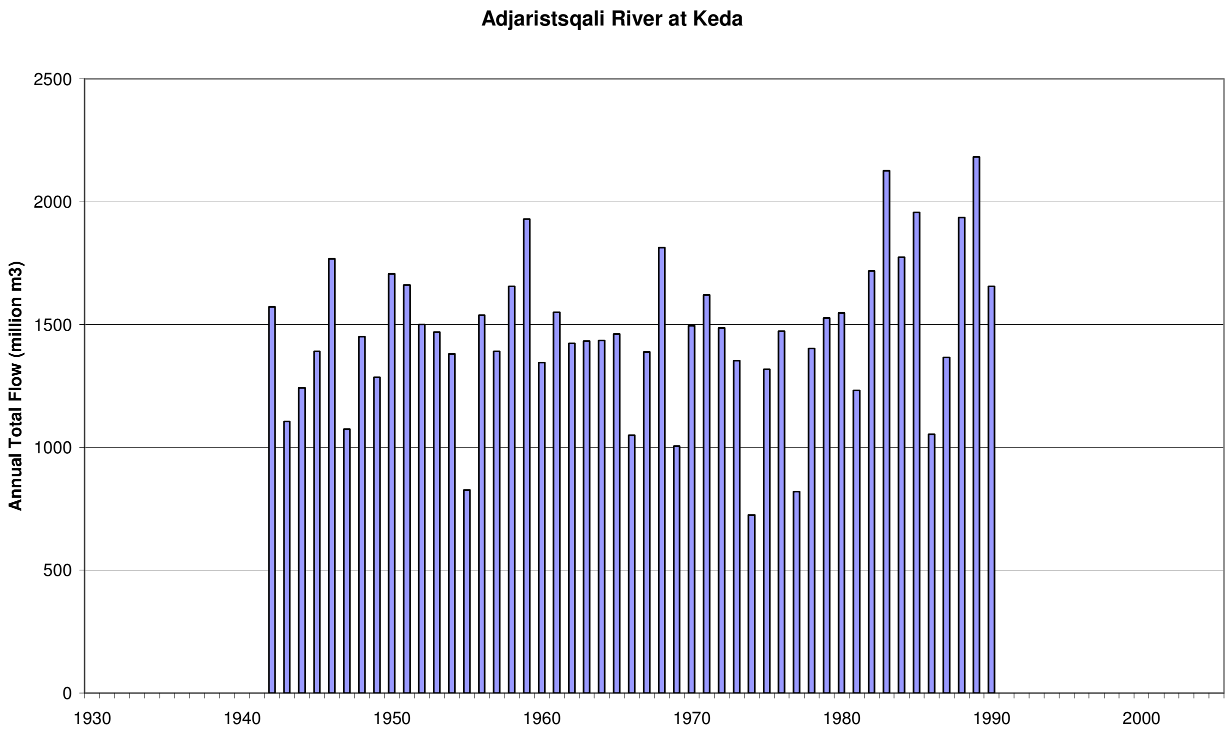
Table 9.7: Details of River Gauges

River	Station	Area km^2	Start Year	Comment
Satsihuri	Didachara	98	1941	Closed 1992
Adjaristsqali	Khulo	251	1940	Closed 1992
Chirukhistsqali	Shuakhevi	326	1942	Closed 1992
Akavreta	Merisi-Sikhalidzeebi	88.2	1942	Closed 1992
Adjaristsqali	Keda	1360	1937	Water level only since 1992
Adjaristsqali	Atsi	1470	-	Private HPP (also called Ats-hesi)
Machakhistsqali	Sindieti	374	-	Closed 1992. Machakhistsqali is a tributary of the Chorokhi River

Source: National Environment Agency

The long term annual variation in runoff in the basin is illustrated by the record at Keda in Figure 9.6. This shows considerable range from year to year.

Figure 9.6: Long Term Variation in Annual Runoff (Keda)

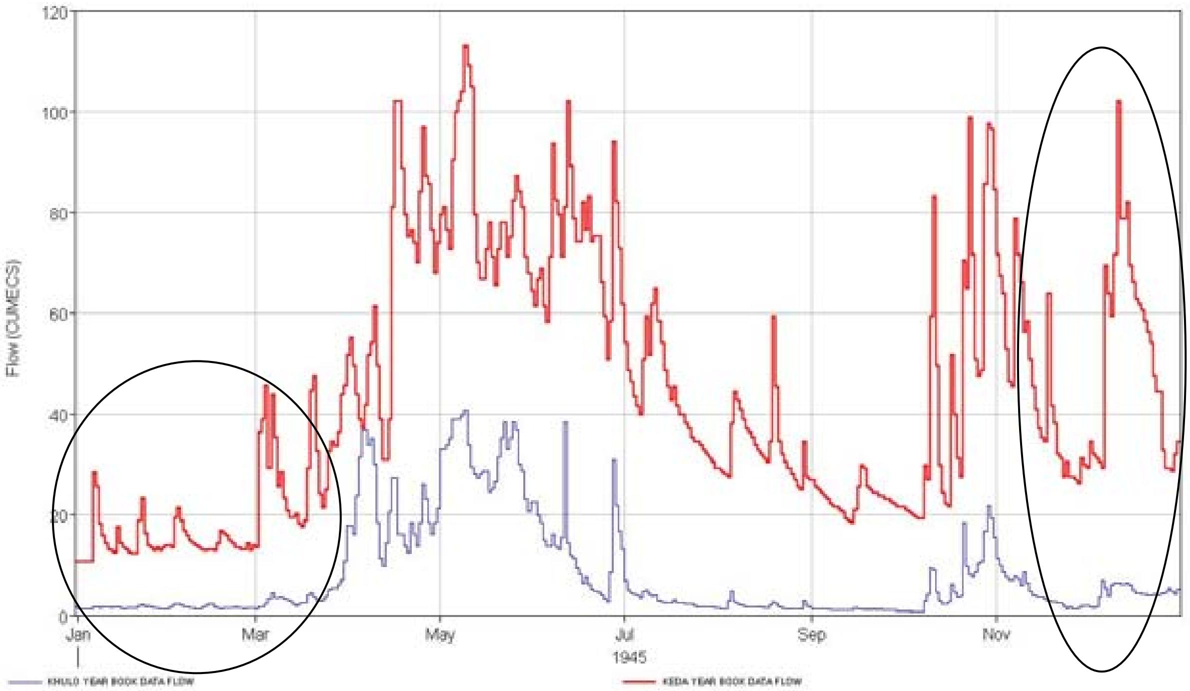


Source: Hydrometric Year Books

Seasonal variation in flow is illustrated in Figure 9.7 – further details are given in the following sections on a scheme by scheme basis. A key difference between the higher catchments as illustrated by the flow at

Khulo and the lower catchment at Keda can be seen in winter months (as circled). In the higher catchments almost constant low flows persist from December through February as precipitation falls largely as snow, while at Keda the flow is relatively higher and shows rainfall driven flood events (see 1945 year comparison highlighting this key difference in regime).

Figure 9.7: Regime in Lower and Upper Catchment Compared



Note: 1945 chosen as a year with average annual flow

The steep upper catchment is very responsive to rainfall events. The river system is very active with erosion, transport and deposition of sediment creating a wide range of channel morphology along the length of the Adjaristsqali River and its tributaries. Some parts of the catchment, for example the River Skhalta tributary, have many active landslides which add large quantities of sediment to the river. In 1989 a major landslide caused the deaths of 19 families and completely blocked the River Skhalta. The blockage was dynamited in order to speed up the process by which the river cut through and re-established its course, thereby avoiding the danger of a sudden dam-break type flooding.

Table 9.8 summarises the baseline regime. The flow representing 10% of the average annual flow is also shown because this parameter has been used in previous schemes in Georgia to set a rule for the minimum environmental flow to be maintained downstream of a scheme (weir, dam, abstraction etc). This minimum enviornmental flow criterion is discussed in Section 9.4.3 in relation to mitigation of potential impacts attributable to development of the Project.

Table 9.8: Long Term Sediment Regime at River Gauges

ID	River	Station	Mean Annual Suspended Sediment Load (kg/s)	Maximum Daily Suspended Load (kg/s)	Month of Highest Sediment Load on Average	Month of Minimum Sediment Load on Average
	Satsihuri	Didachara	2.16	140	April	January
	Adjaristsqali	Khulo	4.60	460	April	August
	Chirukhistsqali	Shuakhevi	2.50	120	April	January
	Adjaristsqali	Keda	16.40	780	April	January
	Machakhlistsqali	Sindieti	1.13	140	April	August

Source: National Environment Agency

There are no historical records for springs.

Table 9.9 summarises the available historical information on sediment in the river system.

Table 9.9: Long Term Sediment Regime at River Gauges

ID	River	Station	Mean Annual Runoff (Mm^3)	Mean Annual Flow (m^3/s)	10% Mean Annual Flow (m^3/s)	Month of Highest Flow on Average	Driest Month on Average
	Satsihuri	Didachara	128	4.05	0.41	April	August
	Adjaristsqali	Khulo	261	8.26	0.83	April	August
	Chirukhistsqali	Shuakhevi	316	10.0	1.00	May	August
	Akavreta	Merisi-Sikhalidzeebi	185	5.87	0.59	May	January
	Adjaristsqali	Keda	1462	46.3	4.63	April	August
	Adjaristsqali	Atsi (Ats-hesi)	1467	46.5	4.65	April	August
	Machakhlistsqali	Sindieti	661	21.0	2.10	May	January

Source: National Environment Agency

There is no historical data on water quality, apart from sediment, for rivers or springs. A survey was therefore undertaken for the present study in August 2011, the results of which are shown in Table 9.10. This represents the summer low flow period.

Table 9.10: Water Quality Baseline – Summer 2011 Field Sampling at Gauging Station Sites

Parameter	Units	Dia1	Khulo	Shuakhevi	Keda
Discharge	m^3/s	0.06	1.07	2.52	9.01
Temperature	℃	17.5	21	16.2	23.0
Oxidation / reduction potential	mV	85	76.8	72.2	60.4
pH	pH units	7.93	8.34	8.3	9.15
Dissolved Oxygen	%	100.9	100.4	119.0	106.9
Electrical Conductivity	µs/cm	157	211	175	135
Total Dissolved Solids	mg/l	101	137	114	87
Salinity	ppt	0.07	0.10	0.08	0.05

Parameter	Units	Dia1	Khulo	Shuakhevi	Keda
Turbidity	NTU	7.2	15.5	5.2	18.4

Source: Present study, various dates in August 2011

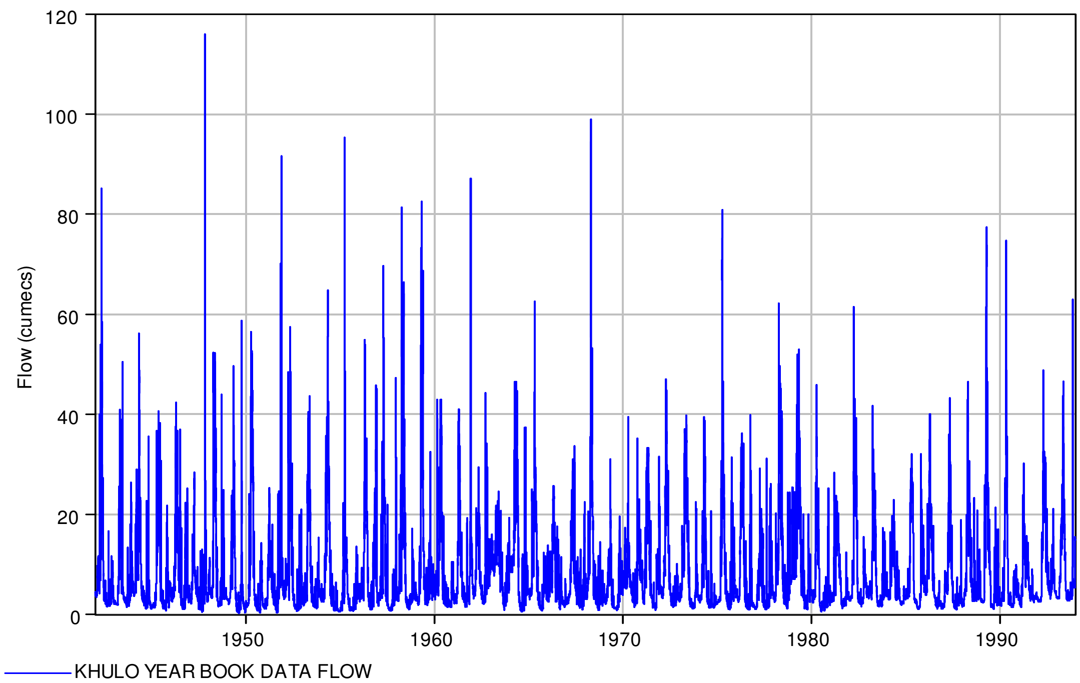
9.3.5.2 Surface Water Baseline for Shuakhevi Scheme

The proposed dams are high and the reservoirs will be capable of retaining flows for a few days, therefore there is a significant potential for impact both during construction and operation. The baseline flow regime has been developed on the basis of three key hydrometric records: Khulo, Didachara and Shuakhevi (see Figure 9.3). As left bank tributaries of the Adjaristsqali, the Skhalta River and Chirukhistsqali River, benefit from slower melting of snowfields at their head than the south facing right bank tributaries this results in stronger summer flows.

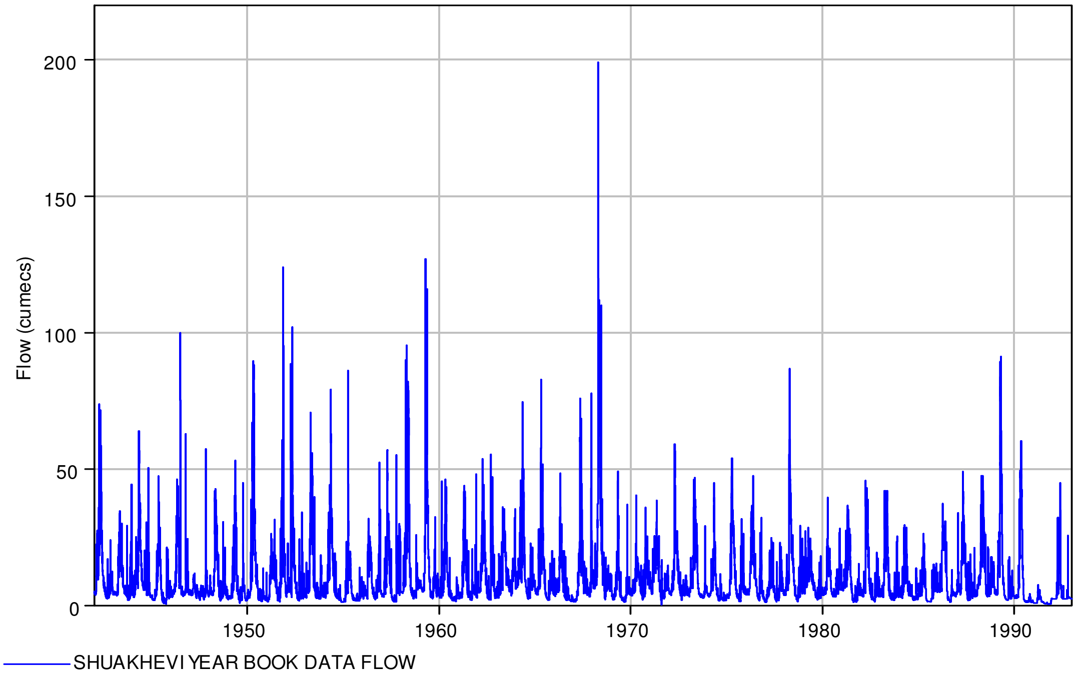
Figure 9.8 shows the long term daily flow records at Khulo and Shuakhevi gauges, Figure 9.9 shows the same data expressed as a flow duration curve (FDC). Figure 9.10 shows the long term monthly characteristics and highlights the flow equivalent to 10% of the mean annual daily flow (see Chapter 10 for discussion of environmental flow criteria and the use elsewhere in Georgia of 10% as the required flow).

Figure 9.8: Long Term Daily Flow Records – Khulo and Shuakhevi

Khulo



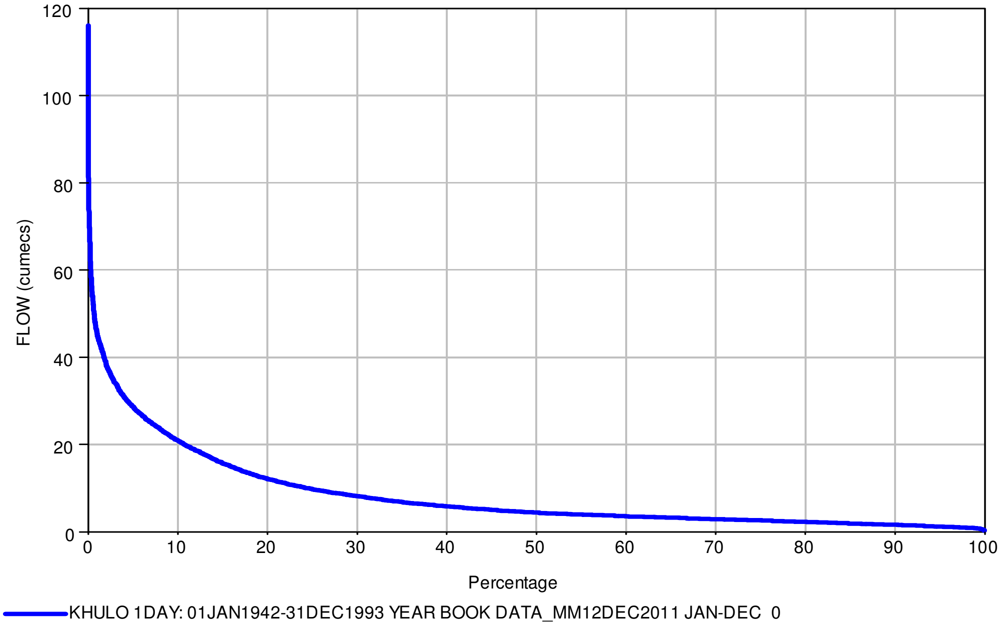
Shuakhevi



Source: Hydrometric Year Books

Figure 9.9: Long Term Flow Duration Curves – Khulo and Shuakhevi

Khulo



Shuakhevi

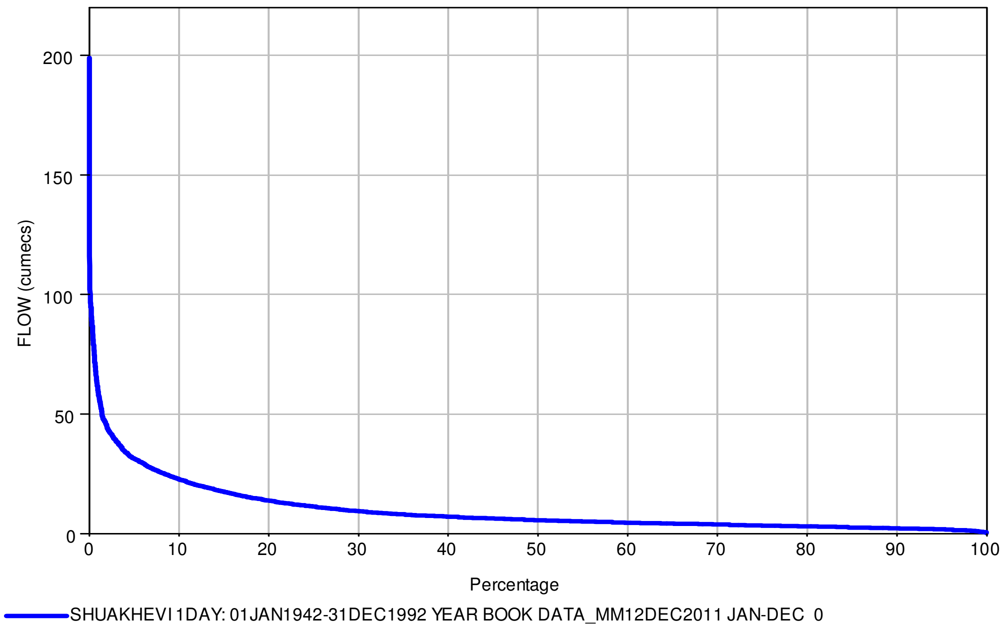
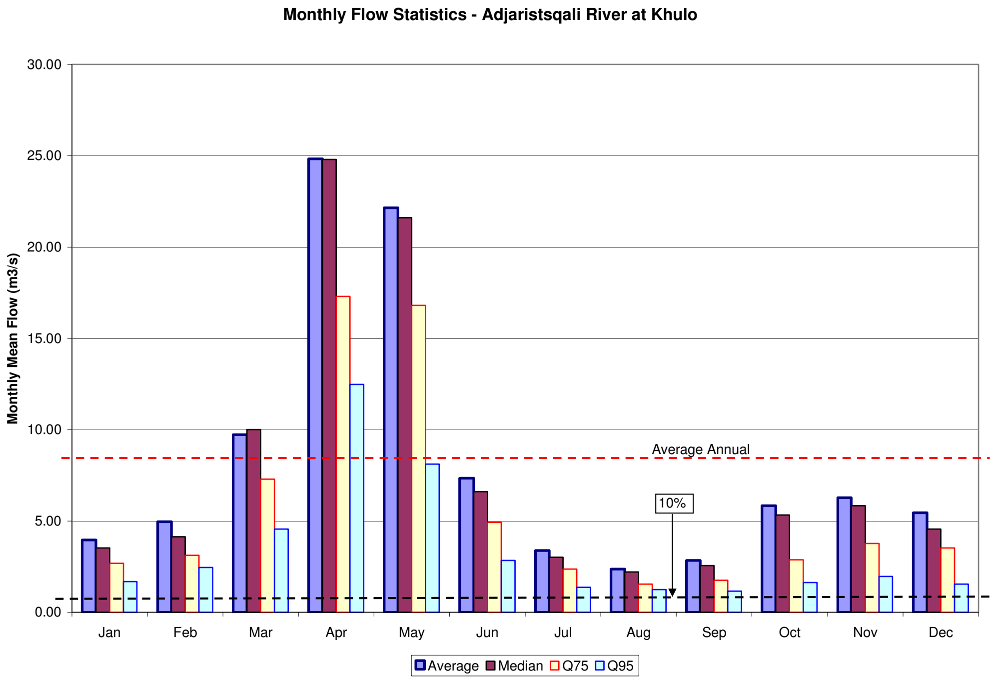

200
150
100
50
0
FLOW (cumecs)
0
10
20
30
40
50
60
70
80
90
100
Percentage
SHUAKHEVI 1DAY: 01JAN1942-31DEC1992 YEAR BOOK DATA_MM12DEC2011 JAN-DEC 0

Figure 9.10: Long Term Monthly Statistics – Khulo and Shuakhevi

Khulo



Shuakhevi

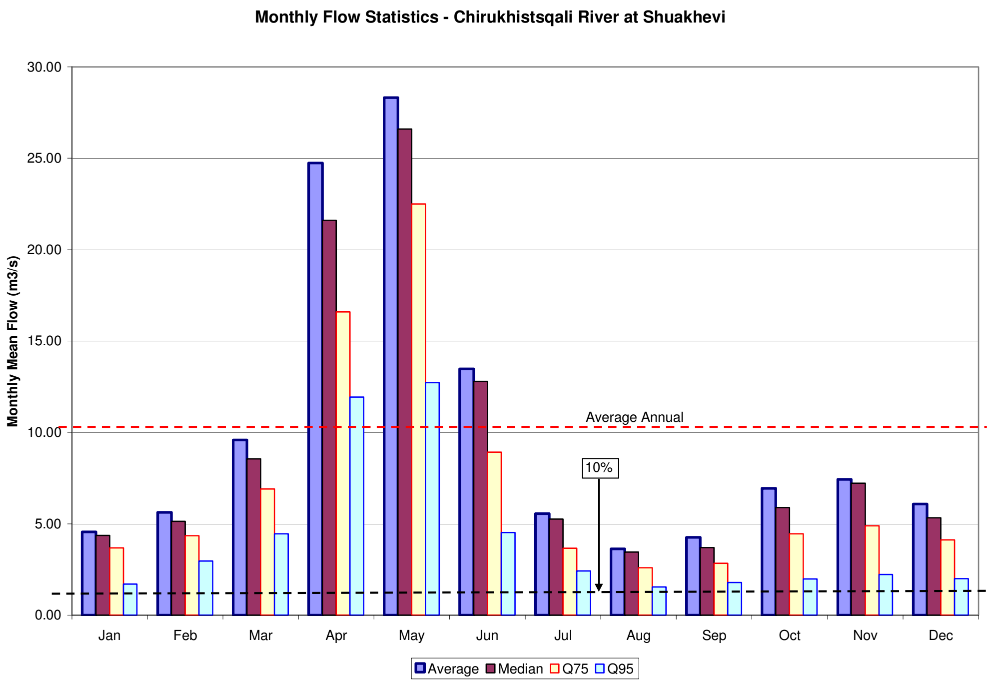


Table 9.11: Water Quality Baseline – Shuakhevi Scheme

Parameter	Units	Dia1	Adj7	Skh1	Chi1
Discharge	m^3/s	0.06	0.55	1.79	0.89
Temperature	°C	17.5	15.3	16.5	18.5
Oxidation / reduction potential	mV	85	76	-	107.6
pH	pH units	7.93	8.2	8.13	8.29
Dissolved Oxygen	%	100.9	104.8	103.5	103.6
Electrical Conductivity	µs/cm	157	220	120	130
Total Dissolved Solids	mg/l	101	142	100	84
Salinity	ppt	0.07	0.01	0.06	0.06
Turbidity	NTU	7.2	30.9	15	4.6

Source: Present study, various dates in August 2011

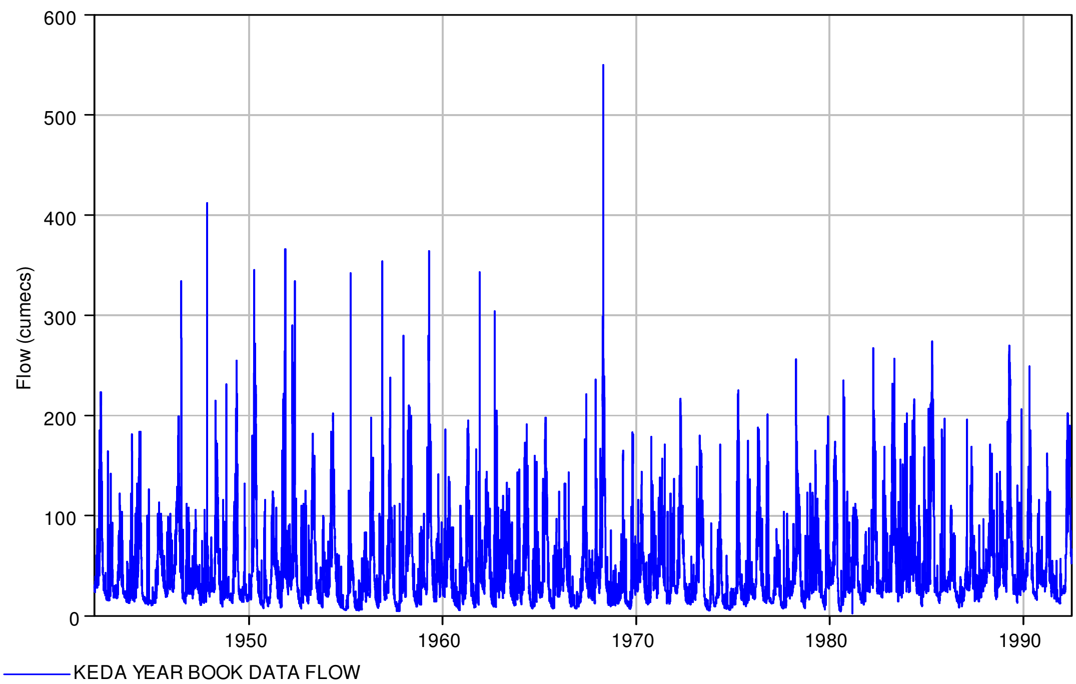
The water quality low flow season baseline shows high quality typical of mountain streams.

9.3.5.3 Surface Water Baseline for Koromkheti Scheme

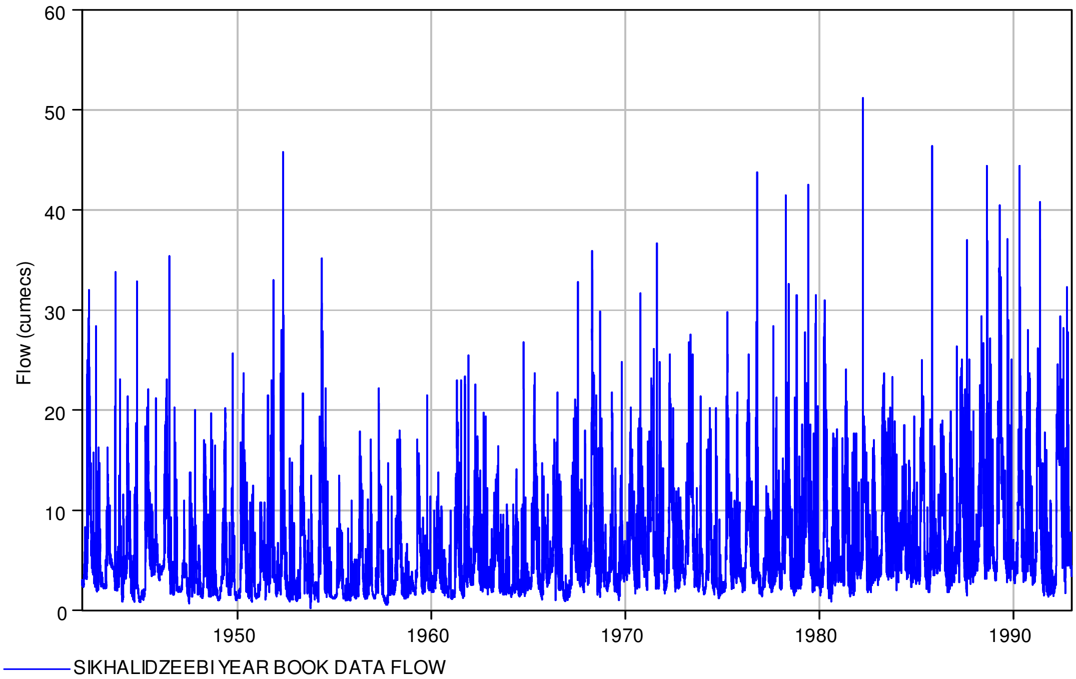
The baseline flow regime has been developed on the basis of three key hydrometric records: Khulo, Keda and Sikhalidzeebi. Figure 9.11 shows the long term daily flow records at Keda and Sikhalidzeebi gauges, while Figure 9.12 shows the same data expressed as a flow duration curve (FDC). Figure 9.13 shows the long term monthly characteristics and highlights the flow equivalent to 10% (Q90) of the mean annual daily flow.

Figure 9.11: Long Term Daily Flow Records – Keda and Sikhalidzeebi

Keda



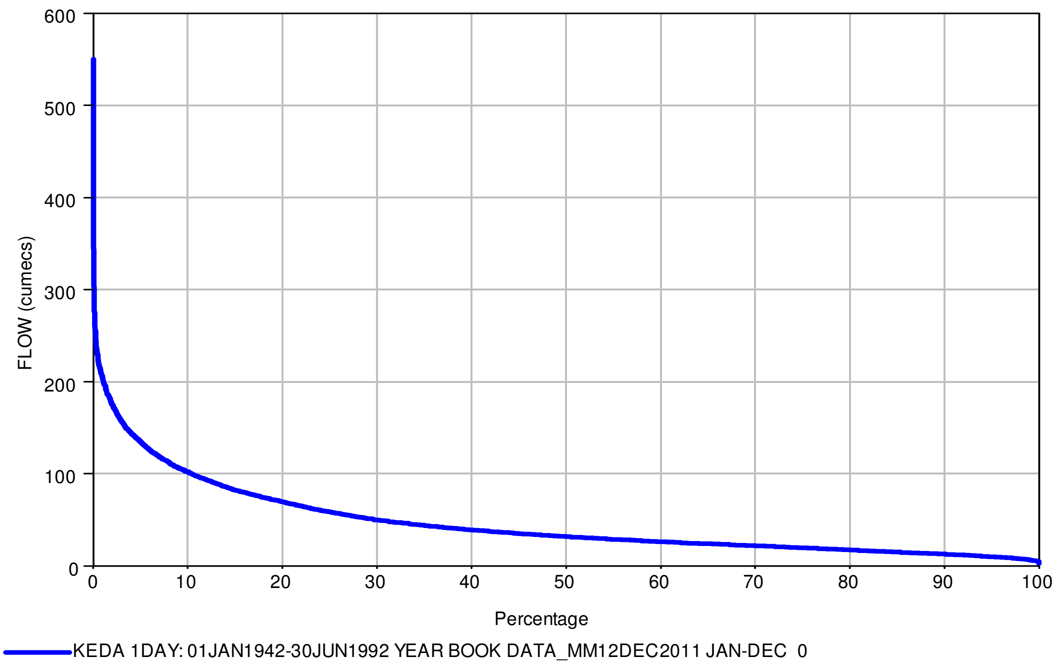
Sikhalidzeebi



Source: Hydrometric Year Books

Figure 9.12: Long Term Flow Duration Curve – Keda and Sikhalidzeebi

Keda



Sikhalidzeebi

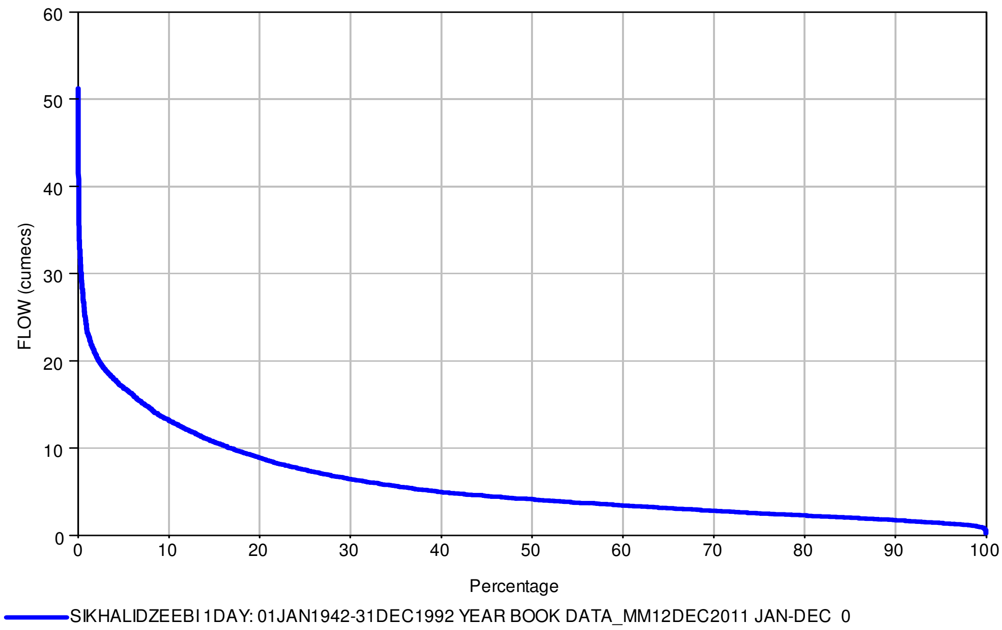
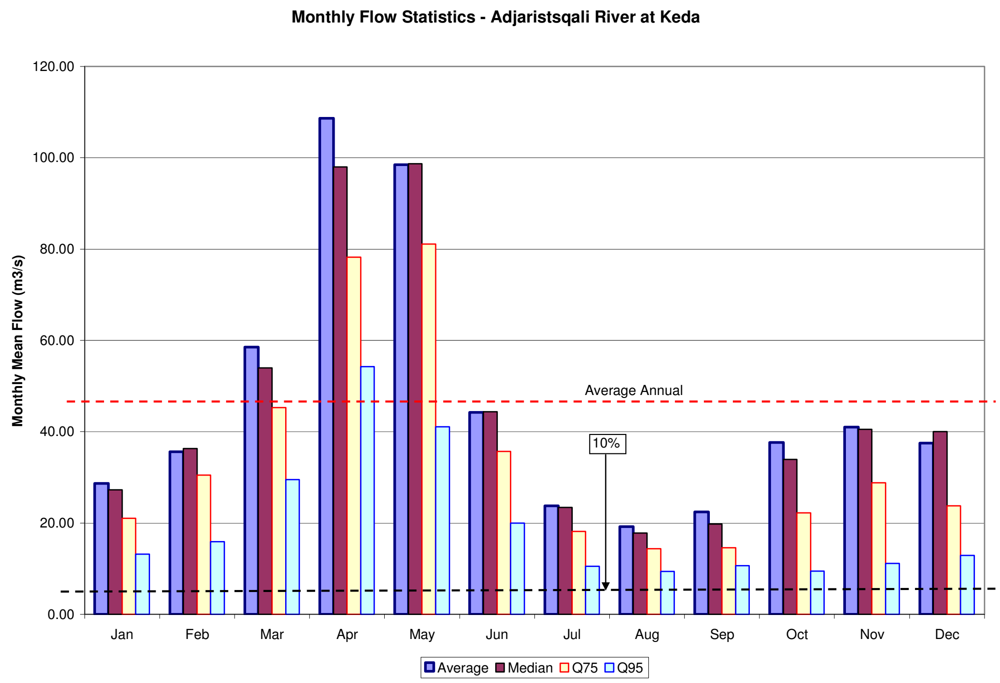


Figure 9.13: Long Term Monthly Statistics – Keda and Sikhalidzeebi

Keda



Sikhalidzeebi

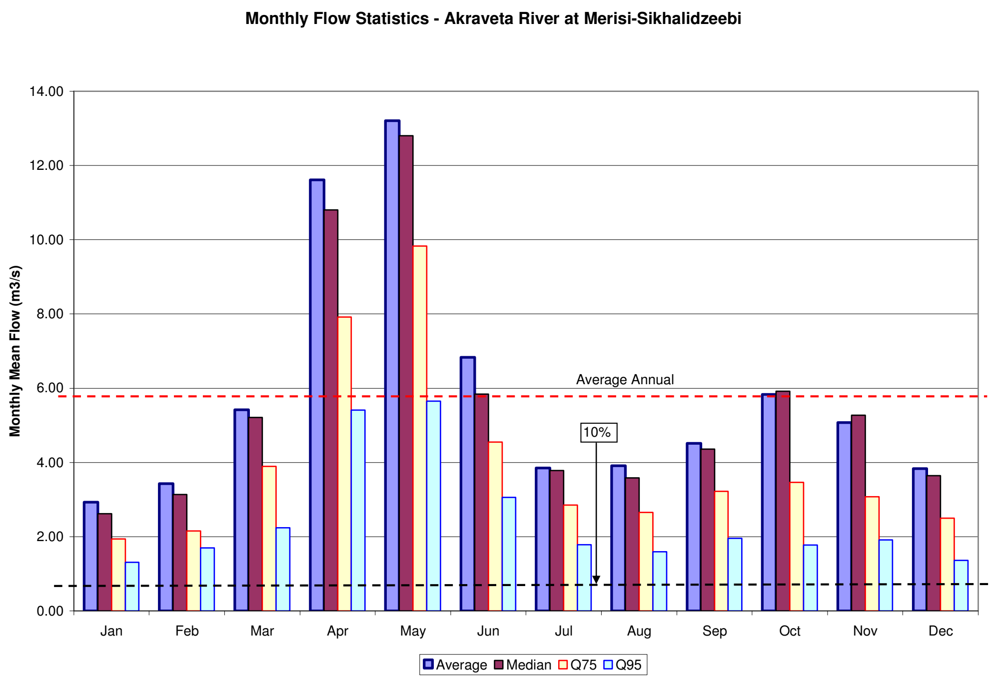


Table 9.12: Water Quality Baseline – Koromkheti Scheme

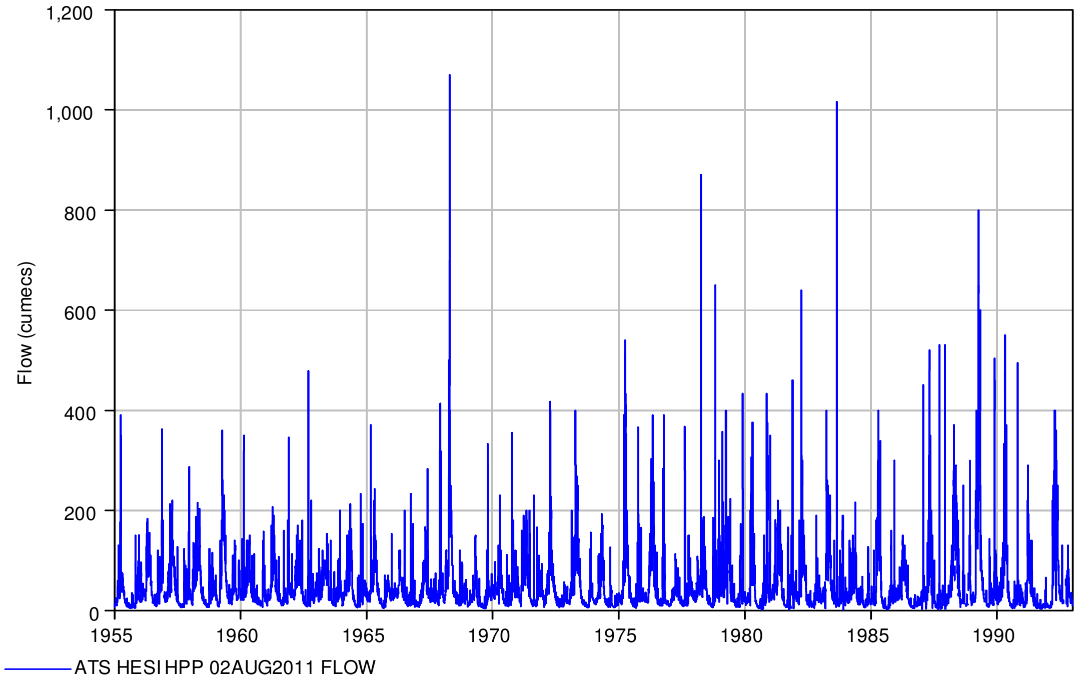
Parameter	Units	Chv1	Adj5	Aka2	SB1
Discharge	m^3/s	2.20	4.34	1.42	0.16
Temperature	℃	18.9	23.9	16.6	18.4
Oxidation / reduction potential	mV	72.3	56.9	83.7	108.4
pH	pH units	8.08	9.16	7.45	7.86
Dissolved Oxygen	%	102.2	107.9	102.4	101.0
Electrical Conductivity	µs/cm	69	162	126	74
Total Dissolved Solids	mg/l	45	105	81	48
Salinity	ppt	0.3	0.08	0.06	0.03
Turbidity	NTU	15.3	6.3	3.2	0

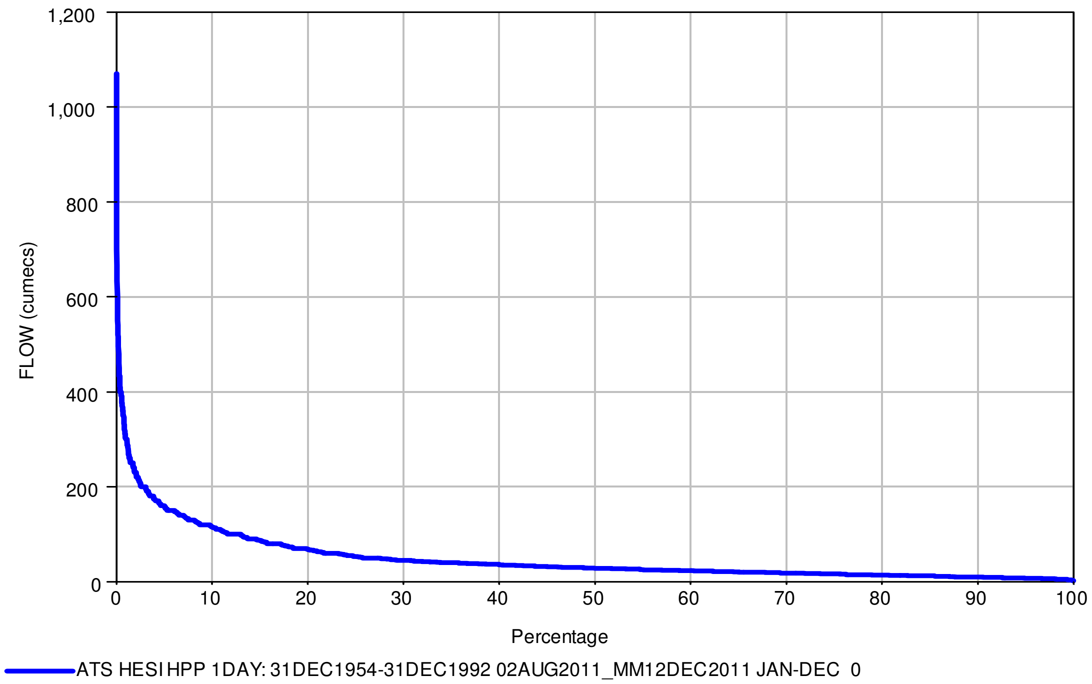
Source: Present study, various dates in August 2011

The water quality low flow season baseline shows high quality typical of mountain streams.

There is an existing run of river HPP immediately downstream of the proposed outfall from the Khoromkheti HPP. Figure 9.14 shows the available information on flows at the Atsi HPP.

Figure 9.14: Flow Regime at the Atsi HPP intake



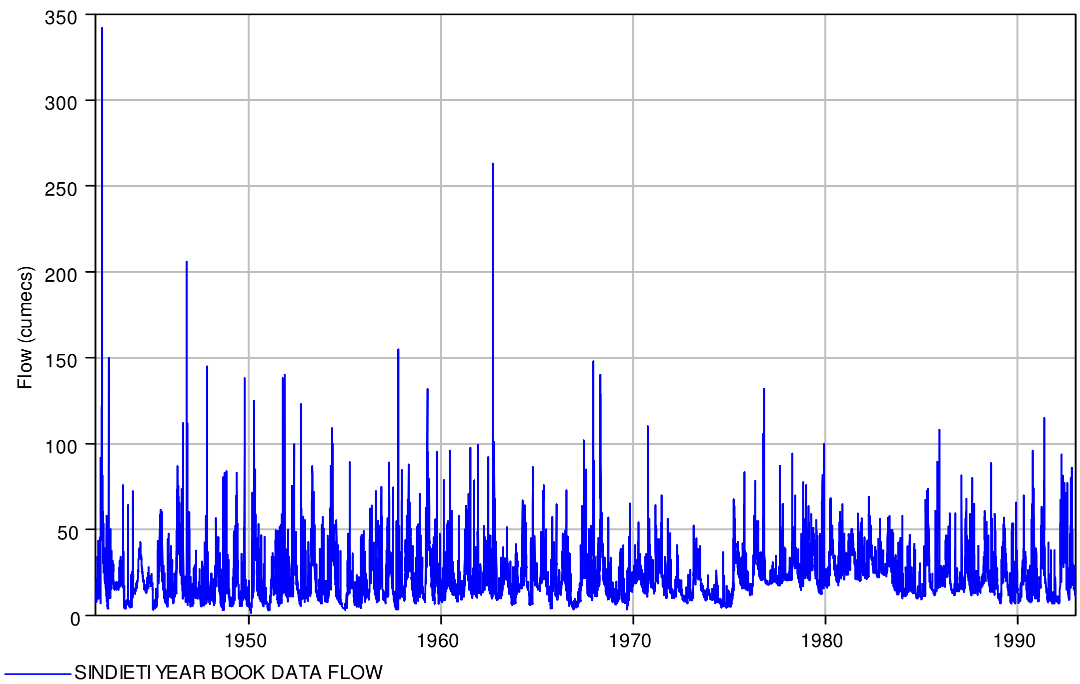


Source: NEA and operator

9.3.5.4 Surface Water Baseline for Khertvisi Scheme

The baseline flow regime has been developed on the basis of two key hydrometric records: Keda and Sindieti. Figure 9.15 shows the long term daily flow records at the Sindieti gauge while Figure 9.16 shows the same data expressed as a flow duration curve (FDC). Figure 9.17 shows the long term monthly characteristics and highlights the flow equivalent to 10% of the mean annual daily flow. In this lower portion of the catchment the pattern of runoff is more evenly distributed throughout the year with a less pronounced spring melt contribution.

Figure 9.15: Long Term Daily Flow Records – Sindieti



Source: Hydrometric Year Books

Figure 9.16: Long Term Flow Duration Curve – Sindieti

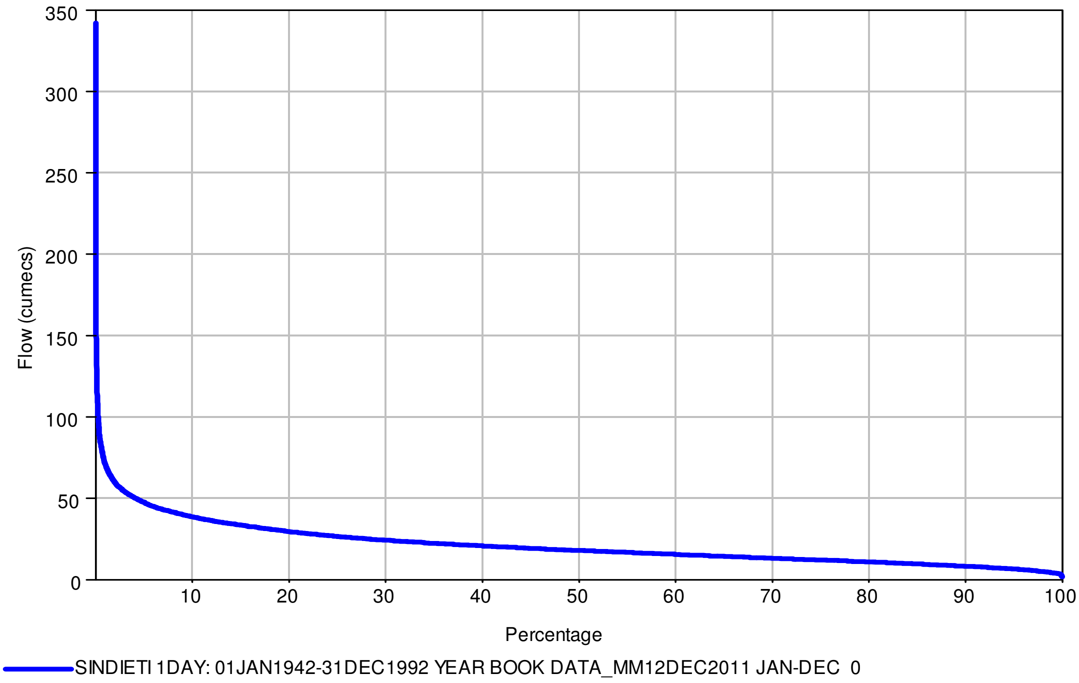


Figure 9.17: Long Term Monthly Statistics – Sindieti

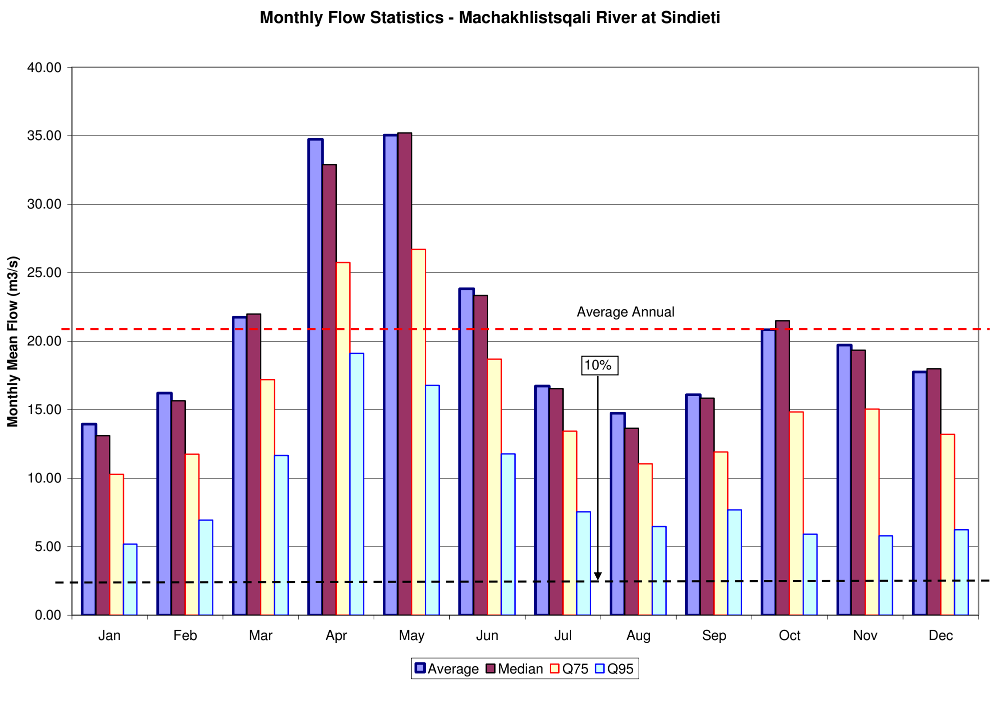


Table 9.13: Water Quality Baseline – Khertvisi Scheme

Parameter	Units	Mac1	Adj1
Discharge	m^3/s	5.62	11.52
Temperature	℃	20.2	24.2
Oxidation / reduction potential	mV	92.5	-
pH	pH units	8.03	9.39
Dissolved Oxygen	%	101.7	101.6
Electrical Conductivity	µs/cm	47	137
Total Dissolved Solids	mg/l	30	89
Salinity	ppt	0.02	0.06
Turbidity	NTU	0	0

Source: Present study, various dates in August 2011

Water quality is again good.

9.3.5.5 Surface Water Baseline Summary

Table 9.14 shows the assessed sensitivity for each component of the three schemes.

Table 9.14 Sensitivity to Potential Construction and Operation Impacts – Surface Water

River	Location	Sensitivity – Construction and Opperation
Shuakhevi Scheme		
Chirukhistqali	Chi1	Low
Skhalta	Skhalta Dam (Skh1)	Medium
Adjaristsqali	Didachara Dam (Adj7)	Medium
Adjaristsqali	Shuakhevi HPP (Adj5b)	Low
	Overall Sensitivity for Shuakhevi	***Medium***
Koromkheti Scheme		
Adjaristsqali	Khichauri Dam (Adj5a)	Medium
Chavanistsqali	Chv1	Low
Akavreta	Aka2	Low
Adjaristsqali	Koromkheti HPP (Adj2a)	Low
	Overall for Koromkheti	***Medium***
Khertvisi Scheme		
Adjaristsqali	Khertvisi Barrage (Adj1)	Medium
Makhakhela	Mac1	Low
Adjaristsqali / Chorokhi	Khertvisi HPP (Cho1)	Low
	Overall for Khertvisi	***Medium***

9.3.6 Groundwater Baseline

There is insufficient historical information to describe a detailed baseline. The solid and superficial geology is very complex due to faulting and landslides.

The tunnels proposed for the Project will be cut in hard rock avoiding unstable landslide areas. The springs used by local communities are associated with landslide areas and hence the groundwater sensitivity is assessed as low.

9.4 Assessment of Impacts

9.4.1 Introduction

This section discusses impacts by scheme with reference to the key hydraulic infrastructure and operating regime.

The Project includes three HPP schemes:
- Shuakhevi scheme in the first phase (total 3 years construction)
- Koromkheti next (phased to start 2 years after Shuakhevi starts, total construction period up to 5 yrs)
- Khertvisi last phase in construction 3 years.

Details of these component schemes are described in Chapter 2.

9.4.2 Construction Impacts

9.4.2.1 Likely Effects

During construction of the Project the potential effects could include:
- Temporary localised changes in hydrological conditions while diversion arrangements in place for in-channel working;
- Temporary localised diversion of drainage paths around construction camps and site workings;
- Increased risk of localised pollution events due to use of construction vehicles affecting adjacent watercourses or springs;
- Sediment release into the river system during construction in-channel or on river banks;
- Sediment release into the river system resulting from the depositing of construction and tunnelling waste into the river;
- Reductions in water quality in the river system resulting from potential release of contaminants into the river as well as localised water quality issues due to discharges from construction facilities;
- Compaction of soils and habitat degradation resulting from an increase in off-road vehicle movements which is likely to effect drainage paths;
- Temporary loss of vegetation cover resulting from the extraction of aggregates for the construction of the tunnels, dams and roads, spoil disposal, site compounds, and construction access roads, increased risk of erosion and sediment load;
- Temporary water supplies for camps and workings, increased competition for water; and
- Disposal of waste water from camps and workings, localised increase in pollution.

9.4.2.2 River Channel Hydraulic Infrastructure

There is potential for impacts on the flow regime from all the three schemes depending on methods of construction over six years. However most of the construction period will be associated with the tunnels and not necessarily within the river.

Impacts during construction are discussed in Table 9.15. Locations of these sites are shown in Figures 2.1 to 2.6 in Chapter 2.

Table 9.15: Assessment of Construction Impacts from In-river Works

River	Location	Construction Method	Potential Impact	Sensitivity	Magnitude	Impact Significance
Shuakhevi Scheme						
Chirukhistqali	Chi1	Weir, sediment trap and run of river intake to transfer tunnel 50 m new channel cut on left bank and river diverted - no interruption to the water flow downstream Excavation for settlement basin and weir foundation – spoil to be removed to avoid future release to the river downstream	Permanent realignment to left bank of 50 m reach of river. Sediment load in river downstream may be temporarily increased during the work	Low	Negligible	Insignificant adverse
Diakonidze	Dia1	Weir, sediment trap and run of river intake	THIS OPTION WAS DROPPED			
Skhalta	Skhalta Dam (Skh1)	22 m high dam and 194,000 m^2 reservoir area River will be temporarily rerouted through a diversion tunnel bypassing an approximate 300m section of river. Embankment coffer dams will be constructed upstream and downstream of the bypassed reach to allow excavation of the river alluvium and placing of the concrete dam foundations. Temporary works designed to pass the 20 year flood. Removal of the coffer dams and closure of diversion tunnel on completion – spoil to be removed to avoid future release to the river downstream	Temporary diversion arrangements should pass natural river and sediment load. There will be a maximum of a few days of reduced river flow downstream during first filling.	Medium	Minor	Minor adverse
Adjaristsqali	Didachara Dam (Adj7)	39 m high concrete dam founded on rock and 169,000 m^2 reservoir area Construction of foundation and temporary low level culvert from one bank while river flows unhindered in the other half of the channel. Then divert flow through low level culvert and start building from the other bank. Construct permanent outlet arrangements. Close low level culvert and divert river	Temporary diversion arrangements should pass natural river and sediment load. There will be a maximum of a few days of reduced river flow downstream during first filling.	Medium	Minor	Minor adverse

River	Location	Construction Method	Potential Impact	Sensitivity	Magnitude	Impact Significance
		through the permanent outlet arrangements.				
Adjaristsqali	Shuakhevi HPP (Adj5b)	Construction of power house on the bank of the Adjristsqali to discharge 48 m^3/s. Temporary works in the river channel during construction of outfall structure likely to be minor.	Flows would not be interrupted in the main channel. Sediment load in river downstream may be temporarily increased during the work	Low	Negligible	Insignificant adverse
Koromkheti Scheme						
Adjaristsqali	Khichauri Dam (Adj5a)	19m high dam and 187,000 m^2 reservoir area Construction of foundation and one of two permanent gated culverts from one bank while river flows unhindered in the other half of the channel. Then divert flow through first gated culvert and start building from the other bank including second gated culvert. Construction programmed to ensure use of single culvert coincides with low flow period in the river. Excavation for dam foundations – spoil to be removed to avoid future release to the river downstream	Temporary diversion through single culvert should pass natural river and sediment load in dry period. There will be a maximum of a few days of reduced river flow downstream during first filling.	Medium	Minor	Minor adverse
Chavanistsqali	Chv1	Small dam, reservoir to act as sedimentation basin, intake to transfer tunnel Temporary diversion cut on left bank during construction of the dam structure Excavation for diversion and dam foundations – spoil to be removed to avoid future release to the river downstream	Temporary diversion arrangements should pass natural river and sediment load. Sediment load in river downstream may be temporarily increased during the work	Low	Negligible	Insignificant adverse
Akavreta	Aka2	Weir, sediment trap and run of river intake, drop shaft to transfer tunnel Construction of foundation and one of two permanent gated culverts from one bank while river flows unhindered in the other half of the channel.	Temporary diversion through single culvert should pass natural river and sediment load in dry period. Sediment load in river downstream may be temporarily increased during the work	Low	Negligible	Insignificant adverse

River	Location	Construction Method	Potential Impact	Sensitivity	Magnitude	Impact Significance
		Then divert flow through first gated culvert and start building from the other bank including second gated culvert. Construction programmed to ensure use of single culvert coincides with low flow period in the river. Excavation for settlement basin and weir foundation – spoil to be removed to avoid future release to the river downstream				
Goderdzistsqali River	SB1	Weir, sediment trap and run of river intake	THIS OPTION WAS DROPPED	-	-	-
Adjaristsqali	Koromkheti HPP (Adj2a)	Construction of power house on the bank of the Adjristsqali to discharge 100 m^3/s. Temporary works in the river channel during construction of outfall structure likely to be minor.	Flows would not be interrupted in the main channel. Sediment load in river downstream may be temporarily increased during the work	Low	Negligible	Insignificant adverse
Khertvisi Scheme						
Adjaristsqali	Khertvisi Barrage (Adj1)	5 m high barrage Construction of foundation and one of two permanent gated culverts from one bank while river flows unhindered in the other half of the channel. Then divert flow through first gated culvert and start building from the other bank including second gated culvert. Construction programmed to ensure use of single culvert coincides with low flow period in the river. Excavation for dam foundations – spoil to be removed to avoid future release to the river downstream	Temporary diversion arrangements should pass natural river and sediment load. Sediment load in river downstream may be temporarily increased during the work	Medium	Minor	Minor adverse
Machakhlistsqali	Mac1	Small dam, reservoir to act as sedimentation basin, intake to transfer tunnel Construction of foundation and a permanent gated culvert from one bank while river flows unhindered in the other half of the channel.	Temporary diversion arrangements should pass natural river and sediment load. Sediment load in river downstream may be temporarily increased during the work	Low	Negligible	Insignificant adverse

River	Location	Construction Method	Potential Impact	Sensitivity	Magnitude	Impact Significance
		Then divert flow through gated culvert and start building from the other bank Excavation for dam foundations – spoil to be removed to avoid future release to the river downstream				
Adjaristsqali / Chorokhi	Khertvisi HPP (Cho1)	Powerhouse to discharge 138 m^3/s, on the bank of Adjaristskali Chorokhi confluence Temporary works in the river channel during construction of outfall structure likely to be minor.	Flows would not be interrupted in the main channel. Sediment load in river downstream may be temporarily increased during the work	Low	Negligible	Insignificant adverse

Magnitude of predicted impacts is greatest for dam construction because of the length of time required for in-channel works. Sediment in particular needs to be well managed during the construction works.

Overall, the significance of the predicted construction effects on water quality and hydrological regime for each scheme is considered to be **minor to insignificant adverse**.

9.4.2.3 Tunnels General

A concern for tunnelling is the potential direct impact on groundwater especially where the groundwater (or springs) is an important local resource. Tunnelling might disturb the flow regime or introduce pollutants to the aquifer.

A concern is the method of disposal of the large quantities of waste material from tunnelling to ensure that there is no potential to impact adversely on rivers and streams in terms of sediment load, or any loss of conveyance capacity to pass major floods.

Impacts during construction are discussed in Table 9.16. Locations of these sites are shown in Figures 2.1 to 2.6 in Chapter 2.

These are all impacts that can be mitigated through best practice construction and erosion minimisation methods which should be specified in the contract and monitored through the Environmental and Social Management Plan (ESMP).

Overall, the significance of the predicted construction effects for tunnelling are considered to be **moderate to minor adverse**.

9.4.2.4 Access Roads General

Access roads will be opened up for vehicles to allow access to the river bed at hydraulic structures and at points along the whole length of tunnels for the construction and maintenance process. The existing roads and access routes would be used where possible and these may need to be upgraded. Details of access road requirements are given in Chapter 2.

The impacts on water features may arise from the construction of the proposed access tracks. The effects are likely to include:

- Alteration of drainage paths (temporary or permanent)
- Loss of vegetation cover and changes to landform causing increased erosion and sediment loads
- Contamination of surface or groundwater during construction works
- Competition for water resources with existing users during construction activities to complete the road.

Impacts during construction are discussed in Table 9.16. These are all impacts that can be mitigated through best practice construction and erosion minimisation methods which should be specified in the contract and monitored through the ESMP.

At any one location, construction activity may only last for a short period - the restoration of full vegetative cover will extend the period somewhat depending on the season - and therefore the construction impacts upon water features are generally not considered to be significant. Overall the assessment is **minor adverse**.

Table 9.16: Assessment of Construction Impacts on Water Features from Tunneling Works

Facility Type	Construction Activity	Potential Impact	Sensitivity	Magnitude	Impact Significance
Transfer tunnel (blasting)	Non-potable water supply Construction waste water disposal Earthworks Concrete batching plant Fuel/chemical storage	Hard rock tunnelling by blasting, generally unlined unless significant ingress of water encountered during construction. Potential impact on springs used by communities could be Major adverse but most springs and users located on old landslip areas avoided by the tunnel alignment so relatively low risk. Where impacts are foreseen they can be minimised by localised tunnel grouting or lining. Explosives, fuel and other chemicals will be stored on site and stores must be bunded to avoid leakage and contamination of surface or ground waters	Low	Moderate	Minor adverse
Transfer tunnel (TBM)	Non-potable water supply Construction waste water disposal Earthworks Concrete batching plant Fuel/chemical storage	Tunnelling by TBM generally unlined unless significant ingress of water encountered during construction. Potential impact on springs used by communities could be Major adverse but most springs and users located on old landslip areas avoided by the tunnel alignment so relatively low risk. Where impacts are foreseen they can be minimised by localised tunnel grouting or lining. Fuel and other chemicals will be stored on site and stores must be bunded to avoid leakage and contamination of surface or ground waters	Low	Moderate	Minor adverse
Tunnel adit sites	Non-potable water supply Construction waste water disposal Earthworks Concrete batching plant Fuel/chemical storage	Adit tunnelling by blasting generally unlined unless significant ingress of water encountered during construction. Potential impact on springs used by communities could be Major adverse but most springs and users located on old landslip areas	Low	Moderate	Minor adverse

Facility Type	Construction Activity	Potential Impact	Sensitivity	Magnitude	Impact Significance
		avoided by the tunnel alignment so relatively low risk. Where impact are foreseen they can be minimised by localised tunnel grouting or lining.			
Spoil Disposal Sites	Earthworks: material to be placed in accordance with design for stability and to minimise erosion potential. In some places the reclaimed land will be used for improved road layout. Erosion protection works: gabions or rock placed to form river bank protection, vegetation planted to cover surface.	Up to 14 sites where tunnelling waste will be placed within flood plain areas along rivers. Potential reduction in flood conveyance capacity and higher flood levels for a distance upstream (distance affected slope dependent). Erosion of material during floods causes increased sediment transport and potential for changes in river morphology downstream. Improved road in a few locations would be beneficial.	Medium	Moderate	Moderate

Table 9.17: Assessment of Construction Impacts on Water Features from Access Road Building/Upgrading Works

Facility Type	Construction Activity	Potential Impact	Sensitivity	Magnitude	Impact Significance
Rehabilitate / upgrade roads	44 km highway and 29 km dirt roads Non-potable water supply for construction processes Construction waste water disposal through settling pond and oil trap Earthworks Culverts Bitumen storage/placing Fuel/chemical storage	Competition for water. Potential for contamination of smaller surface water courses or groundwater, main rivers already have high sediment loads and sufficient dilution capacity. Settlement pond before discharge will limit impacts. Earthworks on steep ground have high potential to increase erosion and sediment load. Disturbance to natural drainage paths on steep slopes, inadequate provision of conveyance capacity may cause localised flooding or gully erosion Fuel and other chemicals will be stored on site and stores must be bunded to avoid leakage and contamination of surface or ground waters	Low	Minor	Minor adverse
New surfaced roads	14.5 km Non-potable water supply for construction processes Construction waste water disposal through settling pond and oil trap Earthworks Culverts Fuel/chemical storage	Competition for water. Potential for contamination of smaller surface water courses or groundwater, main rivers already have high sediment loads and sufficient dilution capacity. Settlement pond before discharge will limit impacts. Earthworks on steep ground have high potential to increase erosion and sediment load. Disturbance to natural drainage paths on steep slopes, inadequate provision of conveyance capacity may cause localised flooding or gully erosion Fuel and other chemicals will be stored on site and stores must be bunded to avoid leakage and contamination of surface or ground waters	Medium	Moderate	Moderate adverse
Rehabilitate / upgrade bridges	2 bridges requiring some upgrading Non-potable water supply for construction processes Construction waste water disposal through settling pond and oil trap Earthworks Deck repairs / strengthening Fuel/chemical storage	Competition for water. Earthworks or piling on river banks or river bed have high potential to increase erosion and sediment load. Fuel and other chemicals will be stored on site and stores must be bunded to avoid leakage and contamination of surface or ground waters	Low	Negligible	Insignificant adverse
New bridges	1 new bridge	Competition for water.	Low	Minor	Minor adverse

Facility Type	Construction Activity	Potential Impact	Sensitivity	Magnitude	Impact Significance
	Non-potable water supply for construction processes Construction waste water disposal through settling pond and oil trap Earthworks for abutments or piers – working in the river channel, coffer dam may be required Piling Construction of piers and deck Fuel/chemical storage	Earthworks or piling on river banks or river bed have high potential to increase erosion and sediment load. Fuel and other chemicals will be stored on site and stores must be bunded to avoid leakage and contamination of surface or ground waters			

9.4.2.5 Construction Facilities

Project facilities required during the phased construction are given in Chapter 2. Facilities include:

- Residential and office accommodation for the workforce
- Storage areas (covered and open) for materials, chemicals, explosives and fuel
- Parking for vehicles and heavy plant
- Workshops
- Concrete batching plant
- Testing laboratory
- Permanent facilities will also include a school, primary health care centre, recreational centre and shop(s).

The geographical spread of the facilities is set out in Table 9.18.

Table 9.18: Proposed Infrastructure by Scheme

Scheme	Camps	Permanent
Project headquarters	Kokotauri / Dandalo construction base camp and future contol centre	✓
All schemes	Roads teams will either have a separate camp or utilise other camps	
All schemes	Tunnel adits will have small camps supported as necessary by the nearest larger camp	
Shuakhevi Scheme	HPP workforce and materials will come from Kokotauri	
	Didachara Dam camp and Skhalta Dam camp will serve the tunnelling teams	✓✓
	Chirukhistqali weir camp will serve the tunnelling teams	
Koromkheti Scheme	Khichauri Dam and Chvanistsqali Weir and tunnelling teams workforce and materials will come from Kokotauri	
	Akavreta weir camp will serve the tunnelling teams	
	HPP camp will serve the tunnelling team and roads teams	
Khertvisi	Khertvisi Dam camp will serve the tunnelling teams	✓
	Machakhlistsqali weir camp will serve the tunnelling teams	
	HPP camp will serve the tunnelling team and roads teams	✓

Impacts on water features may arise from the construction of the proposed facilities. The effects are likely to include:

- Alteration of drainage paths (temporary or permanent)
- Loss of vegetation cover and changes to landform causing increased erosion and sediment loads
- Contamination of surface or groundwater during construction works
- Competition for water resources with existing users during construction activities
- Safe disposal of waste water generated on site.

Impacts during construction are discussed in Table 9.19. These are all impacts that can be mitigated through best practice construction and erosion minimisation methods which should be specified in the contract and monitored through the ESMP. Therefore the construction impacts upon water features are generally not considered to be significant. Overall the assessment is **minor adverse**.

Table 9.19: Assessment of Construction Impacts on Water Features from Support Facilities

Facility Type	Construction Activity	Potential Impact	Sensitivity	Magnitude	Impact Significance
Main Project headquarters (utilising brownfield site ex army camp at Kokotauri / Dandalo)	Water supply for 400 employees in construction phase Waste water disposal Earthworks Concrete batching plant Fuel/chemical storage	Abandoned borehole(s) to be rehabilitated. Discharges to be treated to meet Georgian Standards or taken for off site disposal in Batumi WWTP Fuel and other chemicals will be stored on site and stores must be bunded to avoid leakage and contamination of surface or ground waters	Low	Minor	**Minor adverse**
HPP sites	Water supply for 200 employees in construction phase Waste water disposal Earthworks Concrete batching plant Fuel/chemical storage	Competition for water Discharges to be treated to meet Georgian Standards or taken for off site disposal in Batumi WWTP Fuel and other chemicals will be stored on site and stores must be bunded to avoid leakage and contamination of surface or ground waters	Low	Minor	**Minor adverse**
Dam sites (Small permanent residential/office/ maintenance facility)	Temporary water supply for 100-150 employees (down to 10 after construction) Waste water disposal Earthworks Concrete batching plant Fuel/chemical storage	Competition for water Discharges to be treated to meet Georgian Standards or taken for off site disposal in Batumi WWTP Fuel and other chemicals will be stored on site and stores must be bunded to avoid leakage and contamination of surface or ground waters	Low	Minor	**Minor adverse**
Weir intake sites (temporary sites)	Temporary water supply for 50 employees Temporary waste water disposal Earthworks Concrete batching plant Fuel/chemical storage	Competition for water Discharges to be treated to meet Georgian Standards or taken for off site disposal in Batumi WWTP Fuel and other chemicals will be stored on site and stores must be bunded to avoid leakage and contamination of surface or ground waters	Low	Minor	**Minor adverse**
Tunnel adit sites (temporary site)	Daytime usage only workforce Temporary water supply for 50 employees Temporary waste water disposal Earthworks Fuel/chemical storage	Water supply brought in. Waste water taken off site for disposal. Fuel and other chemicals will be stored on site and stores must be bunded to avoid leakage and contamination of surface or ground waters	Low	Minor	**Minor adverse**

Facility Type	Construction Activity	Potential Impact	Sensitivity	Magnitude	Impact Significance
Road camp (temporary no accommodation)	Mobile team moving on regularly	Water supply brought in. Waste water taken off site for disposal.	Low	Minor	**Minor adverse**

9.4.3 Operation Phase

9.4.3.1 Likely Effects

During operational activities of the Project the potential effects could include:

- Reduction in river flows along the Adjaristsqali to an agreed minimum which, depending on how low the minimum is set, is likely to have a direct effect on the aquatic ecosystem and ecosystem services
- Reduction in river flows has the potential also to impact on existing water users (irrigation, water supply, hydropower)
- Changes in water quality in the main river system, especially during low flows
- Change in frequency and magnitude of flows (higher flow regime) has potential to change the sediment regime with consequent potential impacts on channel morphology
- Sediment release and change in water quality during the flushing of the dam system
- Potential for contamination of groundwater.

The major concern for the operation phase is to establish an environmental flow post scheme that can reduce potential impacts on the flow regime along the main Adjaristsqali River and those tributaries on which intakes are proposed. Changes in the flow regime will also be accompanied by changes in the water levels and aspects of water quality (particularly sediment).

The design team have recognised the importance of these potential impacts and the design process has involved technical input from environmental and social specialists. Given the importance of environmental flows in addressing potential impacts, but taking into account data limitations due to the project timetable, it has been necessary to take a two phased approach to determining environmental flows. This is discussed in more detail in Chapter 10.

9.4.3.2 In-River Structures

Phase I Impact Assessment

This section describes the Phase I impact assessment taken as the starting point for the process of establishing recommended environmental flows. The starting assumption was that the environmental flow should be fixed at a constant level equivalent to 10% of the mean annual runoff expressed as daily discharge, which is consistent with other hydro schemes in Georgia. As discussed in Chapter 10, the surveys during August 2011, undertaken while the overall scheme was undergoing optimisation, provided an initial basis for undertaking the Phase I assessment,

These flow assumptions and the results of ongoing data collection since August 2011 will be used in Phase II to refine and confirm assumptions used as part of the Phase I assessment to define more site specific measures and environmental flow regime at each of the in-river structures in relation to areas significantly affected by the scheme.

Table 9.20 to Table 9.24 compares the natural flow regime pre-Project and the predicted flow downstream at each location based on the scheme operation in the “average” year. Note in the tables ‘LTM’ is the long term mean annual runoff pre-scheme. Seasonal and shorter term impacts are described in Chapter 8.

Figure 9.18 shows the overall impact on the Adjaristsqali River reach by reach in terms of mean annual runoff. The figure illustrates that some reaches and tributaries are more affected than others. Since hydropower operation is essentially a non-consumptive use of water the mean annual flow at the bottom of the Shuakhevi and Koromkheti schemes is identical pre- and post scheme, however, in the case of the Khertvisi scheme water from the Machakhlistsqali tributary of the Chorokhi River is discharged into the lower Adjaristsqali leading to an enhanced flow at this location.

Table 9.20: Impact of Diversions on the Chirukhistsqqali River (mean annual case)

Distance from watershed to outfall (km)	Reach length (km)	Description	Area (km2)		Pre-scheme Flow (m3/s)		Post-scheme Flow (m3/s)		Post-scheme Flow	
			Sub-area	Cum.	From sub-area	Cum.	From sub-area	Cum.	Abstraction m3/s	As % LTM
0	0	Watershed	0	0	0	0	0	0		100%
17	17		150	150	0	0	0	0		100%
17	0	Chi1 weir	150	150	4.69	4.69	0.95	0.95	3.74	20%
23.5	6.5		15	165	0.47	5.16	0.47	1.42		28%
23.5	0	Mod1 inflow	54	219	1.69	6.85	1.7	3.12		45%
29.4	5.9		10	229	0.31	7.16	0.31	3.43		48%
29.4	0	un-named inflow	15	244	0.47	7.63	0.47	3.9		51%
33.1	3.7		10	254	0.31	7.94	0.31	4.21		53%
33.1	0	Tbeti inflow	67	321	2.1	10.04	2.09	6.3		63%
33.3	0.2	Shuakhevi gauge	5	326	0.16	10.2	0.16	6.46		63%
34	0.7	Adjaristsqali confluence	5	331	0.16	10.36	0.16	6.62		64%

Table 9.21: Impact of Diversions on the Skhalta River (mean annual case)

Distance from watershed to outfall	Reach length (km)	Description	Area (km2)		Pre-scheme Flow (m3/s)		Post-scheme Flow (m3/s)		Post-scheme Flow	
			Sub	Cum.	From sub-area	Cum.	From sub-area	Cum.	Abstraction m3/s	As % LTM
0		Watershed	0	0	0	0	0	0		100%
16.3			168	0						100%
0	16.3	Skh1 dam	168	168	5.26	5.26	1.49	1.49	3.99	28%
20.46	4.16	Skh1(A)	22	190	0.69	5.95	0.69	2.18		37%
23.5	3.04	Skh1(B)	18	208	0.56	6.51	0.56	2.74		42%
27.55	4.05	Adjaristsqali confluence	5	213	0.16	6.67	0.16	2.9		43%

Table 9.22: Impact of Diversions on the Akavreta River (mean annual case)

Distance from watershed to outfall	Reach length (km)	Description	Area (km2)		Pre-scheme Flow (m3/s)		Post-scheme Flow (m3/s)		Post-scheme Flow	
			Sub-area	Cum.	From sub-area	Cum.	From sub-area	Cum.	Abstraction m3/s	As % LTM
0	0	Watershed	0	0	0	0	0	0		100%
15	15		100	0	0	0	0	0		100%

15	0	Aka2 diversion	100	100	5.8	5.8	0.82	0.82	5.45	14%
18.4	3.4	Aka1(A)	6	106	0.35	6.15	0.35	1.17		19%
18.4	0	SB1	16	122	0.93	7.08	0.93	2.1		30%
22.15	3.75	Adjaristsqali confluence	8	130	0.46	7.54	0.46	2.56		34%

Table 9.23: Impact of Diversions on the Machakhlistsqali River (mean annual case)

Distance from watershed to outfall	Reach length (km)	Description	Area (km2)		Pre-scheme Flow (m3/s)		Post-scheme Flow (m3/s)		Post-scheme Flow	
			Sub-area	Cum.	From sub-area	Cum.	From sub-area	Cum.	Abstraction m3/s	As % LTM
0		Watershed	0	0	0	0	0	0		100%
20			345	0						100%
20	0	Mac1 diversion	345	345	20.01	20.01	3.17	3.17	17.1	16%
26.64	6.64	Mac1(A)	20	365	1.16	21.17	1.16	4.33		20%
26.64	0	Chorokhi from upstream	0	365	0	21.17	0	4.33		20%
29.49	2.85	Adjaristsqali confluence (Mac1B)	15	380	0.87	22.04	0.87	5.2		24%

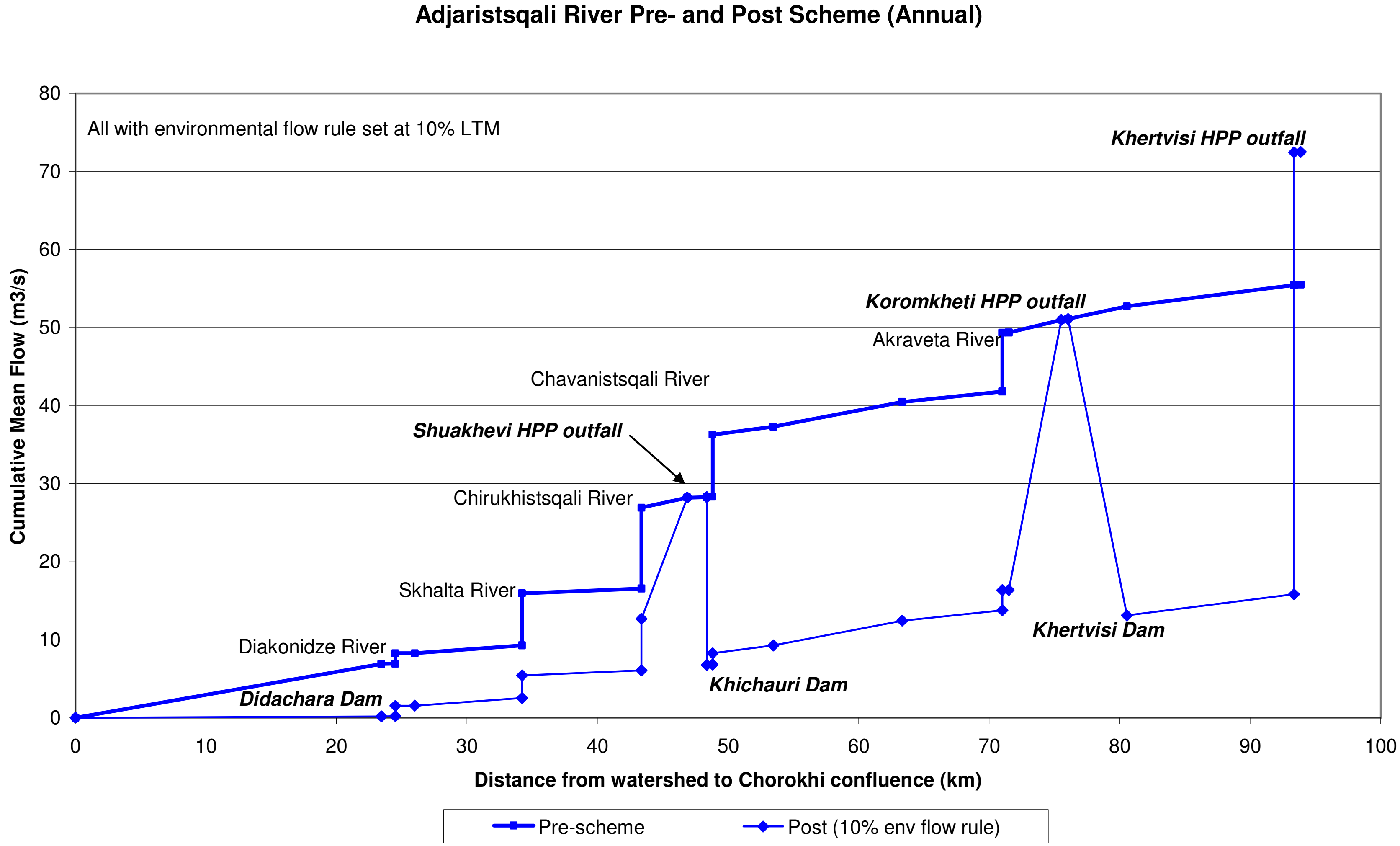
Note: Zero contributing flow shown coming down Chorokhi River from Turkey – the actual flow in the Chorokhi River at the Machakhlistsqali confluence is not known but is highly modified by the operation of dams within Turkey.

Table 9.24: Impact of Diversions on the Adjaristsqali River (mean annual case)

Distance from watershed to outfall	Reach length (km)	Description	Area (km2)		Pre-scheme Flow (m3/s)		Post-scheme Flow (m3/s)		Post-scheme Flow	
			Sub	Cum.	From sub-area	Cum.	From sub-area	Cum.	Abstraction m3/s	As % LTM
0		Watershed	0	0	0	0	0	0		100%
23.43		Didachara dam (Adj7)	210	210	6.9	6.9	0.18	0.18	6.88	100%
24.5	1.07		1	211	0.02	6.92	0.02	0.2		3%
24.5	0	Dia1 inflow	34	245	1.33	8.25	1.33	1.53		19%
26	1.5	Khulo gauge	6	251	0.01	8.26	0.01	1.54		19%
34.22	8.22		25	270	1	9.26	1	2.54		27%
34.22	0	Skhalta	213	483	6.67	15.93	2.9	5.44		34%
43.35	9.13		20	503	0.63	16.56	0.63	6.07		37%
43.35	0	Chirukhistsqali inflow	331	834	10.36	26.92	6.62	12.69		47%
46.86	3.51	Shuakhevi HPP outfall	41	875	1.28	28.2	15.51	28.2		100%
46.86	0		0	875	0	28.2	0	28.2		100%
48.36	1.5		2	877	0.06	28.26	0.06	28.26		100%
48.36	0	Adj5 Khichauri dam	0	877	0	28.26	-21.5	6.76	25.41	24%
48.81	0.45		2	877	0.07	28.33	0.07	6.83		24%
48.81	0	Chvanistsqali inflow	190	1067	7.95	36.28	1.42	8.25		23%
53.47	4.66	Adj5a (A)	30	1097	1.02	37.3	1.02	9.27		25%
63.34	9.87	Adj5a (B)	93	1190	3.17	40.47	3.17	12.44		31%
71	7.66		39	1229	1.33	41.8	1.33	13.77		33%
71	0	Akavreta inflow	130	1359	7.54	49.34	2.56	16.33		33%
71.5	0.5	Keda gauge	1	1360	0.03	49.37	0.03	16.36		33%
75.54	4.04	Koromkheti HPP outfall	47	1407	1.6	50.97	34.61	50.97		100%
76.04	0.5	Ats-Hesi weir	4	1411	0.14	51.11	0.14	51.11		100%
80.54	4.5	Khertvisi Barrage	47	1458	1.6	52.71	-38	13.11	47.02	25%

93.35	12.81		80	1538	2.72	55.43	2.72	15.83		29%
93.35	0	Khertvisi HPP outfall	0	1538	0	55.43	56.6	72.43		131%
93.85	0.5	Chorokhi confluence	2	1540	0.07	55.5	0.07	72.5		131%

Figure 9.18: Schematic to illustrate how the proposed scheme might impact on the annual flow regime throughout the basin



At each proposed intake the needs of all relevant human water users (e.g. irrigation, dilution of wastewater discharges etc) were checked to ensure that their needs could be met. Where, as in the case of existing HPP operators, flow rules were not an option other methods of mitigation have been proposed (negotiated compensation). Similarly, irrigators and fish farms that may be affected are both very small scale operations and few in number. In such a situation it may be more appropriate to provide either compensation or an alternative source of water supply.

As discussed in Chapter 10 it is proposed to revisit the environmental flow rules once a further campaign of field measurements has been carried out to better define the needs to support ecological services.

Table 9.25 shows the impact assessment associated with adopting the 10% of mean annual runoff rule. The localised impacts range from major to insignificant adverse at different locations reflecting the complexity of the Project

Table 9.25: Assessment of Operation Impacts from In-river Works

River	Location	Operations	Potential Impact	Sensitivity	Magnitude	Impact Significance
Shuakhevi Scheme						
Chirukhistqali	Chi1	Weir, sediment trap and run of river intake to transfer tunnel with facility to control downstream flow to meet agreed environmental flow rules The intake and weir pool have a limited capacity and once this is exceeded the water spills over the weir resulting in higher flow levels Sediment trap (to keep sediment out of the transfer tunnel) will be flushed back into the river	Potential for impact on flow over 4 km reach. Impact reduces below first tributary (approximately 1km downstream) as natural flow accretion will occur downstream. Sediment transport minimal impact. Irrigation scheme 133 requirements which are small can be met by either a compensation arrangement or alternative source of water supply.	Low	Minor	**Minor adverse**
Diakonidze	Dia1	Weir, sediment trap and run of river intake	THIS OPTION WAS DROPPED			
Skhalta	Skhalta Dam (Skh1)	22 m high dam and 493,000 m^3 reservoir with facility to release flow to meet agreed environmental flow rules Sediment deposited in the reservoir will be flushed back into the river on "flushing days" (4 per year)	Potential for impact on flow over 1 km reach. Impact reduces below first tributary (approximately 1km downstream) as natural flow accretion will occur downstream. Sediment transport will change with most sediment trapped temporarily in the reservoir until flushing days. Flushing days will be synchronised down the cascade of dams to allow downstream transport. No identified users in the 1km reach.	Medium	Moderate	**Moderate adverse**
Adjaristsqali	Didachara Dam (Adj7)	39 m high dam and 623,000 m^3 reservoir with facility to release flow to meet agreed environmental flow rules Sediment deposited in the reservoir will be flushed back into the river on "flushing days" (4 per year)	Potential for impact on flow over <1km reach. Impact reduces below Diakonidze tributary as natural flow accretion will occur downstream. Sediment transport will change with most sediment trapped temporarily in the reservoir until flushing days. Flushing days will be synchronised down the cascade of dams to allow downstream transport. No identified users in the <1km reach.	Medium	Moderate	**Moderate adverse**
Adjaristsqali	Shuakhevi	Power house on the bank of the	At this point flow in Adjaristsqali is restored to	Low	Negligible	**Insignificant**

River	Location	Operations	Potential Impact	Sensitivity	Magnitude	Impact Significance
	HPP (Adj5b)	Adjristsqali to discharge 48 m^3/s	pre-scheme volume but with a slightly modified regime due to the upstream reservoirs			
Koromkheti Scheme						
Adjaristsqali	Khichauri Dam (Adj5a)	19 m high dam and 577,000 m^3 reservoir with facility to release flow to meet agreed environmental flow rules Sediment deposited in the reservoir will be flushed back into the river on "flushing days" (4 per year)	Potential for impact on flow reduces downstream as natural flow accretion will occur. Sediment transport will change with most sediment trapped temporarily in the reservoir until flushing days. Flushing days will be synchronised down the cascade of dams to allow downstream transport. Irrigation scheme 157 requirements which are small can be met by either a compensation arrangement or alternative source of water supply.	Medium	Moderate	**Moderate adverse**
Chavanistsqali	Chv1	Small dam, reservoir to act as sedimentation basin, intake to transfer tunnel with facility to control downstream flow to meet agreed environmental flow rules The intake and weir pool have a limited capacity and once this is exceeded the water spills over the weir resulting in higher flow levels Sediment trap (to keep sediment out of the transfer tunnel) will be flushed back into the river	Intake is close to the confluence with the Adjaristsqali River so <1km affected. Sediment transport minimal impact. No identified users in the <1km reach.	Low	Minor	**Minor adverse**
Akavreta	Aka2	Weir, sediment trap and run of river intake, drop shaft to transfer tunnel with facility to control downstream flow to meet agreed environmental flow rules The intake and weir pool have a limited capacity and once this is exceeded the water spills over the weir resulting in higher flow levels Sediment trap (to keep sediment out of the transfer tunnel) will be flushed back into the river	Potential for impact on flow over 4km reach. Impact reduces below Goderdzistsqali tributary as natural flow accretion will occur downstream. Sediment transport minimal impact. Fish farm (1) requirements which are small can be met by either a compensation arrangement or alternative source of water supply	Low	Moderate	**Moderate adverse**

River	Location	Operations	Potential Impact	Sensitivity	Magnitude	Impact Significance
Goderdzistsqali River	SB1	Weir, sediment trap and run of river intake	THIS OPTION WAS DROPPED			
Adjaristsqali	Koromkheti HPP (Adj2a)	Construction of power house on the bank of the Adjristsqali to discharge 100 m^3/s	At this point flow in Adjaristsqali is restored to pre-scheme volume but with a slightly modified regime due to the upstream reservoirs Compensation required for potential revenue reduction at Atsi HPP	Low	Negligible	**Insignificant**
Khertvisi Scheme						
Adjaristsqali	Khertvisi Barrage (Adj1)	5 m high barrage 150,000 m^3 reservoir with facility to release flow to meet agreed environmental flow rules Sediment deposited in the reservoir will be flushed back into the river on "flushing days" (4 per year)	Potential for impact on flow reduces downstream as natural flow accretion will occur. Sediment transport will change with most sediment trapped temporarily in the reservoir until flushing days. Flushing days will be synchronised down the cascade of dams to allow downstream transport. No identified users in the immediate downstream reach.	Medium	Moderate	**Moderate adverse**
Machakhlistsqali	Mac1	Small dam, reservoir to act as sedimentation basin, intake to transfer tunnel with facility to control downstream flow to meet agreed environmental flow rules The intake and weir pool have a limited capacity and once this is exceeded the water spills over the weir resulting in higher flow levels Sediment trap (to keep sediment out of the transfer tunnel) will be flushed back into the river	Potential for impact on flow reduces downstream as natural flow accretion will occur. Sediment transport minimal impact. Existing HPP regime totally changed – compensation should be agreed. Irrigation scheme 165 requirements which are small can be met by either a compensation arrangement or alternative source of supply.	High	Major	**Critical adverse**
Adjaristsqali / Chorokhi	Khertvisi HPP (Cho1)	Powerhouse to discharge 138 m^3/s, on the bank of Adjaristskali Chorokhi confluence	At this point flow in Adjaristsqali is restored to pre-scheme volume but with a slightly modified regime due to the upstream reservoirs	Low	Negligible	**Insignificant**

Note Irrigation scheme numbers as shown in Figure 9.3.

9.4.3.3 Tunnels

Following the grouting or lining of tunnel sections that show significant ingress of groundwater during construction it is unlikely that the tunnels in operation will have any impacts on springs used for local water supplies. Community complaints about spring sources should be monitored through the ESMP.

Therefore, the significance of the predicted operational effects on water features is considered to be **minor adverse**.

9.4.3.4 Access Roads

The longer term impact of the proposed access tracks will depend on the surface design (gravel or hardtop) and maintenance arrangements, and on the adequacy of cross drainage and arrangements to maintain conveyance capacity. Poorly finished or maintained roads deteriorate rapidly in the Georgian climate leading to erosion, sediment loads and localised flooding problems. These impacts should be minimised during the design stage and monitored through the ESMP.

Therefore, the significance of the predicted operational effects on water features is considered to be moderate to **minor adverse**.

9.4.3.5 Facilities

The longer term impact of the proposed permanent facilities will depend on maintenance arrangements for the water supply and waste water treatment plant to ensure that Georgian standards continue to be met.

Therefore, the significance of the predicted operational effects on water features is considered to be **insignificant**.

9.4.4 Decommissioning and Post -Operation

The decommissioning phase of the scheme is likely to be more than 30 years away. As it is far into the future, it is difficult to produce an accurate and meaningful prediction of the significance of impacts and their effects because the baseline conditions are likely to have changed notably by this phase of the Project.

Decommissioning activities, similar to the construction of the works, would have the potential in the short term to adversely affect local water features largely through potential for pollution or increased sediment loads in water courses.

Given the estimated timeframe and temporary nature of the decommissioning works, there are no predicted significant impacts on water features.

9.4.5 Cumulative Impacts

Cumulative impacts on the hydrological regime have already been considered in the discussion of the individual scheme components because the inflow to the next reservoir/weir in the cascade is the modified flow continuing downstream of the upstream reservoir.

9.5 Mitigation, Monitoring and Enhancement Measures

9.5.1 Overview

Management of construction activities relating to potential impacts on water features will be included in the Project framework ESMP. Techniques based on the IFC General EHS Guidelines for consideration during construction and decommissioning of the weirs, dams, tunnels and access roads are summarised below. The ESMP is a commitment by the Project that construction contractors will be required to follow through the procurement process. All contractors will be required to demonstrate that they have the procedures in place for implementing EHS management measures. Furthermore AGL or their representatives will undertake regular audits of works against the requirements of the ESMP commensurate with the nature of the risk.

9.5.2 Mitigation Measures

9.5.2.1 Dams, Weirs, Intakes and Outfalls

The proposed mitigation measures for construction and operation of the hydraulic structures are summarised in Table 9.26.

Table 9.26: Dams, Weirs, Intakes and Outfalls – Mitigation Measures Against Impacts on Water Features

Type of Mitigation	
Embedded mitigation – mitigation which is built-in to the project during the EPC procurement and design process	The potential impacts on rivers have been considered through the design of the various scheme components and particularly those across or beside the river channel. Where possible measures have been developed to avoid or minimise impacts on water features, and as result mitigation is an integral part of the scheme. These integral design mitigation measures include (or will include as detailed design progresses): ■ Development of operating rules incorporating environmental flow requirements ■ Incorporation of control structures to allow variable environmental flow rules to be applied over a year ■ Incorporation of fish pass arrangements at sensitive locations ■ Sediment flushing arrangements to maintain the live storage in reservoirs and to maintain sediment transport down river towards the Black Sea ■ Diversion arrangements to maintain flows during construction within the channel. ■ Where practical fill material for dams and weirs to be taken from the reservoir area or from tunnelling spoil ■ Design and scheduling of in-river works to minimise generation of sediment load; ■ Locating construction compounds away from sensitive water features; ■ Adopt best practice to minimise risk of pollution during construction and operation
Mitigation of significant effects	The following mitigation measures will be implemented in order to minimise the significant effects of the scheme on water features. ■ Adpative Management plan for environmental flows to be implemented
Mitigation of non-significant effects	The following mitigation measures will be implemented in order to minimise the non-significant effects of the scheme on water features. ■ Minimise work by/in water courses during the wetter months ■ Provide sufficient diversion capacity to pass natural flow and sediment load during the construction period ■ Control measures during construction to minimise increase in sediment load in the

Type of Mitigation	
	river downstream; ■ Take control measures to minimise erosion and potential for pollution; ■ Site construction compounds away from sensitive water features to avoid pollution (waste or sediment) or erosion; ■ Adopt best practice to minimise risk of pollution during construction and operation ■ If creating a temporary water supply for the Project ensure no adverse impact on other water users.

9.5.2.2 Tunnels, Access Roads and Facilities

Mitigation measures are summarised in Table 9.27 and Table 9.28.

Table 9.27: Tunnels – Mitigation Measures Against Impacts to Water Features

Type of Mitigation	
Embedded mitigation – mitigation which is built-in to the project during the EPC procurement and design process	The potential impacts on water features have been considered through the design of the Project infrastructure and associated tunnels. Where possible measures have been developed to avoid or minimise impacts on water features, and as result mitigation is an integral part of the scheme. These integral design mitigation measures include (or will include as detailed design progresses): ■ Tunnel lining where there is a risk of disrupting groundwater resources (protection of spring sources used by the rural population); ■ Location of spoil dumps will be undertaken to minimise alteration of drainage paths, any loss of river channel conveyance capacity, and generation of sediment load; ■ Hydraulic analysis to confirm no localised increase in flood risk if spoil placed in river bed ■ Where suitable maximise use of tunnel spoil for construction of other components of the Project; ■ Locating construction compounds away from sensitive water features; ■ Adopt best practice to minimise risk of pollution during construction and operation ■ Ensure no adverse impact on other water users by project activities
Mitigation of significant effects	The following mitigation measures will be implemented in order to minimise the significant effects of the scheme on water features. ■ Water feature survey to determine tunnel lining requirements
Mitigation of non-significant effects	The following mitigation measures will be implemented in order to minimise the non-significant effects of the scheme on water features. ■ Avoid altering drainage paths when placing spoil or re-route drainage around the site; ■ Control measures during earthworks to minimise increase in sediment load; ■ Minimise work by water courses during the wetter months ■ Site construction compounds away from sensitive water features to avoid pollution (waste or sediment) or erosion; ■ Adopt best practice to minimise risk of pollution during construction and operation

Table 9.28: Access Roads – Mitigation Measures Against Impacts to Water Features

Type of Mitigation	
Embedded mitigation – mitigation which is built-in to the project during the EPC procurement and design process	The potential impacts on water features have been considered through the design of the Project infrastructure and associated access roads. Where possible measures have been developed to avoid or minimise impacts on water features, and as result mitigation is an integral part of the scheme. These integral design mitigation measures include (or will include as detailed design progresses): ■ When new roads are required on steep valley sides design to minimise potential for washout and erosion. ■ Minimise loss of habitat in design of road and all associated slope stabilisation measures by maintaining iterative design at the detailed design stage.
Mitigation of significant effects	No significant impacts have been identified
Mitigation of non-significant effects	The following mitigation measures will be implemented in order to minimise the non-significant effects of the scheme on water features. ■ Adequate provision of cross drainage structures where building new / rehabilitating roads to avoid altering drainage paths ■ Control measures during earthworks to minimise increase in sediment load; ■ Surface treatment of road to minimise increase in sediment load ■ Minimise work by watercourses during the wetter months ■ At all watercourse crossings take control measures to minimise erosion and potential for pollution; ■ Site construction compounds away from sensitive water features to avoid pollution (waste or sediment) or erosion; ■ Adopt best practice to minimise risk of pollution during construction and operation ■ If creating a temporary water supply for the Project ensure no adverse impact on other water users.

9.5.3 Compensation and Enhancement Measures

The compensation and enhancement measures which would benefit the condition of water features of the project area are recommended to be developed at the detailed design stage where the key local characteristics could be taken in consideration.

However, the compensation and enhancement measures are likely to include the following:
- Localised erosion control measures and re-vegetation after earthworks
- Providing improved crossing of water course for local community
- Good working practices, commence erosion control works at the beginning of construction process
- Providing alternative supply system to the limited number of small scale irrigators or fish farmers that may be affected, by moving their abstraction point and providing a new transfer canal/pipeline or other alternative water supply.

9.5.4 Monitoring Measures

The recommendations for monitoring measures are set out as a series of schematic diagrams in the following figures.
- Set up for a typical reservoir
- Set up for a typical tributary intake
- Set up for a typical environmental monitoring station downstream of the entire HPP cascade.

Figure 9.19: Typical Set Up at Reservoir for Construction Phase

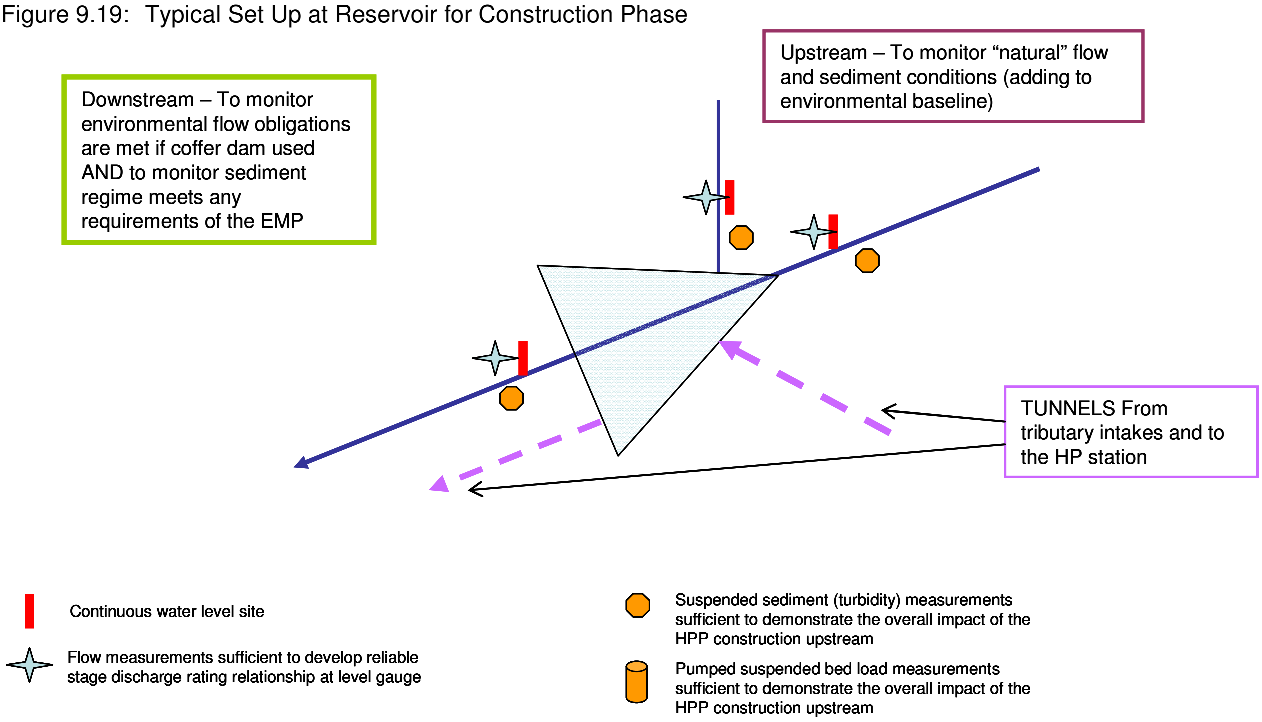


Figure 9.20: Typical Set Up at Reservoir for Operational Phase

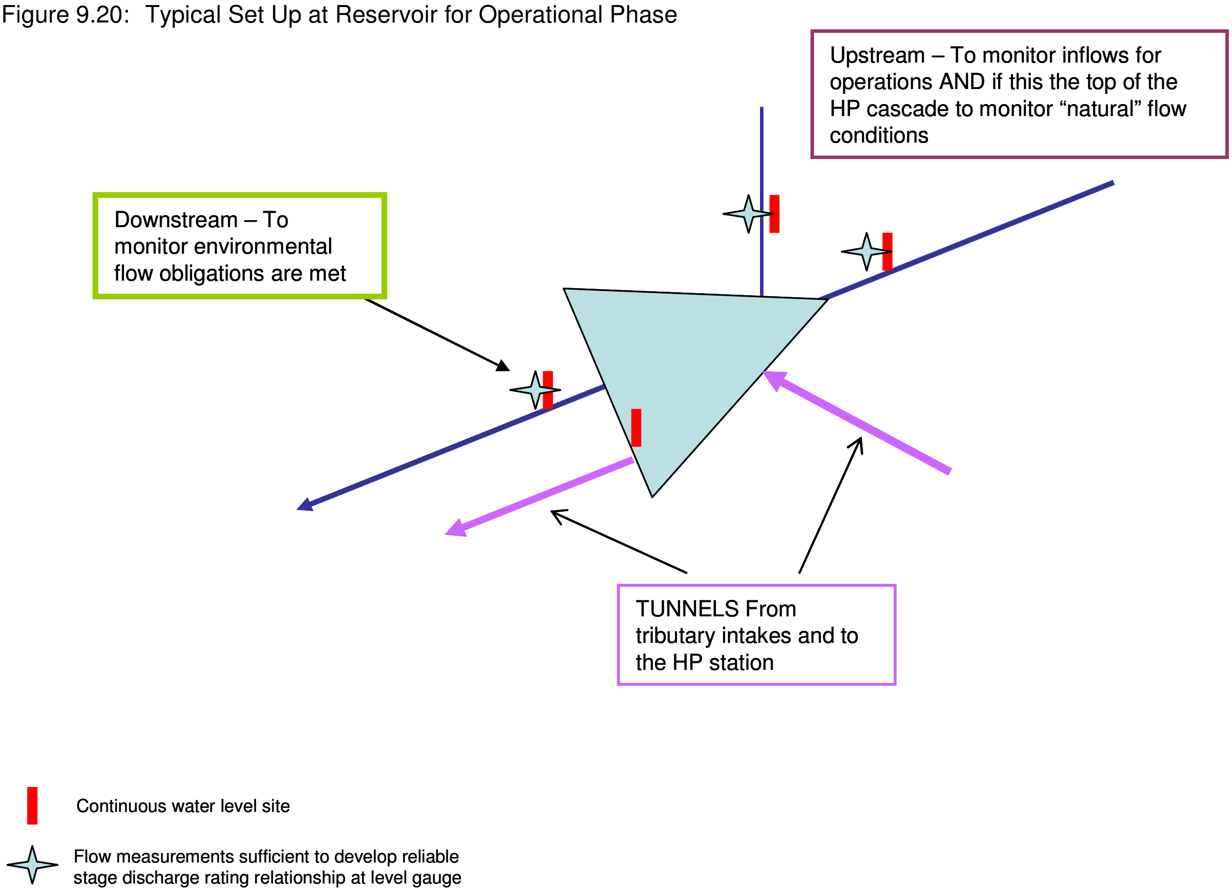


Figure 9.21: Typical Set Up at Tributary Intake for Construction Phase

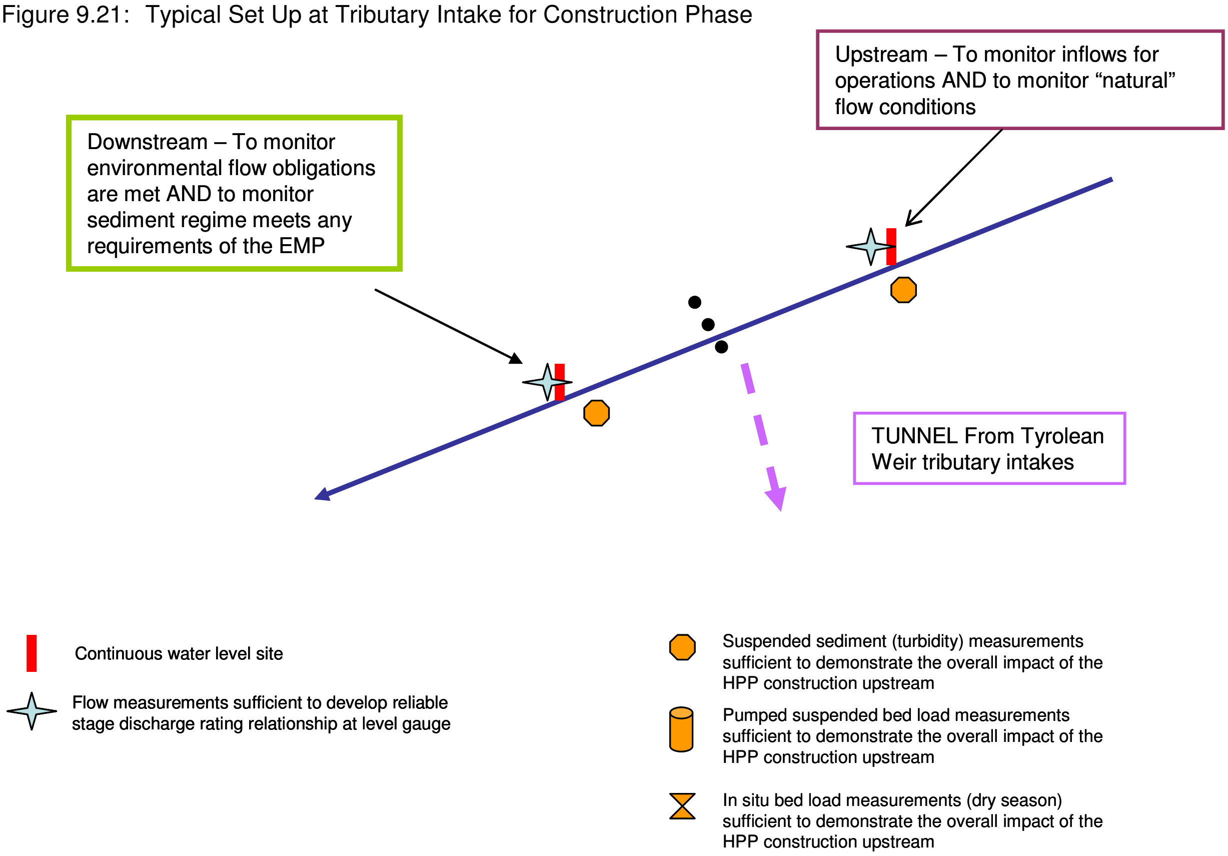


Figure 9.22: Typical Set Up at Tributary Intake for Operational Phase

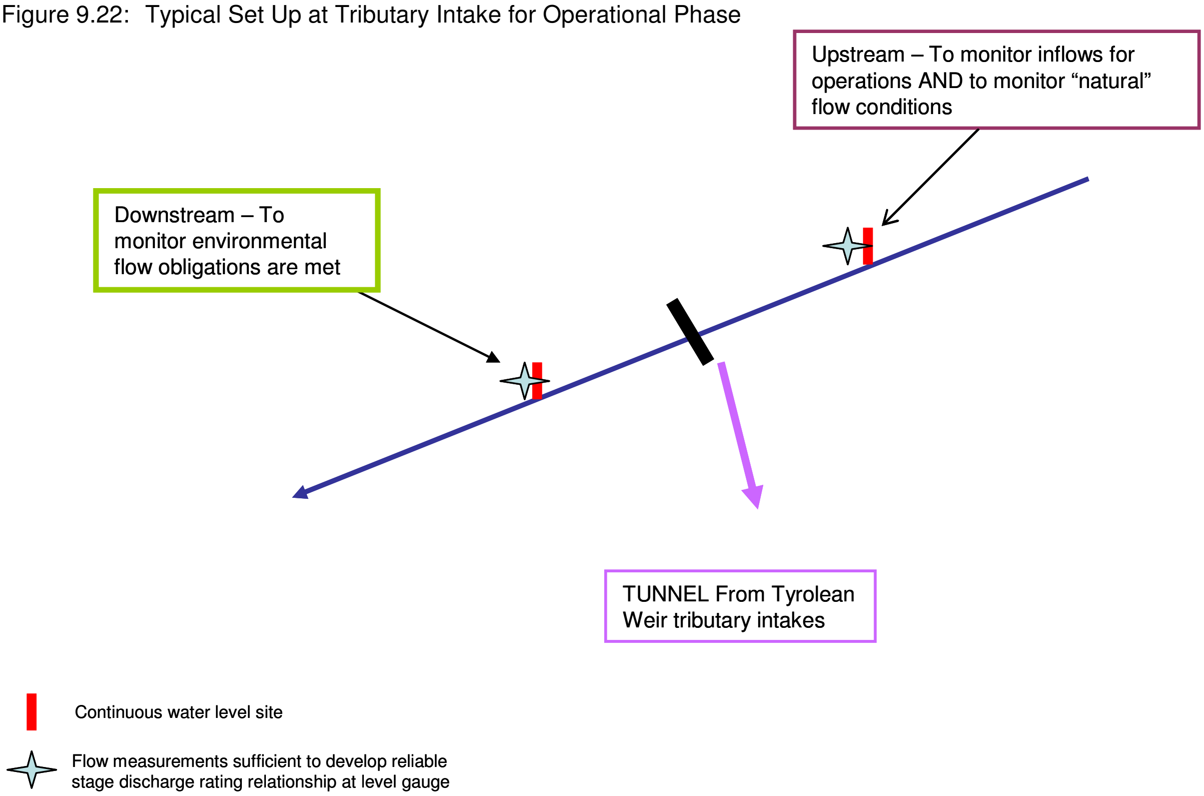


Figure 9.23: Typical Set Up for Construction Phase Downstream of HPP Cascade for Environmental Monitoring

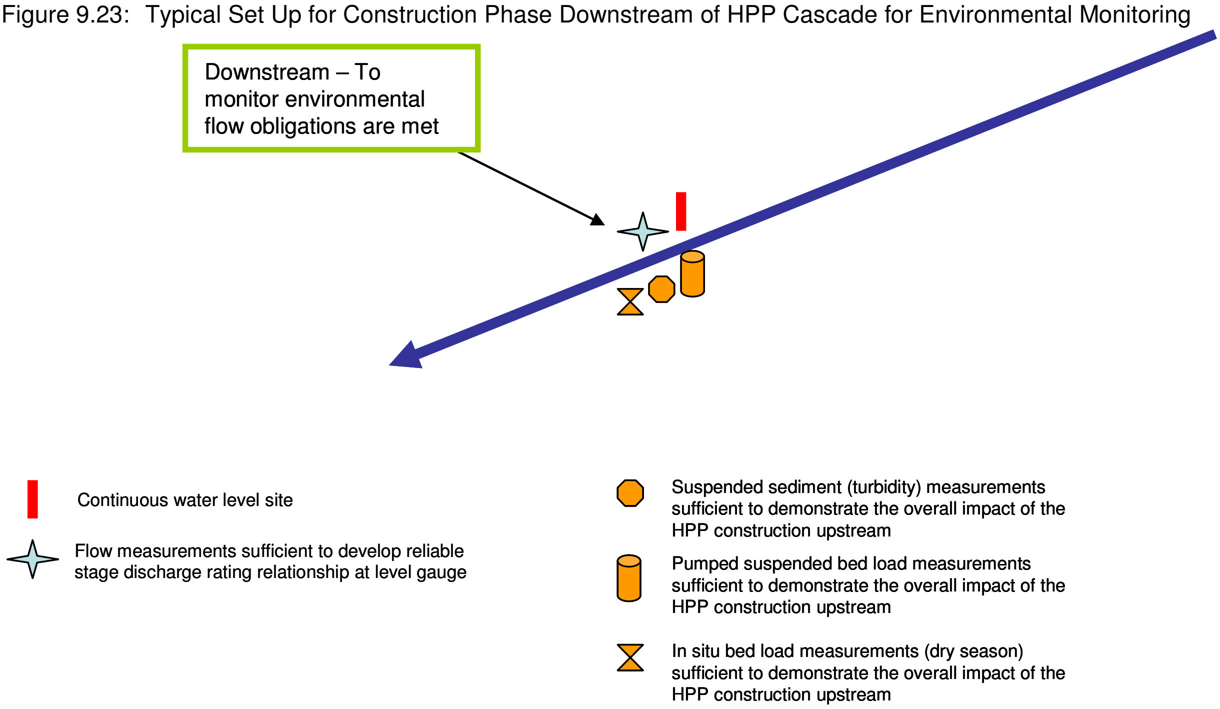
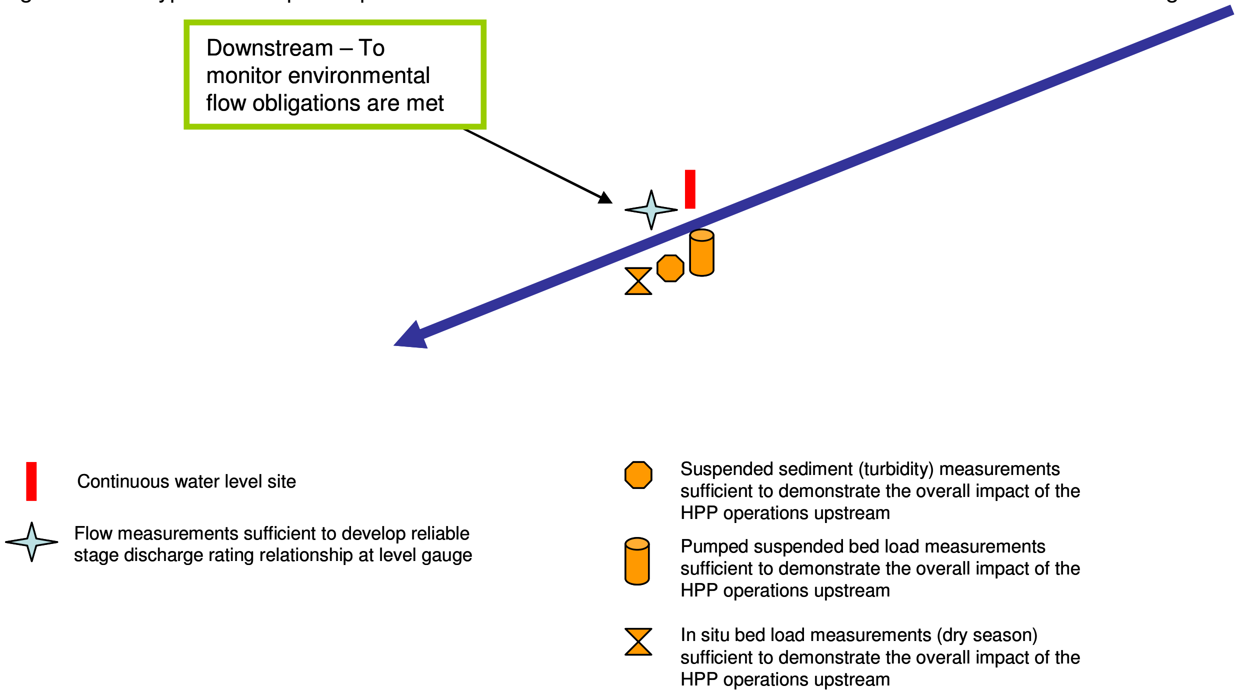


Figure 9.24: Typical Set Up for Operational Phase Downstream of HPP Cascade for Environmental Monitoring



9.6 Summary

9.6.1 Residual Impacts

Residual effects (i.e. the effects of the scheme once mitigation has been applied) have been classified as non-significant or still significant (albeit reduced), as appropriate for each environmental aspect (see Table 9.29).

Table 9.29: Summary of Key Significant Impacts and Mitigations

Activity	Potential Impact	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation	Residual Significance
Construction						
Diversion weirs	Increase sediment load	Low	Negligible	Insignificant	Good practice construction	**Insignificant**
Dams	Increase sediment load	Medium	Minor	Minor Adverse	Good practice construction	**Minor to insignificant**
HPP and outfall	Increase sediment load	Low	Negligible	Insignificant	Good practice construction	**Insignificant**
Tunnels	Spoil disposal	Medium	Moderate	Moderate Adverse	Ensure sediment load in river system not increased beyond transport capacity	**Insignificant**
	Disturb spring sources	Low	Moderate	Moderate Adverse	Grout/line tunnel sections as needed to seal against groundwater flow	**Minor to insignificant**
Access roads	Increase sediment load	Medium/Low	Minor	Moderate to insignificant	Good practice construction	**Insignificant**
Facilities	Competition for water Increase sediment load Pollution	Low	Minor	Minor Adverse	Ensure no reduction in water for existing users. Good practice construction	**Insignificant**
Operation						
Operate diversion (All diversions except Mac1)	Changed/lowered flow regime	Low - Medium	Minor to Moderate	Moderate to Minor Adverse	Negotiate buy-out of existing HPP on Machakhlistsqali. Provide alternative supply or compensation to any small scale affected users	**Minor Adverse to insignificant**

Activity	Potential Impact	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation	Residual Significance
Operate diversion (Mac1)	Changed/lowered flow regime	High	Major	Critical Adverse	Negotiate buy-out of existing HPP on Machakhlistsqali. Provide alternative supply or compensation to any small scale affected users	**Minor Adverse to insignificant**
Operate dam	Changed/lowered flow regime	Medium	Moderate	Moderate Adverse	Environmental flows and closure days for sediment flushing Provide alternative supply or compensation to any small scale affected users	**Moderate to Minor Adverse**
Operate tunnels	Change spring/groundwater regime	Low	Minor	Minor Adverse	Provide alternative supply to affected users	**Insignificant**
Operate HPP and outfall	Changed flow regime	Low	Negligible	Insignificant	Environmental flow rules, river training and protection works	**Insignificant**
Access roads	Increase sediment load	Low	Negligible	Insignificant	Maintenance	**Insignificant**
Facilities	Pollution	Negligible	Negligible	Insignificant	Maintenance	**Insignificant**

9.6.2 Summary of Mitigation Measures

See Table 9.30.Table 9.30: Summary of Water Mitigaiton Measures for the Project

9.6.3 Summary of Monitoring Measures

See Table 9.31.

Table 9.30: Summary of Water Mitigaiton Measures for the Project

Objective	Activity	Mitigation / Enhancement	Standards	Responsibility	Timescales	Cost estimate
Maintain existing water uses and key ecosystem services	Maintain downstream release and flushing flows	Operate in accordance with environmental flow rules	IFC Performance standard 6	Operator	Lifetime of project operation	Part of annual operating costs
Monitoring for adaptive management (see Chapter 10)	Monitor flow, water quality and sediment	Check/adapt environmental flow rules		Operator	Lifetime of project operation	Part of annual operating costs
Prevent erosion and sediment during construction	Earthworks	Best construction practice		Contractor	During all construction near waterbody	Included in construction cost
Prevent pollution during construction	Fuel, chemical, explosives stores	Best construction practice		Contractor	During all construction near surface or groundwater body	Included in construction cost
Supply potable water for workforce	Construction and operation of facilities	Assess capacity of water body to provide for extra demand. Provide water treatment plant	Georgian national standards for potable water	Contractor	During construction and for smaller number over operational lifetime of the project	Included in construction cost
Disposal of workforce waste water without reducing water quality in receiving waterbody	Construction and operation of facilities	Assess capacity of water body is sufficient for dilution. Provide waste water treatment plant or transport to treatment facility	Georgian national standards for discharge to water	Contractor	During construction and for smaller number over operational lifetime of the project	Included in construction cost

Table 9.31: Monitoring Measures

Activity	Project Stages	Parameters	Locations	Frequency	Standards	Implementing Responsibility	Supervision/ Reporting
Diversion weir construction	Construction	Water level	Each diversion weir (Figure 9.21)	Continuous (15 min)		Operator	
		Current meter flow measurement	Each diversion weir (Figure 9.21)	Sufficient frequency to establish and maintain reliable stage-discharge relationship for river location	ISO 748	Operator	
		Suspended sediment	Each diversion weir (Figure 9.21)	Weekly during summer low flow period	ISO 4363	Operator	
Dam construction	Construction	Water level	Each dam / reservoir (Figure 9.18)	Continuous (15 min)		Operator	
		Current meter flow measurement	Each dam/reservoir (Figure 9.23)	Sufficient frequency to establish and maintain reliable stage-discharge relationship for river location	ISO 748	Operator	
		Suspended sediment	Each dam/reservoir (Figure 9.18)	Weekly during summer low flow period	ISO 4363	Operator	
HPP outfall construction	Construction	Water level	Each HPP outfall (Figure 9.23)	Continuous (15 min)		Operator	
		Current meter flow measurement	Each HPP outfall (Figure 9.23)	Sufficient frequency to establish and maintain reliable stage-discharge relationship for river location	ISO 748	Operator	
		Suspended sediment	Each HPP outfall (Figure 9.23)	Weekly during summer low flow period	ISO 4363	Operator	

Activity	Project Stages	Parameters	Locations	Frequency	Standards	Implementing Responsibility	Supervision/ Reporting
Operating diversion weirs	Operation	Water level	Each diversion weir (Figure 9.22)	Continuous (15 min)		Operator	
		Current meter flow measurement	Each diversion weir (Figure 9.22)	Sufficient frequency to establish and maintain reliable stage-discharge relationship for river location	ISO 748	Operator	
Operating reservoir and control structures	Operation	Water level	Each dam/reservoir (Figure 9.20)	Continuous (15 min)		Operator	
		Current meter flow measurement	Each dam/reservoir (Figure 9.20)	Sufficient frequency to establish and maintain reliable stage-discharge relationship for river location	ISO 748	Operator	
		Suspended sediment and bed load	Each dam/reservoir (Figure 9.20)	Sediment monthly, bed load annually during low flow period	ISO 4363	Operator	
		Reservoir bathymetry	Each dam/reservoir	Bathymetric survey annually		Operator	
Operating HPP outfall	Operation	Water level	Each HPP outfall (Figure 9.24)	Continuous (15 min)		Operator	
		Current meter flow measurement	Each HPP outfall (Figure 9.24)	Sufficient frequency to establish and maintain reliable stage-discharge relationship for river location	ISO 748	Operator	
		Suspended sediment and bed load	Each HPP outfall (Figure 9.24)	Sediment monthly, bed load annually during low flow period	ISO 4363	Operator	

9.7 Statement of Significance and Compliance

9.7.1 Significance

The Project has several components: construction and operation of four new dams and seven weirs on the River Adjaristsqali and its tributaries; construction and operation of transfer tunnels and three hydropower stations, and construction of temporary and permanent access roads to support construction, maintenance and operational activities connected with main infrastructure works.

Overall, the proposed Project would have adverse construction impacts on water features. There might potentially be some localised minor adverse impacts on river reaches or springs but with appropriate mitigation the construction impacts upon water features are not considered to be significant.

Overall, the proposed Project would have significant adverse impacts on water features during operation if no environmental flow rules are applied and no provision made for flushing sediment through the system of reservoirs. The most significant impacts will be localised immediately below each key structure and are offset by spilling when reservoir or diversion capacity is exceeded – the latter variable from year to year. Some small scale irrigation or fish farm operations could be affected but because of their small scale the impacts can be mitigated effectively by either financial compensation or provision of an alternative water supply. However, all of the above have been addressed thorugh mitigation measures proposed, and Phase II assessment will further review the environmental flow regime proposed to address any significant impacts on water features and associated impacts on river habitats (see chapter 8 and 10)

9.7.2 International Compliance

In accordance with the requirements of lending institutions, where adverse impacts have been identified the following table specifies actions which the Project must undertake in order to demonstrate compliance.

9.7.2.1 IFC

Table 9.32: IFC Requirements and Project Compliance

Performance Standards	How Project Compliance will be Achieved
IFC Performance Standard 1 - Assessment and Management of Social and Environmental Risks and Impacts	This ESIA and the ESMMP meet the requirements for identification and mitigation of impacts set out in IFC PS1. Consultation is to be guided, monitored, recorded and reported according to SEP (available from the Project website – www.adjaristqali.com). Benefit sharing: ▪ Community investment programme ▪ Provision of training and jobs for local people
IFC Performance Standard 3 – Pollution Prevention and Abatement	The ESMP sets out mitigation measures to ensure that waters are not polluted during construction of dams, tunnels and access roads.
IFC Performance Standard 4 – Community Health, Safety and Security	The Phase I environmental flow regime developed in this ESIA and set out in the ESMMP provides for the maintenance of sufficient flow in the Adjaristsqali River and its tributaries to meet requirements for existing water users (community supply and quality concerns). The ESMP sets out mitigation measures to ensure existing water use is not adversely impacted during construction of tunnels and access roads.
IFC Performance Standard 6 - Biodiversity, Conservation and Sustainable Natural Resource Management	The two phase approach to the establishment of an environmental flow regime developed in this ESIA provides a mechanism for initial identification of areas of significant impacts and further review and

Performance Standards	How Project Compliance will be Achieved
	refinement of mitigation meaures on most affected reaches based on more long term survey results. At this stage this target flow regime is not fully defined but AGL have committed to the process of setting this regime prior to the start of operations and will consult relevant authorities and NGOs in Georgia as part of finalising the flow regime. The ESMP sets out mitigation measures to ensure that waters are not polluted during construction of tunnels and access roads.
IFC EHS General Guidelines (2007) IFC EHS Guidelines for Electric Power Transmission and Distribution (April 2007).	The ESMP sets out mitigation measure (construction best practice) s to ensure that waters are not polluted during construction of hydraulic structures, tunnels, access roads and camps.
World Commission on Dams checklist	The environmental flow has been established based on provision of 10% of the annual average as a guaranteed flow. As part of the mitigation a Phase II assessment of this flow will be undertaken based on additional monitoring prior to construction and during construction phase to better establish any adjustments to flow regime or enhancement measures within critically impacted reaches. The environmental flow regime developed in this ESIA and set out in the ESMP provides for the maintenance of sufficient flow in the Adjaristsqali River and its tributaries to meet requirements for existing water users. The ESMP sets out mitigation measures to ensure existing water use is not adversely impacted during construction of tunnels and access roads.

10. Environmental Flows

10.1 Introduction

10.1.1 Overview

The ecological integrity of river ecosystems depends on their natural dynamic character (Poff *et al.*, 1997). Man-made alterations in rivers have consequences in river structure and flow regime that inevitably effect river communities and overall catchment ecosystems. In particular, impounding structures such as those proposed on the Adjaristsqali River and its tributaries, alter the flow immediately downstream which then become dependent entirely on dam or weir releases (referred to from here on as environmental flows) and only spills when the reservoir is full.

This chapter provides an outline of the two phased approach adopted as part of this ESIA to assess the most appropriate environmental flows along the length of the affected river reaches:

- Phase I – As part of the feasibility design phase and ESIA development, an initial catchment level approach considering a minimum environmental flow release 10% of annual average flows was used to identify and compare key impacts of each of the projects.
- Phase II – Phase I constituted the first step in setting environmental flows for the Adjaristsqali River and its tributaries. The impact assessment has identified that a number of impacts are of either major or moderate significance for certain river reaches affected by the project and as such the use of a constant release (in this case 10% of the average annual flow) , presents a number of limitations. During Phase II a review of the environmental flows will be carried out adopting data obtained from detailed site specific habitat mapping and long term survey/monitoring of those reaches predicted during Phase I to be significantly impacted by the project and targeting identification of mitigation measures specific to requirements in each affected reach. Mitigation measures available include habitat enhancement, alteration of flow regime, and or combination of these measures as well as potential for offsetting where relevant, which can be collectively termed adaptive management approaches. The first stage of this habitat mapping was completed in August 2012.

Chapter 8 has undertaken an assessment of the impacts on aquatic biodiversity and identified potential impacts as a result of the project as well as identifying potential magnitude of impacts. Chapter 9 has reviewed the impacts associated with reduced flows from a water resource user's perspective as well as impacts on river flow regime functions. As part of Phase I the Building Block Methodology (BBM) as described by Tharme and King (2008) was used to ensure that all water users were identified within the assessment, which took into consideration needs for irrigation, fish farms, recreational activities, sanitary dilution, and river functions. However, Phase II will aim to undertake stakeholder engagement activities specifically focused to describe in greater detail requirements and objectives of water resource users and identify priorities to be considered within the adaptive management programme to be described.

This chapter provides a description of the methodology proposed for Phase II which will aim to review the assumption made during Phase I and, using sufficient long-term and site specific analysis, will elaborate an adaptive management plan for release of environmental flows throughout the projects operational lifetime. Phase II will:

- Identify the limitations of a constant release of 10% of the annual flow average (long term) as proposed in Phase I;
- Propose measures to avoid/mitigate and/or offset impacts identified in Chapter 8 and 9 of this ESIA, including;

- Confirm whether existing flows are sufficient for the small number of identified small scale irrigation off takes affected by the scheme ;
- Review environmental flows and/or habitat enhancement measures to mitigate major impacts on fisheries and other aquatic species in identified reaches
- Propose and develop offsetting measures if required as result of additional information and ability of mitigation and enhancement measures to achieve 'no net loss' for important habitats;
- Obtain long term site specific data and commence monitoring to allow for development and implementation of an adaptive management system.

While during Phase I the project was considered as a whole and environmental flows set at a higher spatial scale, during Phase II the objective will be to assess flows at meso and micro-scales, looking at specific reaches of each affected river on an individual basis. Phase II will confirm a flow release (environmental flow) that will protect the fish communities present in the Adjara Rivers taking into account key fish species life cycle and environmental requirements, as well as taking in consideration other users needs.

10.1.2 Determining Environmental Flows

There is no agreed definition of environmental flows that is consistently used amongst the scientific community. The following definition has been adopted in the IUCN (International Union for Conservation of Nature) publication '*Environmental Flows' The Essentials*':

> *'An 'environmental flow' is the provision of water within rivers and groundwater systems to maintain downstream ecosystems and their benefits, where the river or groundwater system is subject to competing water uses and flow regulation. Since regulation of flow can occur through direct infrastructure (like on-stream dams) as well as through diversions of water from the system (for example by pumping water away), there are different ways in which environmental flows can be provided.'*

(Dyson *et al*., 2003)

Due to the increasing concern about the impacts from dams and flow regulation on rivers, more than 200 different methods have been developed and used by the scientific community to establish environmental flows. Poff *et al*. (2010) and Tharme (2003) provide a detailed description of different methods used in the past decades. A summary is provided in Section 10.2 of this ESIA. Over the past decades scientists have developed a solid conceptual understanding of the importance of natural flows for river ecosystem Therefore, setting environmental flows is a key element of integrated water resources management.

Many factors contribute to the ecological status of a river ecosystem including the following (Acreman and Dunbar, 2004):

- Discharge (flow);
- Physical structure of the channel and riparian zone;
- Water quality;
- Channel management;
- Level of exploitation (fishing); and
- Presence of physical barriers.

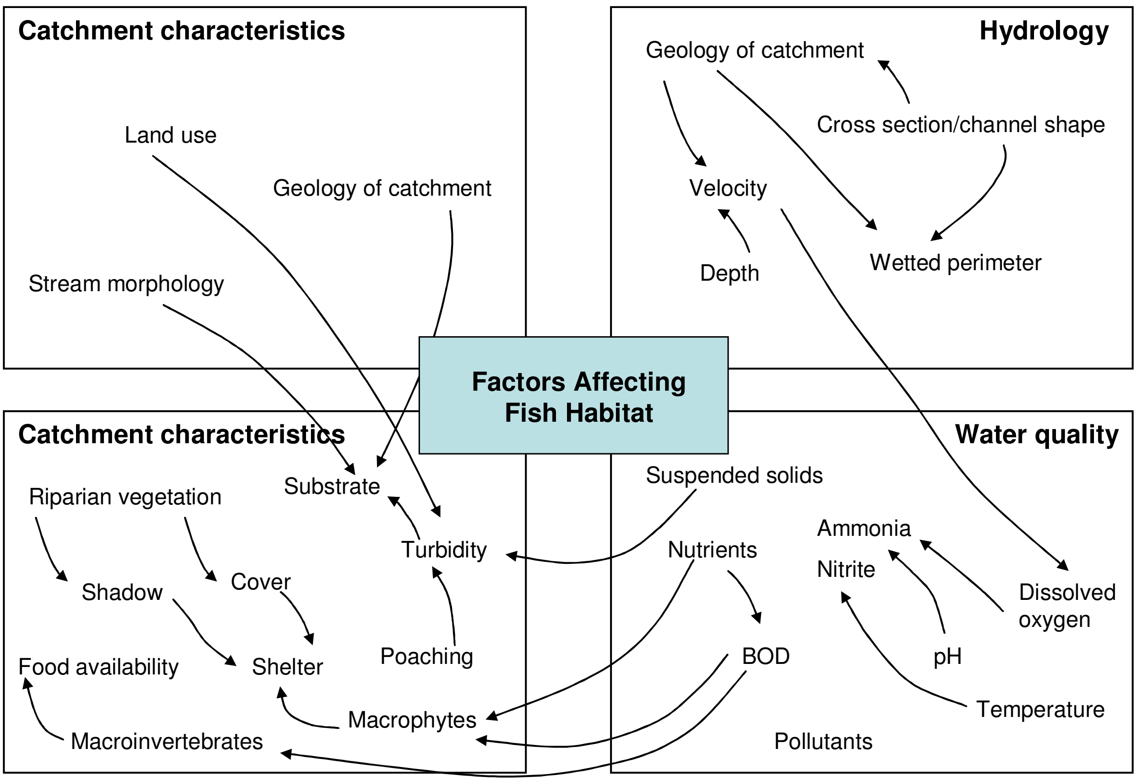
The flow regime is one of the overriding determinants of a river ecosystem, reflecting its geographical location and the geological and topographic features of the area (Tharme and King, 2008). It varies geographically in response to climate (precipitation and temperature) and catchment controls and run-off (topography, geology, land cover, position in network (Poff *et al*., 2010)).

Although flow is a key factor in determining the habitat structure in rivers other factors play important roles. As an example of the complex inter-relationship between fish habitat, and chemical and physical factors, a summary of relationship between these factors is presented in Figure 10.1.

Because of the complexities, and although there has been great advance in producing methods to determine environmental flows, there is still an inadequate understanding of the relationships between flow and fish community dynamics and recognition that different rivers and even different reaches of the same river behave differently (Cowx *et al*., 2010).

Environmental flows can be set at different levels of resolution, from single annual flow volume or a minimum flow limit below which diversions are not permitted, through to a comprehensive flow regime which specifies the distribution of a range of flows throughout the year (Gordon *et al*., 2004).

Figure 10.1: Factors Affecting Fish Habitat



The spatial scale of environmental flows assessment also varies widely from whole catchment to river reach. In addition, the ability of the scheme to make different releases should be taken into account when establishing environmental flows. This may be limited due to the design of the project especially for the release of high flows or frequently varying flow releases.

The key principles when setting up environmental flows from impoundments are listed below.

Table 10.1: Principles for environmental flows from impoundments

Principles of environmental flows from impoundments	
Hydrology	■ Mimic natural flow variability that would exist (except on a smaller scale) and release flows to coincide with natural flow events. However, this must take into account he functionality of each flow event from an ecological perspective and not done just as a proportion of the natural flows. ■ Allow year to year variation in flows such that the regime is optimum in different years ■ Flow releases should maintain natural connectivity between river and floodplain ecosystems ■ Natural low flow regime should be maintained for proportion of time to protect from invasive species and prevent fry washout ■ Elevated flows at times of natural low flows can be ecologically damaging ■ Release floods to maintain channel geomorphology ■ Recognise that overall there will be less total volume of water released from an impoundment than would occur downstream under natural conditions, such that releases need to be optimised for where it is most beneficial ■ Other impacts, such as land use, may mean that the un-impounded flow regime is not necessarily natural
Biology	■ Flow releases regimes should be based on ecological requirements of different communities/species/life stages ■ Habitat modifications may be needed to work with flow release regime
Infrastructure	■ Where possible build environmental flows around current release pattern procedures, such as floods, freshets and compensation flows ■ Draw-off structures may be required at different levels to achieve good water quality releases
Monitoring	■ Monitor release regimes and river ecosystem response and employ adaptive management
Water quality and sediment	■ Temperature is as important as flow and should match reference conditions ■ Water from different levels within the reservoir can be different in temperature, pH and nutrient level.

10.1.3 The Need for Environmental Flows in the Adjara Rivers – Phase I

The base case of the Project design has assumed that a minimum environmental flow would be required for any project. Phase I of the assessment has assumed 10% of annual average flow to be the base case for assessing the project at catchments scale as has been established as minimum environmental flow for other hydropower projects in Georgia. This was based on the previously established 'need' for downstream water use (environmental and human) and the historical use in Georgia of setting environmental flows at 10% of the annual average.

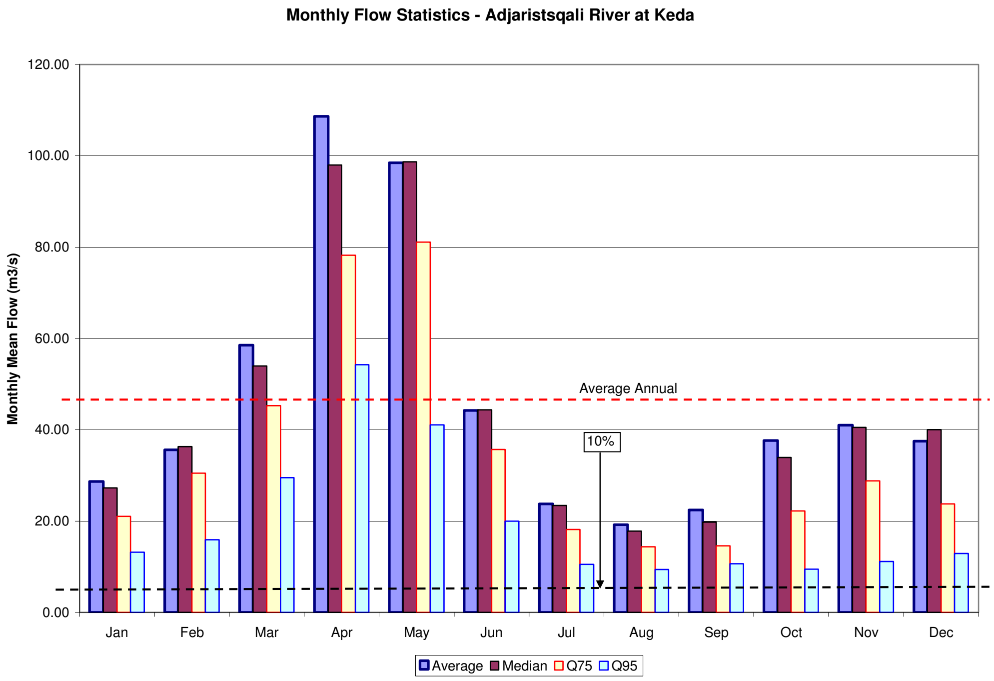
The basic Tennant Method (Tennant, 1976 in Tharme and King, 2008) or modifications, is also used routinely in many other countries, often as the primary, basin wide scoping level of a two-tier system of environmental flow assessment (Tharme and King, 2008). This approach is similar to that adopted in assessing environmental flows for the Adjaristsqali Rivers and its tributaries as part of Phase I.

This method addresses environmental flows for fish, wildlife, recreation and related environmental resources. Percentages of the mean annual flow, where various percentages of this value (corresponding to defined categories of environmental flow conditions), are used to formulate river base flow regimes to satisfy environmental flow needs. For example, 10% of the mean annual flow represents the minimum instantaneous flow recommended to sustain short-term survival habitat for most aquatic biota (Tharme and King, 2008).

In the Adjara rivers this value (10%) has been assumed during Phase I to be applied at all times and would only be exceeded at times when the weirs/dams overflow due to the intake capacity of the scheme being exceeded by flows in the river.

As an example, 10% of the annual flow for the Adjaristsqali River at Keda compared to monthly flow statistics is provided in Figure 10.2.

Figure 10.2: Monthly Flow Statistics in the Adjaristsqali at Keda



Because the intake capacity of the weir at this site is sometimes exceeded due to river flows, the constant environmental release of 10% of annual average flow is supplemented during some periods of the year due to spilling of excess water over the weir. In Chapter 8 (Biodiversity) of this ESIA a detailed analysis of the changes in the flow regime pre and post scheme have been described. In addition depending on the affected river several tributaries contribute to flows thereby reducing the impact on the affected river. This adds flows as well as increases seasonal and interannual variability.

The Phase I proposed flow (10% of the annual average) is comparable to flows present in the river during summer months in a dry year. Having a flow of this magnitude maintained all year and in fact for consecutive years would impose a significant change to the environmental conditions and consequently have a major adverse impact on the ecological receptors.

Setting the environmental flow as a proportion of the natural flow and applying it throughout the year has some limitations as it removes the hydrological variability and fails to maintain much of the natural variability in the flow regime which perform important functions in rivers. However, as stated previously, most of the proposed dams will spill at certain times of the year and their operational regime includes for periods of flushing during high flows to maintain sediment transport downstream. Consequently the 10% rule used as part of Phase I assessment is not an actual constant minimum release, as it will be supplemented by the natural regime resulting in some variability in flows throughout the year.

The expected adverse impacts from adopting a 10% minimum environmental flow could include:

- Impacts due to alteration of flow patterns
  - Reduction of habitat due to change in area, frequency and duration of flooding of floodplains and terminal wetlands
  - Riparian zone degradation through altered flow patterns
  - Increased habitat for invasive species
  - Loss or disruption of ecological function
- Increased dry-spell duration
  - Loss of suitable habitat due to decline of water level and wetted perimeter; reduction of habitat diversity with reduction of riffle habitat, pool areas;
  - Loss of connectivity between viable habitat patches
  - Reduced water quality (changes in dissolved oxygen and temperature)
  - Reduced diversity and biomass of fish and macro-invertebrates
- Reduction of small floods/high flow pulses
  - Less frequency of substrate-disturbing flow events leading to reduced benthic invertebrate species richness as fine sediments accumulate, blocking substratum interstitial spaces
  - Changes in channel geomorphology
  - Limited floodplain inundation leading to reduced invertebrate and fish biomass due to loss of flooded habitat and food resources supporting growth and recruitment
  - Decrease in inter annual variation in flood frequency leading to a decline in overall fish species richness and riparian vegetation species richness as habitat diversity is reduced
  - Potential encroachment of terrestrial vegetation and invasive species to the bed of the river.

Despite some additional inter-annual variability as a result of dams spilling in high flows, the assessment of 10% minimum environmental release has identified some significant impacts on aquatic biodiversity. Consequently during Phase II additional mitigation measures including review of the environmental flow regime will be undertaken at key sensitive reaches of the river identifying flow needs and enhancement measures that will reduce impacts significantly.

10.2 Phase II Assessment

10.2.1 Introduction / Background

Phase II is focused on defining any potential changes that can affect each biodiversity aspect in significantly impacted reaches. Through stakeholder engagement and understanding of priorities, Phase II aims also to establish a long term monitoring campaign to support an adaptive management programme for the project.

10.2.2 The Building Block Method

Phase II will continue to use the BBM approach partially adopted in Phase I but most importantly supplemented by additional long term data gathering to further define the assumptions made in Phase I. Key activities in Phase II will be to undertaken meso-habitat mapping as well as additional fish surveys to gain a better understanding of local requirements.

The BBM approach has been found to be the most appropriate approach as it is not constrained by analytical tools and builds on stakeholder engagement as well as inputs from different methods. In addition, it is a holistic approach which attempts to consider the entire ecosystem making use of all relevant information, as well as the hydrological and habitat rating methods which usually focus on key species. Therefore as more data is obtained through long term monitoring and uncertainties reduced these can be incorporated into the overall approach. A key aspect of the BBM methodology is that it should cover all ecological and physical processes in the river as well as other users such as for irrigation purposes, which are relevant for the Adjara Rivers.

The basic premise of the BBM approach is that riverine communities and species are reliant on basic elements (building blocks) of the flow. According to Tharme and King (2008) the underlying assumptions of the BBM are:

- There is spare water in the river;
- Rivers will recover from most perturbations;
- The natural disturbance regime of rivers is important for the maintenance of their biodiversity; and
- The maintenance of habitat will ensure the persistence of species.

A fundamental principle of this method is to maintain the natural variability of flows (Acreman and Dunbar, 2004). All elements of the flow regime may have a role in structuring a river ecosystem, including high flows, average, and low flows as all have a direct influence upon fish, macroinvertebrates and macropyte communities as well as riparian and associated terrestrial ecosystems (Acreman *et al.* 2009).

However, it is also important to recognise when managing flows, that some flows within the total flow regime of a river are more important than others for its maintenance (Cowx *et al.* 2010). These flows can be identified and described in terms of their timing, duration, frequency and magnitude. To identify these flows the key ecological objectives to be supported by the flow recommendations need to be identified. A summary is presented in Table 10.2.

Table 10.2: Ecological functions performed by different river flow levels

Flow Component	Ecological roles
Low (base) flows	Normal level • Provide adequate habitat space for aquatic organisms • Maintain suitable water temperatures, dissolved oxygen and water chemistry • Maintain water levels in flood plains • Keep fish and amphibians eggs suspended • Enable fish to move to feeding and spawning areas • Support hyportheic organisms (living in saturated sediments) • Eliminate invasive species from aquatic and riparian communities
High pulse flows	• Shape physical character of river channel including pools riffles • Determine the size of stream bed substrate (sand, gravel, cobble) • Prevent riparian vegetation from encroaching into channel • Restore normal water quality conditions after prolonged low flow, flushing away waste

Flow Component	Ecological roles
	products and pollutants • Aerate eggs in spawning gravels, prevent siltation • Maintain suitable salinity conditions in estuaries.
Floods	• Provide migration and spawning cues for fish • Trigger new phase life cycle (insects) • Enable fish to spawn on floodplain, provide nursery area for juvenile fish • Provide new feeding opportunities for fish, waterfowl • Recharge floodplain water level • Control distribution and abundance of plants on floodplain • Deposit nutrients on floodplain • Shape physical habitat sin floodplain • Deposit gravel and cobbles in spawning areas • Flush organic materials(food)and woody debris (habitat structures) into channel • Eliminate invasive species from aquatic and riparian communities

Source: Ritcher et al., 2006.

Based on this information the elements of the natural flow regime that are important to the river ecosystem downstream can be identified as:

- High flows;
- Freshets (the flood of a river from heavy rain or melted snow);
- Medium flows; and
- Low flows.

The selected elements for the project need to be specified in terms of their magnitude, duration, timing and frequency and then combined to define an ecological flow release. This should be achieved from the knowledge of the species that are present (or should be present) and their flow and associated habitat requirement in terms of, for example, temperature, sediment concentrations, and oxygen levels. Upstream impacts should also be assessed. For this purpose the use of a meso-habitat method is recommended. Details on the required data collection and data analysis in Phase II are provided in Section 10.3.

This method will also aim to collect information that will inform the decision on habitat enhancement measures that will provide for key sensitive habitats and minimise impacts through habitat improvement. These measures can, depending on circumstances, allow for long-term low flows to be maintained with limited significant impacts.

As far as possible the environmental flow requirement (downstream of an impoundment) should be based on ecological requirements of different communities/species/life stages, which can vary within and between rivers and geographic regions (Acreman, *et al*. 2009). At this stage specific information on key species (such as the Colchic barbell and Black sea salmon) are unknown in the international literature; however further investigation will be undertaken as part of Phase II to better define these requirements or identify species close enough to these species in terms of ecology to explore if they could be used as surrogates for the Adjara species.

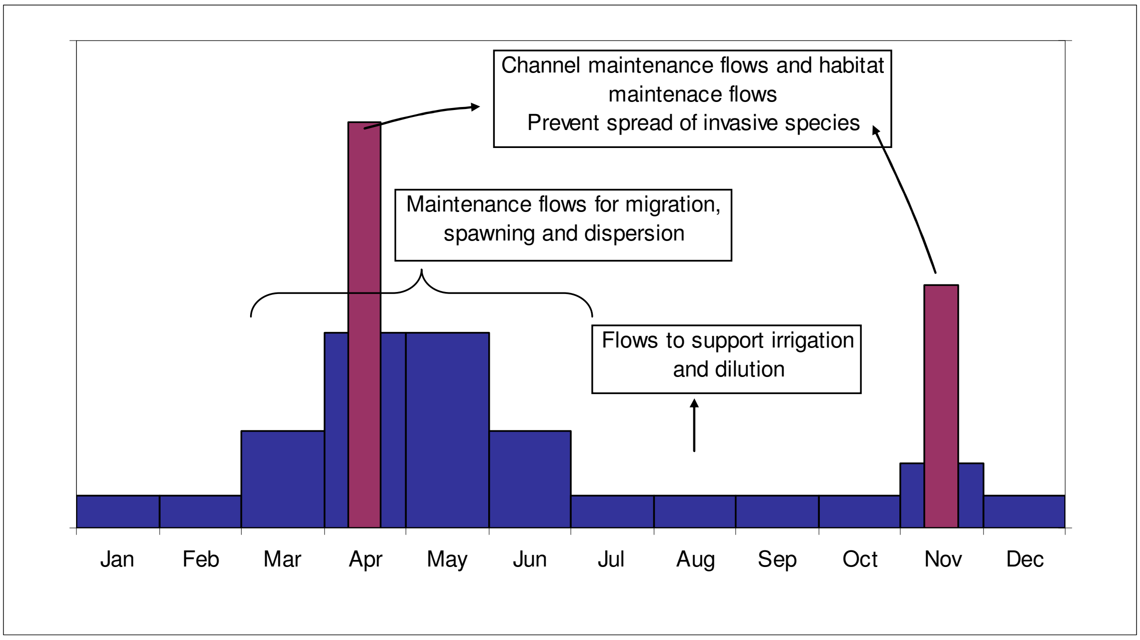
As suggested by Acreman (2007) a BBM check list will be used to ensure all features of flows are protected by any amendments proposed to the flow regime as part of Phase II assessment.

Table 10.3: Building Block Check list

Building Block	Purpose
Low Flows	Habitat for juveniles and prevention of invasive species
Maintenance flows	Stimulate species migration, spawning and dispersal
Freshets	Stimulate species migration, spawning and dispersal
Small floods	Sort river sediments, connect river and floodplain habitats
Large floods	Remove un-desired species, maintain channel structure and evolution

Figure 10.3 shows an example of a potential environmental flow pattern.

Figure 10.3: Flow regime and functions in the Adjaristsqali catchment



Data on irrigation and fish farms is already available for the project and is considered to be sufficient to assess the needs for these users. Impacts were addressed in Chapter 9 and found to be of minor significance with readily available mitigation measures available.

10.3 Phase II Methodology Approach

10.3.1.1 Meso-habitat Method

Phase II will undertake a meso-habitat classification of all significantly impacted reaches as well as representative "control" sites to enable review of the environmental flows for the Adjara Rivers. This method builds up on the widely applied riffle-run-pool-methods, but provides more detail, yet can be rapid in application, flexible and objective than previous approaches (Borsányi *et al.*, 2004).

The method classifies the river sections into a maximum of physical meso-scale morphological (meso-habitat) classes by visual observation. This method, which has been used in Norway, Albania and in the Rhône River, showed that it is possible to apply the method to a large river. For comparison and simplicity the same categories were applied with success in different types of rivers (Hardby *et al.* 2007).These results give confidence that this method could also be applied successfully in the Adjara Rivers.

The describing factors of meso-habitat classes are water depth, surface pattern, surface gradient and surface velocity and by combining this information ten different classes are obtained (impossible combinations are neglected). Table 10.4 provides the decision process followed on site to classify sections of the river.

Within each meso-habitat class the local velocity and depth may show a high variability, even though the meso-habitat class is supposed to be defined as a homogeneous object. To evaluate the local variability random measures of velocity and depth must be taken in different meso-habitats. Meso-habitat surveys should be taken at both high and low flow conditions.

By comparing the results at different flows, e.g. under low and high flow conditions, changes in the different meso-habitat classes can be identified. This way it will possible to track changes in habitat diversity, under different flow conditions, identifying potential loss of important areas for fish such as spawning, feeding or refuge for example. The data collected will also be relevant as it will constitute the basis for a long term monitoring campaign (three years).

Table 10.4: Mesohabitat Classification Method

Criteria	surface pattern	surface gradient	surface velocity	water depth	Code
Decision tree	smooth / rippled	steep	fast	deep	A
				shallow	
			slow	*deep / shallow*	
		moderate	fast	deep	B1
				shallow	B2
			slow	deep	C
				shallow	D
	broken / unbroken standing waves	steep	fast	deep	E
				shallow	F
			slow	*deep / shallow*	
		moderate	fast	deep	G1
				shallow	G2
			slow	deep	
				shallow	H

Borsányi *et al.*, 2004

This method proved to be useful in previous studies to describe habitat availability for invertebrate and fish communities at two contrasting discharges (or in other situations at low and high flows) as well as being an efficient method to describe habitat characteristics and to relate these characteristics to the ecological preferences of invertebrates and fish (Hardby *et al.* 2007). So that fish preferences to the different meso-habitat classes can be made with confidence fish surveys will be conducted at the same time of meso-habitat surveys. There are several reasons to do this:

- Different fish preference may occur in different geographic regions, even within the Adajara Rivers, and therefore there is a risk in transposing fish preferences from other locations;
- Within the same species different size classes can also present different preferences; and
- Fish surveys in 2011 were successful in identifying the fish community composition and potential spawning habitats but specific information on habitat use by different species at different life cycle stages in different meso-habitats is key to linking meso-habitat characteristics and ecological preferences of fish, which will allow for long term monitoring and evaluation of impacts of mitigation measures developed during Phase II assessment.

In addition landscape metrics as well as cross section analysis will be carried out at different meso-habitats to accurately characterize each meso-habitat and verify the classification criteria (as presented in Table 10.4) for Adjara Rivers.

10.3.2 Habitat Enhancement

One of the applications of this method is to inform river restoration or enhancement projects. This method should highlight key sections of the river at most danger from being damaged/lost due to implementation of the scheme. The results should inform where enhancement measures can be carried out to provide extra suitable habitats for key species and compensate for the loss of these habitats elsewhere in the river. In some cases it may be possible to overcome/avoid loss of particular habitats by undertaking enhancement measures. These could include:

- creation of hydraulic gradients to introduce variability is sections of the river by generating riffle/glide/pool sequences and improve the river carrying capacity;
- Use of boulders to create deflectors, side bars to add variability in the river and create resting places and pools. This is particularly important for salmonids as stable resting habitats for adults which must hold and ripen in streams prior to spawning; and
- Addition of appropriate substrate in certain section to provide additional spawning areas for key species;

These are general examples, any suggested measure will have to provide a specific function that is relevant to key species in particular section of the affected rivers. It is important to note that during the construction phase of the scheme a lot of material will be generated that could be used to provide for these measures.

10.3.3 Stakeholder Engagement

As part of Phase II, consultation and engagement with local stakeholders as well as conservation groups interested in improving and understanding applications for defining environmental flow regimes will be consulted with, the aim being to engage with relevant stakeholders to define the full scope and detail of Phase II assessment and to identify key priorities for conservation and resource use. Water resource users (irrigation and fish farming) within the project area have already been identified and are largely unaffected by the project, however the river resources are used recreationally for fishing and thus will have an interest in identifying their conservation priorities.

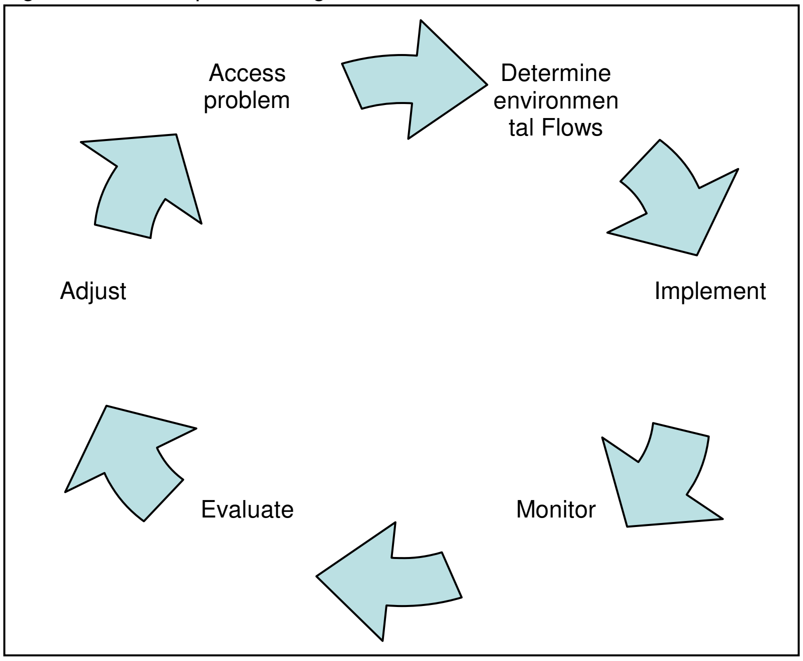
10.3.4 Adaptive Management Programme

Adaptive management is a structured, iterative process which aims to reduce uncertainty over time through monitoring. Adaptive management of environmental flows means that a monitoring programme is put in place to evaluate impacts on ecological communities and establish if the environmental flows are effective.

Where impacts are found to be significantly adverse additional mitigation measures including potential for revised flow regime may be required and the river system monitored further. The results of the Phase II assessment and monitoring will allow the scheme to define an adaptive management process as illustrated in Figure 10.4.

This is in agreement with the principles of the BBM which has a strong emphasis on operational monitoring although it does not define specific methods for doing this.

Figure 10.4: Adaptive Management



To support an adaptive management system a monitoring programme will be initiated once the scheme is in operation. By doing this the ecological effects of implementing the proposed environmental flows can be evaluated adequately.

Ecological indicators will be monitored to assess the ecological status of the Adjara Rivers and determine as much as possible biotic responses to flows. The operational monitoring programme will build upon the work undertaken as part of the Phase II assessment and provide an ideal basis for long-term comparison of effects pre and post scheme and effectiveness of mitigation measures adopted.

A key issue in the design of the monitoring programme to track the response of the ecological communities to changes in the flow regime will be to identify ecosystem indicators that are sufficiently representative of the health of the river ecosystem (Ritcher *et al.*, 2006). It is proposed that fish and macroinvertebrate communities will be the key indicator groups for this scheme.

Fish communities are particularly sensitive to impoundments schemes. In this case the relevance of fish as a key indicator rises given that data on fish populations are virtually the only ecological data available and therefore can be used as a benchmark against future data.

Macroinvertebrate communities are good indicators of the ecological sates of rivers and widely used of aquatic ecosystem condition as they are:

- A very important part of food chains in aquatic ecosystems;
- Relatively easy to study; and
- Their life span (a few months to several years) and the lack of mobility means that changes in communities can sensitively indicate impacts.

Furthermore these are well studied organisms and information on organisms preferred habitats and requirements, including flows, are known and can be used to interpret habitat quality and degree of deviation from natural conditions.

The monitoring programme will include:

- Annual fish surveys carried out at key locations upstream and downstream the proposed weirs and dams;
- Continue to collect fish data through interviews with fisherman;
- Macroinvertebrate surveys carried out twice a year (spring and autumn) at the same locations; and
- Meso-habitat surveys - the repetition of meso-habitat surveys during operation will allow to identify were/if key units of the river were actually maintained once the scheme is in operation. This will also enable to verify if the areas where habitat enhancement measures were carried out are being effective in provided suitable habitat for fish.

Prior to the start of works a detailed monitoring programme will be put in place which will determine the exact locations (which will be in the most sensitive areas) and time of the year.

10.4 Phase II Programme

A monitoring programme to be implemented from May 2012 is presented in Table 10.5. The objectives of this programme are:

- Provide data for Phase II of assessing environmental flows;
- Collect data to inform decisions on enhancement measures to be implemented before/alongside construction phase as appropriate; and
- Provide baseline data for comparisons with data collected during operation. This data will be basis of the implementation of adaptive management process once the scheme is in operation. Sites to be monitored must include tributaries not affected by the scheme.

Table 10.5: Monitoring Programme

Monitoring Programme	
Pre-construction 2012- 2015 - Assessing environmental flows/ baseline information collection	
Meso-habitat surveys	June 2012 – September 2012 (repeated every year up to 2015)
Fish surveys	June 2012 – September 2012 (repeated every year up to 2015)
Macroinvertebrate surveys	May 2013
Enhancement measures	June 2013 decide on sections of river that will benefit from these measures
Stakeholder consultation	Initiated in 2012 extending up to the conclusion of setting environmental flows
Post-construction 2015	

Monitoring Programme	
Meso-habitat surveys	Year after construction, repeat every two years up to five years
Fish surveys	Year after construction, repeat every two years up to five years
Macroinvertebrate surveys	Spring and Autumn year after construction, repeat every two years up to five years

10.5 Preliminary Results

The habitat monitoring (meso-habitat surveys) of the Shuakhevi Scheme area was started in August 2012. During this month habitat data as well as physical data were collected in the following rivers:

- Adjaristsqali River;
- Chirukhistsqali River; and
- Skhalta River.

This first monitoring campaign was aimed at collating physical and flow data as well as meso-habitat mapping under low flow conditions. A second site visit is planned for March – April 2013 to carry out the same surveys but under higher flow conditions.

Due to access constrains, it was not possible to undertake habitat mapping at along the entire stretch of the rivers surveyed. Nevertheless the mapped area is sufficient to understand the meso-habitats that are most common in each of the rivers. Table 10.6 shows the preliminary results (no statistical analysis of the data has been carried out as only one of the two proposed habitat mapping campaigns has been conducted to data and information from both high and low flows is required to apply the method).

Table 10.6: Meso-habitat Surveys Preliminary Results

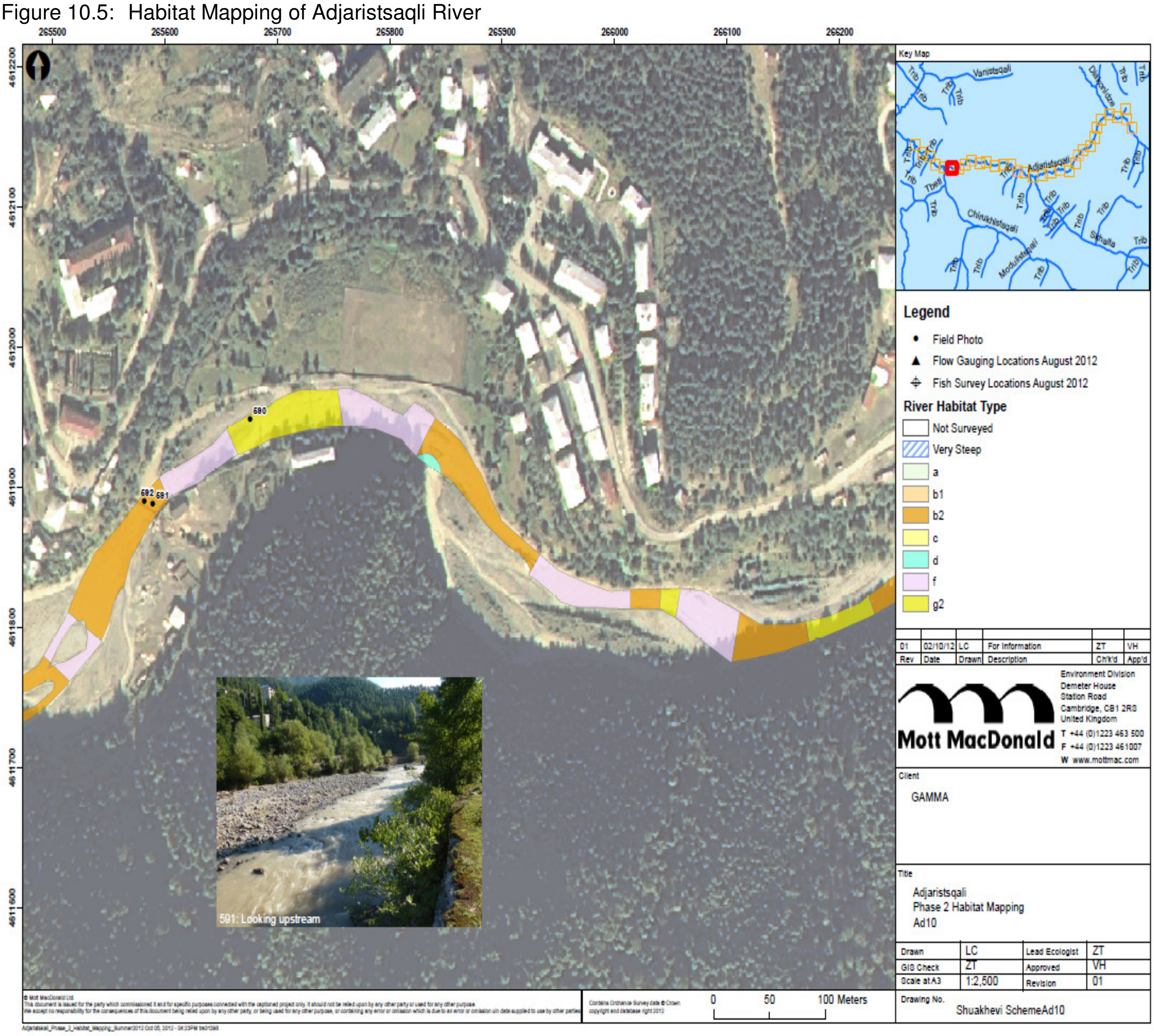
River Name	Mesohabitat Type	Length (m)	%
Adjaristsqali	A	54.873	0.22671
	B1	929.207	3.83906
	B2	3449.705	**14.25261**
	C	221.588	0.915501
	D	473.912	1.957988
	F	14094.899	**58.23369**
	G2	4979.843	**20.57444**
Total surveyed area		24204.027	95.63573
Not Surveyed		1104.533	4.364266
Total		25308.560	
Chirukhistsqali	B1	48.100	0.677603
	B2	163.680	2.305822
	D	247.965	3.493177
	F	5914.695	**83.32256**
	G2	724.112	**10.20084**
Total surveyed area		7098.552	38.41627
Not Surveyed		11379.431	61.58373
Total		18477.983	
Skhalta	B2	483.061	3.507608
	D	353.234	2.564907
	F	12804.735	**92.9779**

River Name	Mesohabitat Type	Length (m)	%
	G2	130.775	0.949585
Total surveyed area		13771.805	85.64258
Not Surveyed		2235.386	13.90117
Total		16080.559	

Results indicate that although different types of habitats were recorded in the three rivers the meso-habitat type F (broken/unbroken standing waves, steep, fats and shallow habitat) is the most representative.

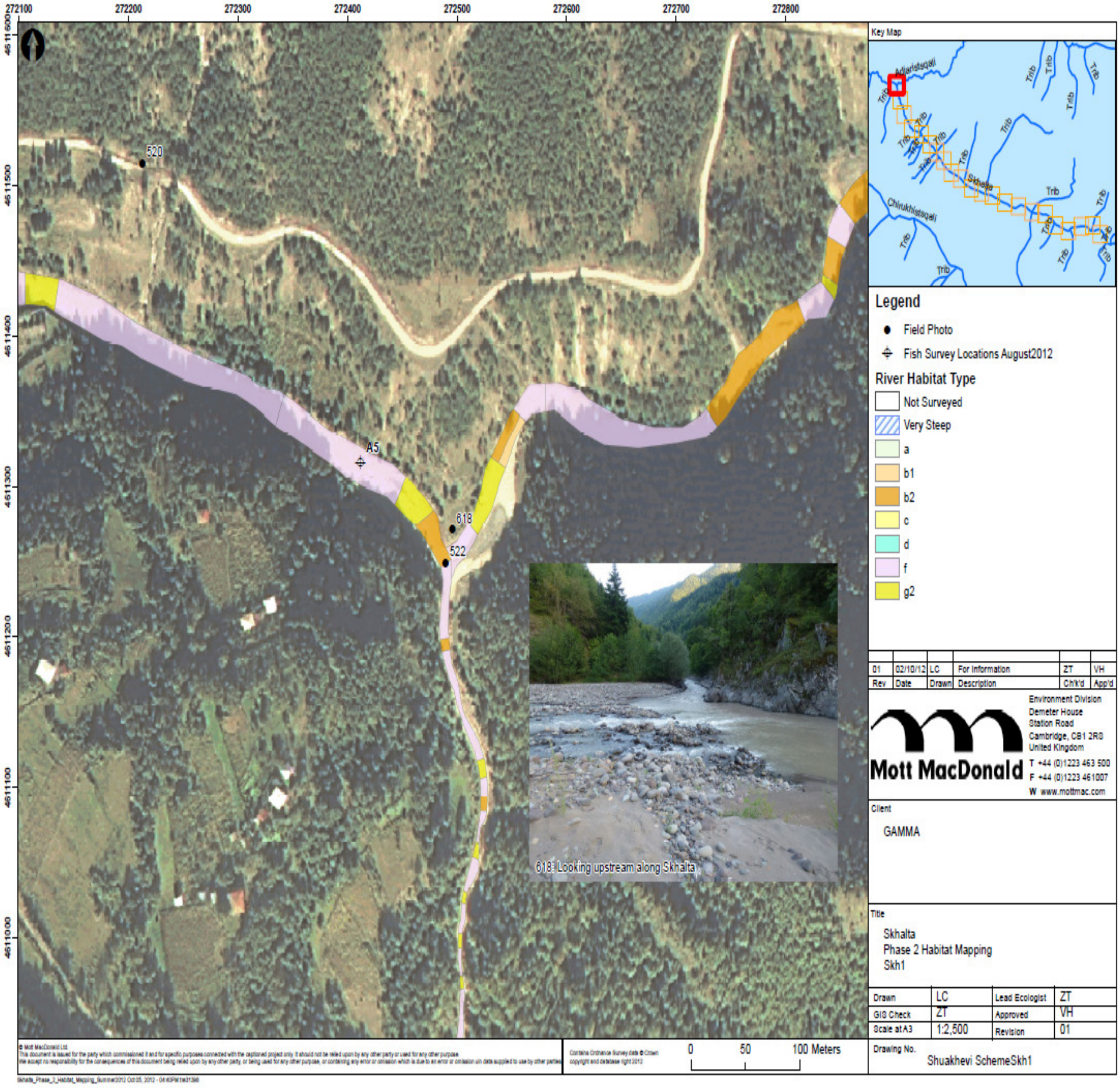
Figures 10.5 to 10.7 present examples of habitat mapping at different locations on the Adjaristsqali, Chirukhistsqali and Skhalta Rivers. Full results will be submitted once the surveys are completed, next year along with a full analysis of results.

Figure 10.5: Habitat Mapping of Adjaristsaqli River



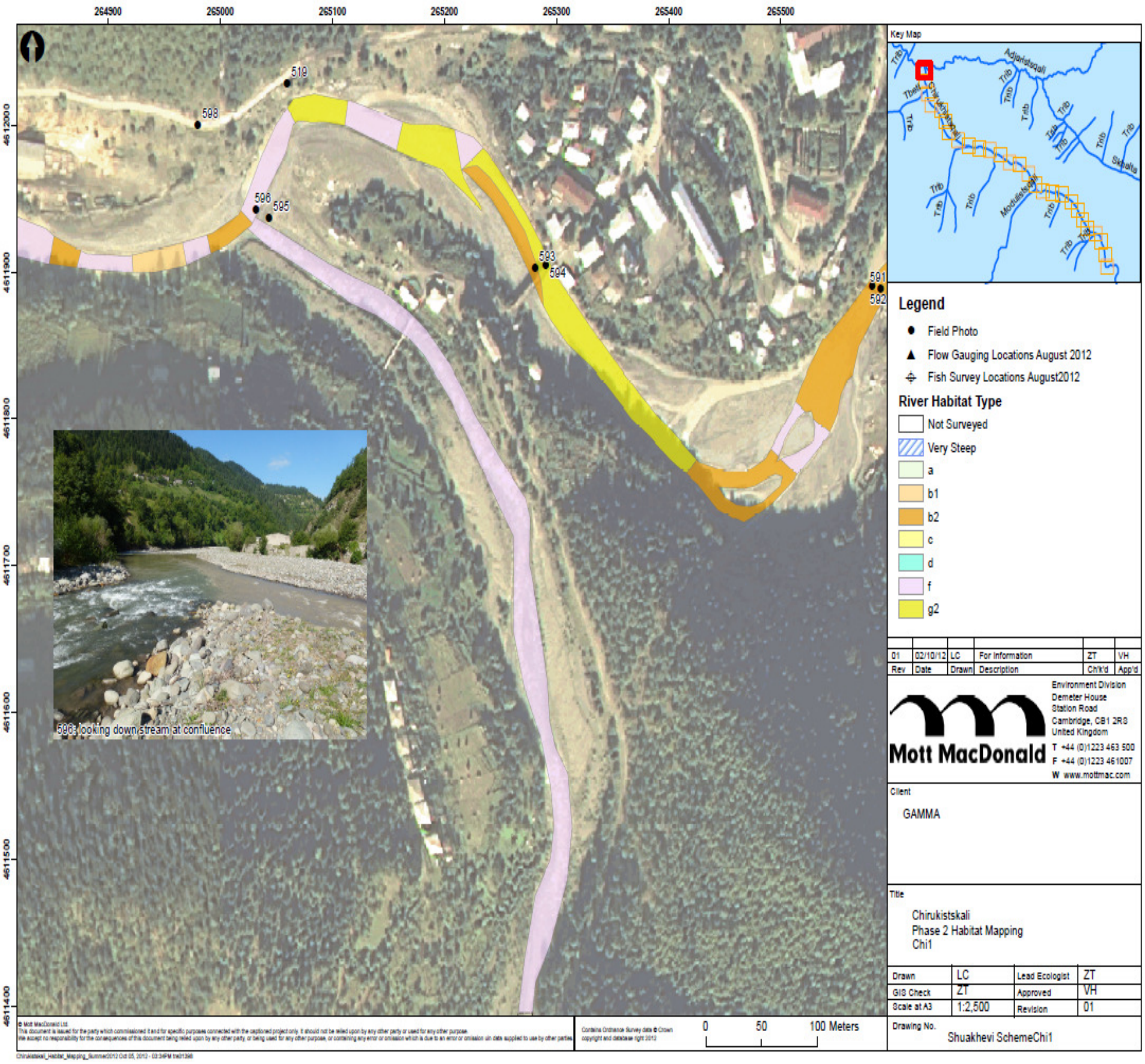
Source: Mott Macdonald

Figure 10.6: Habitat Mapping of the Adjaristsqali and Skhalta River confluence



Source: Mott Macdonald

Figure 10.7: Habitat Mapping of the Adjaristsqali and Chirukhistsqali River confluence



Source: Mott Macdonald

11. Geology, Landslides and Seismic Risks

11.1 Introduction

Assessment of geology, landslides and seismic risks will be based on combination of desk based review of available aerial photography and survey work, limited to areas directly impacted by construction activities and project structures. The aim of the assessment will be to generally characterise the potential risks of landslide hazards associated with project activities.

The characterisation of seismic risks will be undertaken in sufficient detail to define the engineering requirements of the project structures to withstand the most likely seismic risks.

Following a description of the assessment methodology in Section 1.2, subsequent sections provide information on the baseline ground conditions (Section 11.3), the impact assessment (Section11.5) and mitigation measured proposed (Section 6). A Summary of the impacts and any residual impacts following mitigation are reported in Section 11.6.

11.2 Methodology and Assessment Criteria

11.2.1 Legislative Background

11.2.1.1 International

The World Bank Operational Manual – Safety on Dams (OP 4.37) states that for the life of any dam the owner is responsible for ensuring that appropriate measures have been taken and sufficient resources provided for the safety of the dam due to the serious consequences of a dam not functioning properly or failing. This includes the need to consider the impact that potential landslide and seismic hazards and unsuitable geological foundations may have on dam structures.

OP 4.37 makes the following important distinction between small and large dams;

- Small dams are normally less than 15 m in height. This category includes, for example, farm ponds, local silt retention dams, and low embankment tanks.
- Large dams are 15 m or greater in height. Dams that are between 10-15 m in height are treated as large dams if they present special design complexities (e.g. an unusually large flood handling requirement, location in a zone of high seismicity, foundations that are complex and difficult to prepare or retention of toxic materials). Dams less 10 m in height are treated as large dams if they are expected to become large dams during the operation of the facility.

For new dams, compliance with OP 4.37 with respect to geological, landslide and seismic hazards and associated risks involves the following undertakings;

- The dam is to be designed and its construction is to be supervised by experienced and competent professionals. Dam safety measures are to be implemented for the design, bid tendering, construction, operation, and maintenance of the dam and associated works;
- For small dams, generic dam safety measures designed by qualified engineers are usually adequate. However, for large dams, the following is required;
  - reviews by an independent panel of experts (the Panel) of the investigation, design, and construction of the dam and the start of operations;
  - preparation and implementation of detailed plans which includes an emergency preparedness plan;
  - prequalification of bidders during procurement and bid tendering; and,

- periodic safety inspections of the dam after completion.

Also of relevance is the IFC EHS Guidelines with respect to Emergency Preparedness and Response which state that projects should have an Emergency Preparedness and Response Plan (EPRP) that is commensurate with specific risks. This includes the requirement to assess the risk posed to the Project by geological, landslide and seismic hazards and formulate appropriate strategies that effectively reduce any potential impact associated with these hazards on the Project. As noted in OP 4.37, the preparation of an EPRP is also required for compliance with these requirements.

11.2.1.2 National Legislation

Law of Georgia on Soil Protection

The Law aims at ensuring preservation of integrity and improvement of soil fertility. It defines the obligations and responsibility of land users and the State regarding the provision of soil protection conditions and ecologically safe production. The Law sets the maximum permissible concentrations of hazardous matter in soil and restricts the use of fertile soil for non-agricultural purposes, the execution of any activity without prior striping and preservation of top soil, open quarry processing without subsequent re-cultivation of the site, terracing without preliminary survey of the area and approved design, agricultural activities that could lead to overgrazing, wood cutting, damage of soil protection facilities, and any activity that could potential deteriorate soil quality (e.g. unauthorized chemicals/fertilisers, etc).

11.2.2 Methodology

The evaluation of baseline conditions uses a variety of sources, including historical information on the geology, landslides and seismicity as well as surveys of the existing status of the current landslide and seismic activity in the proposed construction areas. For the engineering design of the scheme, the baseline assessment has focused on structure locations. The following information sources have been used to establish the baseline conditions:

- Desk based research of published literature / journals / maps / studies and online resources. (geology, landslides and seismic viewpoint)
- Map the extent and type of morphological features associated with landsliding activity by aerial photograph interpretation;
- Obtain local knowledge through talking with the local population (landslides);
- Field mapping (both geological and geomorphological) of each main structure site to confirm and augment the aerial photograph interpretation and desk based research enabling a visual assessment of the baseline conditions at the project sites.
- Landslide hazard mapping with respect to the impact on the scheme and local population. It should be noted that landslide mapping is not an exact science; it is a dynamic process and requires a dynamic approach. Using a precautionary, professional and considered approach, the geomorphological mapping work has been utilised to produce the landslide hazard maps. Each landslide area has been categorised and then steps were taken to avoid those areas deemed to pose an unacceptable risk.
- A ground investigation survey and testing to provide information on the geology and nature of the superficial deposits where required to aid determination of landslide hazard.
- A micro-seismic network has been put in place to monitor the region for assessment of any active faults, the results of which will be made available in March 2012.

11.2.3 Assessment of Impact Significance

11.2.3.1 Determining Sensitivity and Magnitude

The determination of the impacts of the project on geology, landslides and seismicity are identified through consideration of:

- The site investigation data
- The geomorphological mapping and landslide hazard mapping assessments
- Micro- seismic network information
- Influential construction activities such as tunnel excavation (blasting / tunnel boring machine)
- Operation of the project
- Decommissioning of the project.

The following section provides further information regarding the methodology adopted to determine significance of impacts related to geology and slope conditions.

Table 11.1 presents the criteria for determining the sensitivity of geological receptors and the sensitivity of current landslides and slope receptors. The sensitivity is in relation to the affect that the construction / operation and decommissioning of Adjaristsqali Hydropower Scheme (the 'Project') has on the geology / landslides / seismicity. High sensitivity reflects existing conditions with little capacity to absorb proposed changes or conditions that present minimal opportunity for mitigation. The opportunity for mitigation of slopes/landslides is also affected by the extent of the affected feature, with many more mitigation options being available for small scale features.

Table 11.1: Criteria for Determining Sensitivity

Sensitivity	Definition
High	Vulnerable receptor with little or no capacity to absorb proposed changes or minimal opportunities for mitigation e.g. • Geological site of international importance. • Slope in a condition at or close to failure – existing soil slope failure in area of deep superficials subject to ongoing degradation, highly weathered materials in steep slopes subject to ongoing weathering, rock slopes with inclined low shear strength discontinuities where excavations are proposed, moisture sensitive poorly consolidated materials in reservoir side slopes. Failure may occur regardless of mitigation.
Medium	Vulnerable receptor with limited capacity to absorb proposed changes or limited opportunities for mitigation, e.g. • Geological site of regional importance. • Slope condition worsened by construction works but not increased to failure, potentially small local failures manageable with standard mitigation approaches.
Low	Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation, e.g. • sites locally important for its geology • slope condition with minimal mitigation would not be affected by the construction / operation
Negligible	Vulnerable receptor with high capacity to absorb proposed changes or numerous opportunities for mitigation, e.g. • areas of no geological importance. • slopes that will not be affected by the works, and will not require mitigation to support. i.e. fresh unweathered rock slopes with favourable joint orientations, relatively flat gravel terraces, shallow well drained soil slopes.

Table 11.2 presents the criteria for determining magnitude of impacts on geology, soils and groundwater.

Table 11.2 Criteria for determining Magnitude

Magnitude (positive or negative)	Definition
Major	Long term (>35 years) fundamental change to the specific environmental conditions assessed resulting in long term or permanent change, typically widespread in nature (regional national and international), would require significant intervention to return to baseline; exceed national standards and limits.
Moderate	Life span of the project. Medium term (10-20 years) spatial extent beyond immediate project components site boundaries or local area. Detectable change to the specific environmental conditions assessed resulting in non-fundamental temporary or permanent change.
Minor	Less than the project lifespan. Spatial extent of impact within the project areas. Meets minimum national standards and international guidelines. Detectable but minor change to the specific environmental conditions assessed.
Negligible	Temporary duration with no detectable impact. No perceptible change to the specific environmental conditions assessed.

The significance of an impact has been determined by the interaction between the magnitude of impacts and the sensitivity of receptors affected as depicted in the significance matrix shown in Section 5.3.4.4. Professional judgement has been used by appropriately qualified Engineering Geologists and Seismologists when assigning significance and consideration of likelihood has also been taken into consideration. If the impact is negative then the effect is adverse, if the impact is positive then the effect is beneficial.

The landslide risk assessment has been performed as part of a separate concurrent study and as such the methodology followed for determination of impact significance does not strictly follow the ESIA guidelines. The methodology for this Chapter is presented in Section 11.2.4.

11.2.4 Methodology for Landslide Assessment

Geomorphological hazards, of which landslide hazards are a subset, are naturally occurring processes and conditions that can in certain circumstances present a risk to life, property and the proposed scheme. Hazard maps have been prepared which identify units of similar geomorphological behaviour (i.e. landslide type), hazard impact and hazard likelihood. The hazards range from catastrophic and dramatic effects, such as large scale debris flows which can dam up the river or cause overtopping at a dam, to the barely perceptible but persistent processes such as slow creep movements and localised rockfall events. Landslide hazards resulting from seismic activity are not identified, although it is likely that seismicity will act as a trigger increasing the likelihood of landslide events. The potential hazards implied on the map may not affect the whole unit; the map merely indicates that a certain landslide hazard may exist within a designated area.

The geomorphological maps and landslide hazard maps have been prepared from aerial photo interpretation supplemented by ground truthing and are not the result of detailed field mapping with full ground coverage. Both maps should therefore be used to indicate the general condition of the land surface over large areas. Detailed ground investigations may be necessary for assessment of small areas and specific sites.

The risk rating given in the landslide hazard maps is based upon a qualitative assessment where each defined unit has been assigned a rating. This is based on two aspects:

a. The **impact** (magnitude, extent, duration, and reversibility) of the landslide hazard on the local population and the dam structures and;
b. the **likelihood** of the project construction and operation causing the landslide hazard.

The definitions for the impact ratings are given below:
- **Low impact:** Event having little affect on the local population or the dam structures, low spatial extent (<5000 m^3) and with small volumes of material in one instant or larger volumes at a slower rate. For example, localised rockfall or shallow creep movement on soil slopes.
- **Medium Impact:** Event where the dam structure / farmland / local population may be directly impacted by slope movement. Spatial extent of the hazard is restricted to affecting only local areas and a single scheme structure. For example where the fluctuating water levels in a reservoir may increase the porewater pressure in the side slopes and cause a slope failure which destroys a roadway.
- **High Impact**: Event having a catastrophic impact on the regional community or the project. Large scale movement with a high spatial extent, with little ability or likelihood for reversibility. For example: a large debris flow (such as that which occurred at Tsablana) which has potential to cause dam overtopping and severe disruption to the project and to communities including death.

The definitions for the likelihood of the project to cause the hazard to occur are given below:
- **Low Likelihood**: Landslide hazard is not likely to occur within the lifetime of the project.
- **Medium Likelihood:** Landslide hazard may occur within the lifetime of the project.
- **High Likelihood**: Landslide hazard is actively occurring or is likely to occur in the near future, almost certain to occur within the lifetime of the project

The resulting matrix is shown in Table 11.3 and also on the Landslide Hazard maps.

Table 11.3: Landslide Risk Matrix

	Low Impact / Magnitude	Medium Impact / Magnitude	High Impact / Magnitude
Low Likelihood	1 (Negligible)	2 (Minor)	3 (Moderate)
Medium Likelihood	2 (Minor)	3 (Moderate)	4 (Major)
High Likelihood	3 (Moderate)	4 (Major)	5 (Critical)

Those areas that have been assessed as major or critical risk have been avoided during optimisation of the scheme layout; those rated as moderate risk have mostly been avoided. Where areas rated as moderate risk have been unavoidable, mitigation or monitoring measures will be designed and put in place as part of the detailed design.

Throughout the feasibility stage, input from the geomorphological assessments have been used by the design teams to ensure that the scheme is developed in such a way that landslide risk is not increased and where possible is actually reduced. For example, the locations of a number of the structures have moved during the optimisation phase of the project in order to avoid destabilising potentially large landslides. This baseline attempts to identify the existing slope conditions at each structure location but also documents an understanding of processes and triggering events to be able to determine whether the construction works will have a detrimental impact on stability. The detailed assessments are included in the “Adjaristsqali Hydropower Cascade Geological and Geotechnical Assessment Reports” Volumes 1a, 1b and 1c. Prediction and evaluation of impacts are based on a risk-based classification of identified landslip features. This looks at the likelihood of further movement, and the magnitude of movement. The assessment has been made in relation to the planned engineering structures but also considers the impact on the local population. The landslide hazard maps are provided in Appendix E to accompany this report.

11.2.5 Data Limitations

To the extent that some of the assessment in this report is based of information gained in ground investigations, persons using or relying on this report should recognise that any such investigation can examine only a fraction of the sub-surface conditions. This limitation is particularly relevant to this project due to its large scale and hence limited spatial coverage of ground investigation.

Unexpected ground conditions may be encountered during the course of the construction works. Access to some of the smaller weir sites and along the tunnel alignments was also not gained so mapping in these areas is based on a combination of the desk based assessments, research from published resources, geological maps and aerial photographic interpretation. However, these areas are considered to have generally low sensitivity to the proposed scheme.

Landslides are dynamic natural events which may occur independently of the Adjaristsqali hydropower project construction, operation and decommissioning.

The seismic network analysis is based upon the draft interim report of seismic monitoring and does not represent the duration of monitoring that would typically be desired. Monitoring will continue to ensure the seismic hazard is fully understood and mitigated as appropriate.

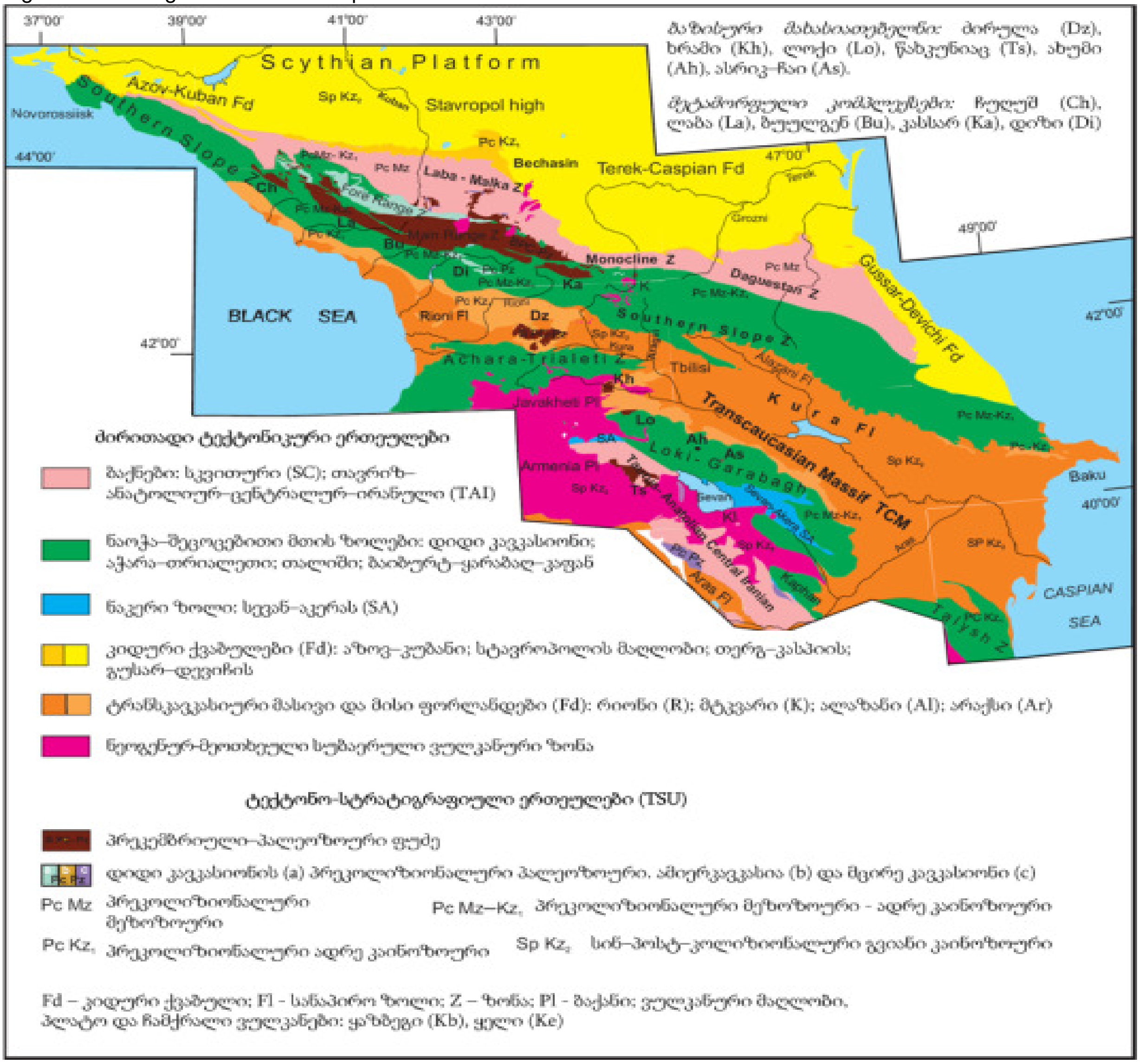
11.3 Baseline Description

11.3.1 Overview

The tectonic history of the Caucasus region is primarily controlled by its location between the currently converging Eurasian and Africa-Arabian plates. The relative position of the two plates and ensuing collision resulted in a relatively wide zone of continental-continental collision. The Adjaristsqali Hydropower Cascade Project is within this zone.

Six main tectonic units are apparent in the region (Figure 11.1). These comprise platforms, fold-thrust mountain belts, an ophiolite suture belt, foredeeps, the transcaucasian massif and related forelands and Neogene-Quaternary subaerial volcanics. The Adjaristsqali Hydropower Cascade Project is located in the Achara-Trialeti Fold-Thrust mountain belt.

Figure 11.1: Regional Tectonic map of the Caucasus



Source: (Adamia et al 2011)

From the late Proterozoic (≈550 Million years ago (Mya)) through to the late Mesozoic (≈65Mya) the region was part of the Tethys Ocean and was dominated by island arcs, intra-arc rifts and back-arc basins of varying complexity, associated with the tectonic convergence of the Eurasian and African-Arabian plates. (Adamia et al 2011) considered, that towards the end of this time, within the Cretaceous Period (145 – 65 Mya), it is understood that the Adjara region was a small part of a deep trough generated through rifting within a broadly converging tectonic regime. The resulting rift basin is known as the Adjara-Trialeti basin. From the Palaeocene (65.5 – 56 Mya) through to the end of the Eocene (33 Mya) thick sequences of basaltic volcanics, and terrigenous and tuffogenous turbidites were deposited within the basin, and these formations form the bedrock currently found in Adjara (Adamia et al 2011).

Following closure of the Tethys, the early Oligocene (33 Mya) is considered to be the start of the syn-collisional (orogenic) development of the Caucasus (Saintot et al. 2006; Adamia et al 2011). As the

Eurasian and Africa-Arabian plates collided the Adjara-Trialeti basin was inverted into the mountain range, the eroded form of which is seen today. Due to the uneven nature of the tectonic collision and the wedge shape of the Africa-Arabian plate, the resulting orogenic belt has a curved expression (known as oroclinal bending) over the Lesser Caucasus area comprised of Georgia, Northeast Turkey, Armenia and Azerbaijan. This oroclinal bending resulted in regional northeast southwest trending structures in the west (i.e. within Georgia and Northeast Turkey) and regional southeast northwest trending structures in the east (i.e. Armenia and Azerbijan).

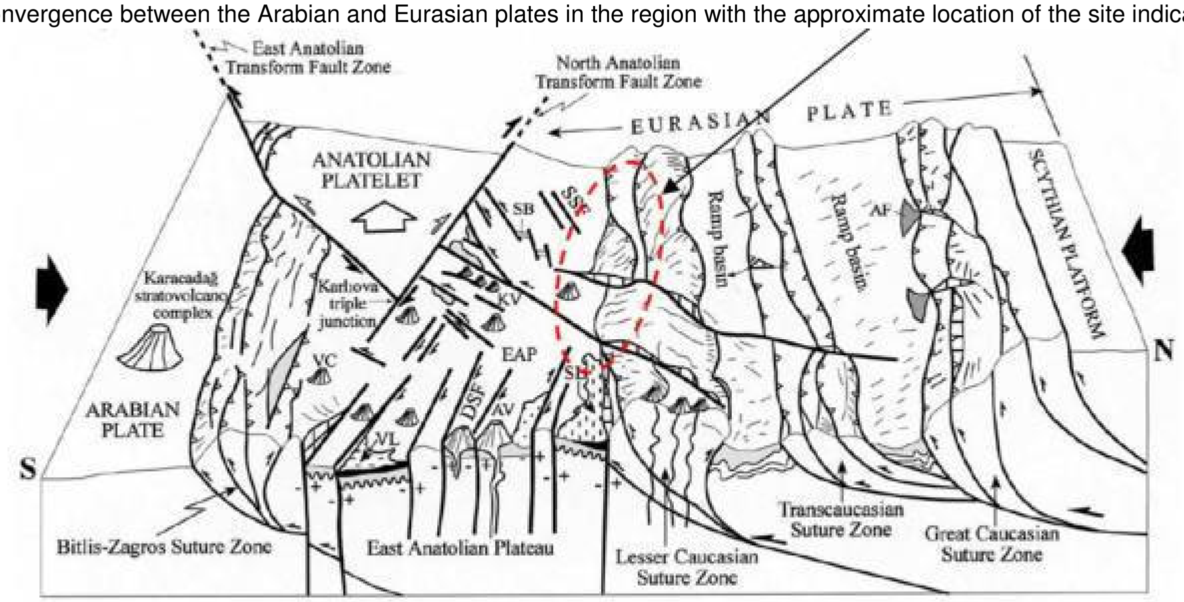
Oroclinal bending, in conjunction with a gradual transition from a thrusting tectonic regime in the north of the Lesser Caucasus area to a strike slip regime in the south also resulted in several tectonic structures present across the Adjara-Trialeti unit. The thrusting features in the north comprise of the following:
- ramp basins (west northwest – east southeast in orientation);
- thrust faults (west northwest – east southeast south dipping thrust faults and east – west north dipping thrust faults); and
- folds (axis striking east - west).

The strike slip features in the south comprise of the following:
- strike slip faulting (northeast – southwest orientated);
- strike slip basins; and
- fissures and lines of volcanoes (north northwest – south southeast orientated as associated with the extensional induced normal faulting).

Such features are conceptually illustrated in **Error! Reference source not found.** along with the relative position of the study area which is located in an intermediate zone where both sets of features may be anticipated. In the region it is considered that the generally northwest – southeast orientated features were dominantly formed between the Palaeogene Period and within the early to late Miocene (28Mya to 16Mya) and the northeast – southwest features between the late Miocene to the Quaternary (11.6Mya to present day) (Avagyan et al. 2010).

Regionally, three main stages of syn and post collisional magmatism are thought present. These phases are thought to have occurred during and between the Oligocene-Miocene, Miocene-Pliocene and Quaternary.

Figure 11.2: Block diagram depicting compressional and tensional neotectonic structures resulting from north south convergence between the Arabian and Eurasian plates in the region with the approximate location of the site indicated



Source: Koçyiğit et al. 2001

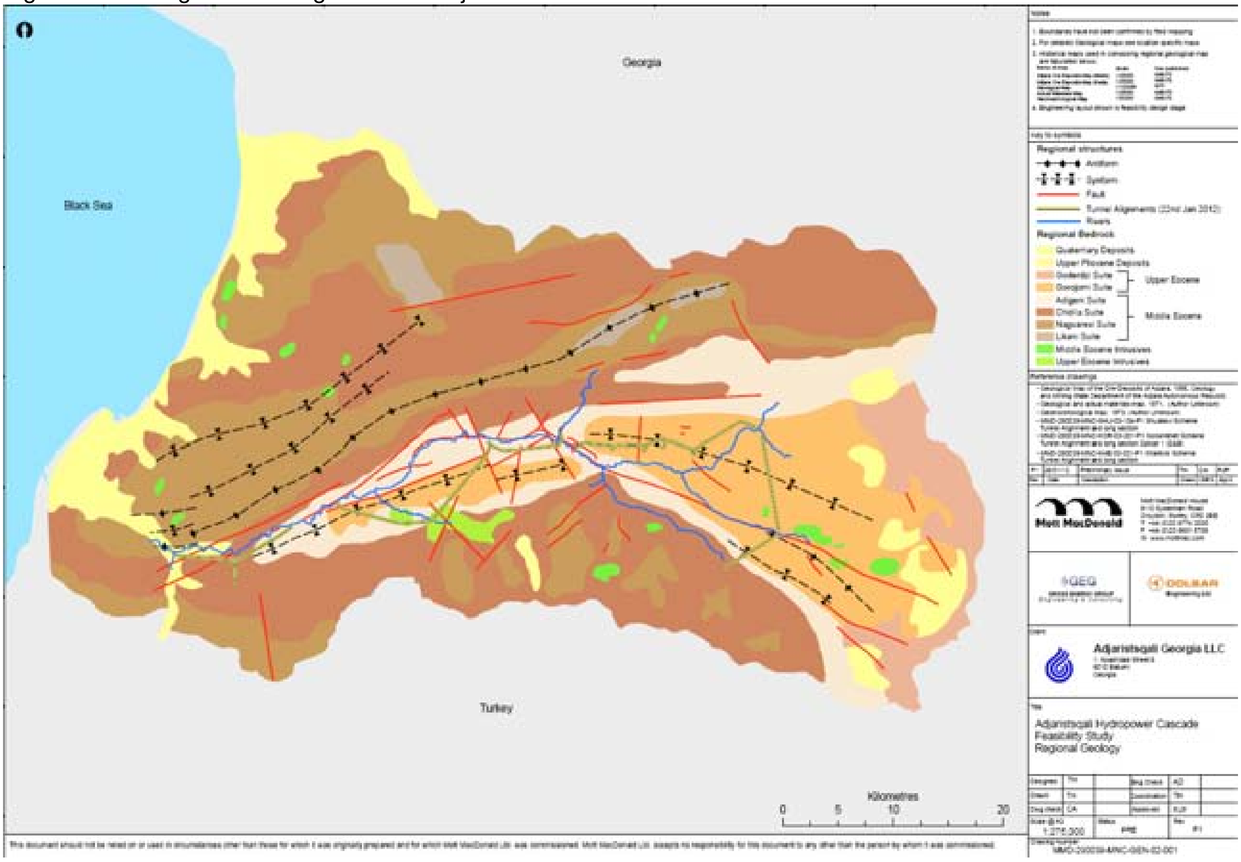
AF Quaternary alluvial fan. **AV** Ararat stratovolcano complex. **DSF** Dextral strike-slip fault**. Kv** Kargapazari volcanoes. **SL** Sevan Lake. **SB** Strike-slip basin. **SSF** Sinistral strike-slip fault. **Vc** volcanic cone. **VL** Van Lake.

11.3.2 Geological and tectonic setting of Adjara

Situated in the north-western part of the Lesser Caucasus the Adjaristsqali region is located in the Adjara-Trialeti tectonic zone. The zone is approximately 100km wide (north – south) and 400km long (east – west) (Yilmaz et al. 2001). A regional geology map is presented in Figure 11.3 below.

The stratigraphic sequence comprises more than 5000m of volcanic and volcanoclastic sediments deposited since the beginning of the Palaeogene (65 Mya). In the west of the region alkali and tholeiitic basalts are encountered towards the top and base of the sequence, whereas in the middle of the sequence basic, alkali intermediate and acidic volcanoclastic and tuffaceous rocks with sedimentary interbeds are present. Further eastwards the thickness reduces, and calc-alkali volcanic rocks prevail (Bazhenov & Burtman. 2002). In summary, the bedrock in the Adjara region was formed during the Eocene and it is conformably underlain by the Cretaceous-Palaeocene rocks which are present in the centres of eroded anticlines.

Figure 11.3: Regional Geologic Plan of Adjara



Source: Mott MacDonald

Table 11.4: Geological suites in Adjara

Epoch	Mya	Suite	Geological Description	Thickness
Pliocene – Pleistocene	5,30 – 0,01	Goderdzi	Carbonate and tuffaceous breccias, laminated marls, sandstones and micro conglomerates.	-
Upper Eocene	40-33	Ghorjomi	Interbedded shoshonites, conglomerates and volcanoclastic sandstones.	2000 m
Upper Eocene	40-33	Adigeni	Fine grained volcanoclastic and terrigenous deposits, and coarse grained massive volcanoclastics. Rare interbeds of marls, limestones, basalts, trachy-basalts and trachy-andesites.	300 – 800 m
Middle Eocene	48-40	Chidila	Massive coarse grained volcanoclastics interbedded with fine grained laminated tuffs and breccias.	Up to 2000 m
Middle Eocene	48-40	Naghvari	Thin to medium bedded fine grained occasional coarse grained volcanoclastics, basalts, trachytes, andesites and dolomites interbedded with tuffs, marls and argillites and Breccias.	500 m
Palaeocene – Lower Eocene	58-48	Peranga	Coarse grained, thick layered, massive volcanoclastics and basalts.	>1500 m

Two significant unconformable intrusive bodies thought to be developed during different phases are recognised in the region. These are known as the Merisi and Namonastrevi intrusions and both occurred post deposition of the predominately extrusive bedrock in the region.

Significant structural geological variation is apparent in Adjara as the region is situated in a transitional area therefore, several structures are present such as strike-slip pull-apart basins and thrusting regimes.

Due to the oroclinal nature of the compression in the west of the region the folds strike northeast – south west, whilst in the east the fold axes strike east-west, however Bazhenov & Burtman (2002) state the north and south of the region are bound by east west trending northward and southward respectively dipping thrust faults.

The major structures indicated in the regional map compiled from published material fit the geological model by indicating the following structures in Adjara:

- An anticline and syncline with curved axis allowing for a southwest-northeast orientation in the west and a northeast-southwest orientation in the east;
- South-west trending thrust faulting in the north of Adjara;
- Northwest-southeast strike-slip faulting in the east of Adjara; and
- Northeast-southwest strike-slip faulting in the west of Adjara.

The main Adjaristsqali River valley approximately follows the axis of a regional syncline. Existing geological mapping indicates that the southern limb of the syncline is dipping approximately 15-35° towards 340° in the west and towards 010° in the east. The northern limb of the syncline (and southern limb of the anticline) dips approximately 10-30° predominantly to the southwest, with the axis of the anticline not as curved as the axis of the syncline. It should however be noted that it is likely that the regional folds have subordinate anticlines and synclines superimposed.

Conceptual ground models of the dam, weir and powerhouse sites indicating the geological and geotechnical risks derived from both literature and intrusive investigations are presented in the geological and geotechnical assessments undertaken by Mott MacDonald in February 2012.

Previous work on the Adjaristsqali Hydropower Cascade, along with ongoing drilling and monitoring, will further contribute to the ground models and improve the understanding of the ground conditions as the project evolves.

There are some geological exposures which will be impacted by the scheme but none of these would be considered of particular interest and not of regional importance. Many of the interesting exposures along the main road following the Adjaristaqali River will be unaffected by the scheme.

11.4 Scheme Specific Geology Features

11.4.1 Introduction

In this section of the report the general geology and sequences in each of the scheme areas is interpreted based on recent geological investigation work as well as geological mapping by GEG and Mott MacDonald. The following discussions on the geology, as presented in this section of the report, are based on the following:

- Review of the recent site investigation results including boreholes, rock mass mapping, geological and geomorphological mapping;

- Geological map of the Adjaristsqali region at 1:50,000 scale. (author unknown); and
- Regional scale geological map.

11.4.2 Engineering geology of territories for the Shuakhevi scheme

11.4.2.1 Overview

Within the scheme area, covering Chirukhistsqali weir, Skhalta dam, Didachara dam, Shuakhevi powerhouse and associated tunnels, the geology is dominated by rock formations, although superficial deposits are significant in some areas.

A summary of the rock types encountered is presented in Table 11.5 below:

Table 11.5: Stratigraphic and Lithological sequence of the project area

Age	Suite	Lithological features
Upper Eocene	Ghorjomi	Interbedded shoshonites, conglomerates and volcanoclastic sandstones.
Upper Eocene	Adigeni	Sequences of Shoshonites (trachybasalts, trachyandesites), high potash calc-alkaline hornblend andesites and turbidites.
Middle Eocene	Chidila	Sequences of basalts, breccias and tuffs with rare incalculations of turbidites.

According to the regional geological map the Chirukhistsqali weir is underlain by the Chidila suite with approximately 25% of the transfer tunnel to Skhalta dam site also in this formation. About 15% of the tunnel will pass through the Adigeni suite with the remaining length of tunnel and cascade structures in the Gorjomi suite.

The remaining structures and tunnels of the scheme pass through or are in the Gorjomi suite, with the exception of approximately the last 3km of the headrace tunnel to Shuakhevi powerhouse which is in the Adigeni suite.

Occasional unconformable intrusive igneous dykes are encountered throughout the scheme area. The surface expression of a Mid Eocene intrusion is present close to the alignment of the transfer tunnel from Skhalta to Didachara and it is considered the tunnel is likely to pass through this intrusion and the associated altered rocks surrounding it for a length of up to 1.5km.

11.4.2.2 General rock and soil mass descriptions

Chidila Suite

The Chidila suite of the Adjara-Trialeti unit are the oldest rocks in the project area. This volcanic and volcanoclastic suite was encountered in the geological mapping of Chirukhistsqali weir and three different rock types were identified. Thin sections of 3 samples of representative rocks in the area were taken in order to confirm the geological descriptions and to help define the different material types encountered on site. The following materials were encountered:

- Tuff – medium strong, purple, microbedded (in thin section) very fine grained silt grain sized Tuff with occasional porphyroclasts of a green vitreous mineral (altered calcite). Where weathered in outcrop a reduction in strength to weak is evident. The thin section indicates it is a clastic rock with a porphyroblast texture, with the main porphyroblast minerals being: calcite (2mm to 15mm in size) and plagioclase probably bytownite or andesine (1-2mm in size). The main matrix and calcite crystals are moderately weathered evident in slight colour alteration;

- Andesite-Basalt – medium strong to very strong light grey and grey green occasionally porphyritic, predominantly with an aphantic groundmass, crystalline Andesite-Basalt. The dominant porphyroclast minerals are pyroxene and calcium plagioclase. The thin sections show that one of the samples has rare calcite in the groundmass and this is thought to be a result of hydrothermal processes / weathering;
- Andesite-Basalt Breccia - medium strong to strong grey massive, with bedding spacing typically >2m. The breccia clasts range in size from gravel to cobble, sub-angular to angular and are comprised of porphyritic Andesite-Basalt. The clasts are in a matrix of fine grained crystalline Andesite.

Variable thicknesses of interbedding of the three materials were encountered from the geological mapping however beds were typically at a scale of tens of metres. From the mapping undertaken in the Chidila Andesite-Basalt Breccia and Andesite-Basalt are considered the predominant materials in the suite, with limited (<10%) comprising Tuff. At Chirukhistsqali weir site the Chidila suite rocks were typically fresh or slightly weathered in outcrop with three sets (including bedding) of closely to medium spaced discontinuities.

Adigeni Suite

In the Shuakhevi scheme the Adigeni suite is encountered along the Chirukhistsqali headrace tunnel, along the far end of the Shuakhevi headrace tunnel and at the Shuakhevi powerhouse. No investigative work was undertaken in the Adigeni suite at the region of the Chirukhistsqali headrace tunnel alignment. At the Shuakhevi powerhouse site the following material was encountered:

Andesite Basalt Breccia - medium strong and strong purple grey and grey, Breccia Andesite. The clasts comprise of angular gravel sized Andesite. The rock is porphyritic with porphyroclasts of pyroxene, hornblende, calcium plagioclase and rare biotite.

In the vicinity of Shuakhevi powerhouse the rock is fresh to moderately weathered in outcrop with three sets of main discontinuities. Discontinuity spacing varies between very closely spaced to widely spaced and is typically medium to widely spaced in the boreholes. The other materials that are present within the Adigeni suite were not encountered during mapping but should be anticipated to occur in the tunnels. These materials are likely to include sequences of shoshonites, hornblende Andesites and turbidites.

Ghorjomi Suite

The majority of the Shuakhevi scheme is underlain by the Gorjomi suite which forms the core of the regional scale syncline. The following section details the encountered materials in the Gorjomi suite at Didachara and Skhalta sites:

- Andesite-Basalt Breccia – medium strong to very strong blue grey, purple grey, dark grey coarse grained porphyritic Andesite-Basalt Breccia. Clasts comprise angular to subangular gravel to cobble size of Andesite in a matrix of fine grained Andesite. Phenocrysts predominately comprise pyroxene, feldspar and hornblends.
- Andesite-Basalt – medium strong to very strong blue grey occasional aphanitic but predominantly porphyritic fine grained crystalline Andesite-Basalt. The porphyroclasts comprise predominantly calcite plagioclase feldspar and occasionally pyroxene. Some calcite and quartz overgrowth is present. Occasionally vesicles are observed. The thin sections show that some of the samples have calcite in

the matrix and this is thought to be a result of hydrothermal processes / weathering. There are thought to be two phases of alteration – an initial silica rich phase followed by a later carbonate phase due to some of the mineral alteration states.

- Tuff (only mapped at Skhalta) – weak to medium strong orange brown, grey cream, volcaniclastic Tuff. The thin section indicates it is a clastic rock, comprising angular clasts of quartz in a matrix of clay and iron rich minerals which weathers to iron oxide.

From the geological mapping undertaken the apparent predominant material in the suite is Andesite-Basalt, however significant proportions of Andesite-Basalt Breccia are also evident. Outcrops of Tuff were limited, possibly due to its increased susceptibility to weathering, and are likely to comprise of approximately 10% of the rocks in the suite.

The rocks are generally fresh, however where present the weathering reduces the strength to a weaker state, and is often iron stained along the joints.

Superficial Deposits

Variable thicknesses of superficial deposits cover the valley slopes and are present in the valley bottom of the Adjaristsqali and Skhalta River and the tributaries. Superficial deposits are divided based on their origin:

- Alluvial deposits; and
- Colluvial deposits (including landslide material).

The main characteristics and broad distribution of these deposits is described below.

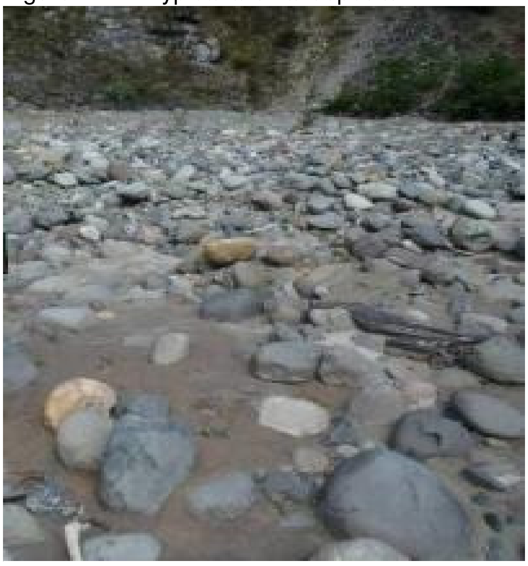
Alluvial Deposits

The alluvial deposits are highly variable in vertical and lateral extent. In the boreholes the deposits were typically recovered as a medium dense to very dense subangular to subrounded silty sandy gravel with variable proportions of cobbles and boulders. Fines are estimated at varying between 5% to 20% with gravel content ranging from 40% to 70%. It is noted that the deposit has a silty sandy matrix which was probably largely washed out during drilling, therefore a higher fines fraction should be expected.

At both locations where alluvium was sampled, Shuakhevi and Skhalta, a finer grained layer up to 21m thick was encountered at depth between coarser deposits. This material ranged from a very loose gravelly, silty fine to coarse sand (typically 60% sands, 20% gravel, 20% fines) to soft sandy clayey silt (typically 35% sand 65% fines).

Alluvium is a variable deposit and layers and lenses of clays, sands and boulders should be anticipated. Photographs of typical surface alluvium are presented in Figure 11.4 below.

Figure 11.4: Typical alluvial deposits



Source: Mott Macdonald

Source: Mott Macdonald

Alluvial deposits are located around and along current and historical water courses. Across the scheme the thicknesses of the alluvial deposits is significantly variable.

Colluvial Deposits

Colluvial deposits are formed by transport of material downslope under gravity. Colluvium comprises a variable mixture of both rock and soil of varying sizes and shapes, mainly coarse and angular grains. In most cases the colluvial deposits comprise subangular to angular gravel with cobbles and boulders within a silty sandy matrix. The size of the boulders generally range from 20cm to 1m, however boulders up to 5m in size are present. Rare fine grained deposits are present in colluvial deposits, and are typically described as stiff sandy silty gravelly clay.

11.4.3 Engineering geology of territories for the Koromkheti scheme

11.4.3.1 Overview

Within the scheme area, including Chvanistsqali weir, Khichauri dam, Akavreta weir and Koromkheti powerhouse and associated tunnels, the geology is dominated by rock formations, although superficial deposits are significant in some areas.

A summary of the rock types encountered is presented in Table 11.6 below.

Table 11.6: Stratigraphic and lithological sequence of the project area

Age	Suite	Lithological features
Middle Eocene	Merisi intrusion	syenites, diorites, granodiorites, quartz diorites and monozonites
Upper Eocene	Ghorjomi	Interbedded shoshonites, conglomerates and volcanoclastic sandstones.
Upper Eocene	Adigeni	Sequences of Shoshonites (trachybasalts, trachyandesites), high potash calc-alkaline hornblend andesites and turbidites.

According to the regional geological map, the Chvanistsqali weir is underlain by the Adigeni suite with the entire transfer tunnel to Khichauri dam site also in this formation.

The first quarter of the headrace tunnel between Koromkheti dam and the Koromkheti powerhouse is on the northern limb of the regional scale syncline. For the remaining three quarters, the tunnel crosses the syncline axis and then generally runs along the southern limb of the regional scale syncline. Approximately 20% of the tunnel is located in the Merisi Intrusion, with the remaining tunnel alignment approximately in half the Gorjomi suite and half in the Adigeni suite.

11.4.3.2 General rock and soil mass descriptions

Adigeni Suite

In the Koromkheti scheme the Adigeni suite is encountered along the Chvanistsqali transfer tunnel, Khichauri dam, intermittently along the headrace tunnel and at Koromkheti powerhouse. At Chvanistsqali weir, Khichauri dam and reservoir and Koromkheti powerhouse the following materials were encountered:

- **Andesite-Basalt Breccia** – weak to medium strong, yellow brown, brown, grey and purple, thick to massive Andesite-Basalt Breccia. The matrix is basic and predominantly aphanitic with porphyroclasts mainly comprising calcium plagioclase (2-3mm) with orthorhombic and monoclinic pyroxenes and hornblende also present. The clasts are generally angular and subangular. In the vicinity of Khichauri dam the rock is highly weathered to fresh in both boreholes and outcrop with three sets of main discontinuities. Discontinuity spacing varies between closely spaced to widely spaced in outcrop and typically closely to medium spaced in the boreholes.
- **Andesite-Basalt** - Strong and very strong, green grey, massive fine to medium crystalline Andesite-Basalt. The matrix is predominantly aphanitic with occasional porphyroclasts that predominantly comprise calcium plagioclase, with occasional orthorhombic and monoclinic pyroxene and olivine crystals. In the boreholes at Khichauri dam the Andesite-Basalt is generally fresh with discontinuities varying being closely to medium spaced in both boreholes and outcrop.
- **Tuff** – weak to medium strong, red brown, brown, yellow brown, very thinly to thinly laminated silt and sand sized Tuff. Where encountered in boreholes the Tuff is weathered to very weak. Discontinuities are predominantly very closely to medium spaced.

Ghorjomi Suite

A significant proportion of the headrace tunnel between Khichauri dam and Koromkheti powerhouse is underlain by the Gorjomi suite. No geological mapping or intrusive investigations were undertaken in this suite along the Koromkheti scheme; however considerable investigations where undertaken in this suite across the Shuakhevi Scheme. As similar materials are expected in the same suites the following section details the encountered materials in the Gorjomi suite on the Shuakhevi scheme:

- **Andesite-Basalt Breccia** – medium strong to very strong blue grey, purple grey, dark grey coarse grained porphyritic Andesite-Basalt Breccia. Clasts comprise angular to subangular gravel to cobble size of Andesite in a matrix of fine grained Andesite. Phenocrysts predominantly comprise pyroxene, feldspar and hornblends.
- **Andesite-Basalt** – medium strong to very strong blue grey occasional aphanitc but predominantly porphyritic fine grained crystalline Andesite-Basalt. The porphyroclasts comprise predominantly calcite plagioclase feldspar and occasionally pyroxene. Some calcite and quartz overgrowth is present. Occasionally vesicles are observed. The thin sections show that some of the samples have calcite in the matrix and this is thought to be a result of hydrothermal processes / weathering. There are thought

to be two phases of alteration – an initial silica rich phase followed by a later carbonate phase due to some of the mineral alteration states. Both materials weather locally to a weak orange cream colour.
- **Tuff** – weak to medium strong orange brown, grey cream, volcaniclastic Tuff. The thin section indicates it is a clastic rock, comprising angular clasts of quartz in a matrix of clay and iron rich minerals which weathers to iron oxide.

Merisi Intrusion

Part of the headrace tunnel between Khichauri dam and Koromkheti powerhouse, Akavreta weir and associated shaft are located in the Merisi Intrusion. Geological mapping undertaken at Akavreta weir encountered the following materials:

Microdiorite – strong and very strong, light grey, green grey, phaneritic medium grained Microdiorite. Thin sections of the material indicate varying proportions of quartz, hornblende and plagioclase with secondary minerals, likely to have been from hydrothermal alteration, including pyrite, epidote and saussurite (identified as 'sosorite' in the thin section reports by GEG in Volume; Saussurite is formed due to the alteration of calcium-bearing plagioclase feldspar and it is an assemblage of minerals the typical assemblage formed includes zoisite, chlorite, amphibole, and carbonates.

A slight reduction in strength and color alteration to orange brown was observed in weathered material.

Superficial Deposits

Variable thicknesses of superficial deposits cover the valley slopes and are present in the valley bottom of the Adjaristsqali River and the tributaries. Superficial deposits are divided based on their origin:
- Alluvial deposits; and
- Colluvial deposits (including landslipped deposits).

The main characteristics and broad distribution of these deposits is described below.

Alluvial Deposits

The alluvial deposits are highly variable in vertical and lateral extent. In the boreholes the deposits were typically recovered as dense to very dense subangular to subrounded silty sandy gravel with variable proportions of cobbles and boulders. Fines are estimated at varying between 5% to 20% with gravel content ranging from 40% to 70%. It is noted that the deposit has a silty sandy matrix which was probably largely washed out during drilling, therefore a higher fraction should be expected.

At Khichauri dam a finer grained layer up to 12m thick was encountered at depth between coarser deposits. This material comprised soft to firm greenish grey silty sandy clay.

Alluvium is a variable deposit and layers and lenses of clays, sands and boulders should be anticipated.

Alluvial deposits are located around and along current and historical water courses. Across the scheme the thicknesses of the alluvial deposits will vary considerably.

Colluvial deposits

Colluvial deposits are formed by transport of material downslope under gravity. Colluvium comprises a variable mixture of both rock and soil of varying sizes and shapes, mainly coarse and angular grains. In most cases the colluvial deposits comprise subangular to angular gravel with cobbles and boulders and a variable amount of fines. The size of the boulders generally range from 20cm to 1m, however boulders up to 5m in size are present. Rare fine grained deposits are present in colluvial deposits, and are typically described as stiff sandy silty gravely clay.

11.4.4 Engineering geology of territories for the Khertvisi scheme

11.4.4.1 Overview

According to the regional geological map, the Khertvisi dam and reservoir is underlain by the Adigeni suite. Approximately 30% of the headrace tunnel is also in this formation. The remaining 70% of the tunnel and remaining scheme structures are within the rocks of the Chidila suite.

A summary of the rock types encountered is presented in Table 11.7 below:

Table 11.7: Stratigraphic and lithological sequence of the project area

Age	Suite	Lithological features
Upper Eocene	Adigeni	Sequences of Shoshonites (trachybasalts, trachyandesites), high potash calc-alkaline hornblend andesites and turbidites.
Middle Eocene	Chidila	Sequences of basalts, breccias and tuffs with rare intercalations of turbidites.

11.4.4.2 General rock and soil mass descriptions

Chidila suite

The Chidila suite of the Adjara-Trialeti unit are the oldest rocks in the project area. This volcanic and volcanoclastic suite was encountered in the geological mapping of Machakhlistsqali weir and Khertvisi powerhouse at which three different rock types were identified. Thin sections of four samples of representative rocks in the area were taken in order to confirm the geological descriptions and to help define the different material types encountered on site. The following materials were encountered:

- **Tuff** – Strong, brown, light-brown and grey, silt and sand grain size, laminated Tuff. In thin section it is evident that approximately 90% of the matrix is aphanitic in texture. The porphyroclast minerals are represented almost exclusively by plagioclase, between 2mm and 2cm in size. Occasional hydrothermal alteration is evidenced by the presence of saussurite (this is 'sosorite' in the thin section reports by GEG in Volume 2). Saussurite is formed due to the alteration of calcium-bearing plagioclase feldspar and it is an assemblage of minerals the typical assemblage formed includes zoisite, chlorite, amphibole, and carbonates. In rock subjected to weathering an increase in iron oxide mineralisation is observed;
- **Andesite-Basalt** – Medium strong, grey and dark-grey, porphyritic Andesite-Basalt. A miarolitic texture (infilled vesicular texture) was observed in thin section at Khertvisi powerhouse, in which two phases of mineralisation is evident. First, the deposition of quartz is apparent around the rim of vesicles, which were then subsequently infilled with calcite. Hydrothermal alteration of calcium plagioclase to saussurite was also evident in this suite at Khertvisi powerhouse.
- **Andesite-Basalt Breccia** – Strong, dark-grey, green-grey porphyritic Andesite-Basalt Breccia. The clasts are often gravel to cobble size, rarely boulder size, dark-grey, purple-grey Andesite-Basalt. The matrix is predominantly an aphanitic Andesite-Basalt with occasional plagioclase and pyroxene.

Variable thicknesses of interbedding of the three materials were encountered from the geological mapping however beds were typically at a scale of tens of metres. From the mapping undertaken in the Chidila suite Andesite-Basalt Breccia and Andesite-Basalt are considered the predominant materials. A single outcrop of Tuff was present at both Machakhlistsqali weir and Khertvisi powerhouse, and therefore it is considered a significantly smaller proportion of the composition of the materials in the suite. At both sites the rocks were typically fresh or slightly weathered in outcrop. Where weathering was present, small reductions in strength and colour alteration were apparent.

Adigeni Suite

In the Khertvisi scheme the Adigeni suite is encountered along the headrace tunnel and at Khertvisi dam and reservoir. Thin sections of six samples of representative rocks were taken in order to confirm the geological descriptions and to help identify the different materials at the site. The following material was encountered:

- **Tuff** - Strong dark-brown and grey, silt and sand grain size, laminated to thickly bedded aphanitic Tuff. The matrix is predominantly aphanitic and mafic in composition. Porphyroclasts comprise of plagioclase, quartz and pyroxenes, all less than 0.5mm in length. Secondary mineralisation is also apparent, with the presence of saussurite and iron oxide;
- **Andesite-Basalt Breccia** – Strong, dark-grey, green-grey porphyritic Andesite-Basalt Breccia. The matrix and porphyroclasts in both the cement and clasts of the Breccia are of similar composition. The matrix is predominantly aphanitic and mafic. The porphyroclasts generally consist of plagioclase and pyroxenes.
- **Andesite-Basalt** – Medium strong, grey-brown and grey, fine and medium grained porphyritic Andesite-Basalt. The porphyroclasts generally comprise plagioclase and pyroxenes. Occasional secondary minerals are present, in the form of saussurite and chlorite.

11.4.4.3 Superficial Deposits

Variable thicknesses of superficial deposits cover the valley slopes and are present in the valley bottom of the Adjaristsqali and Machakhlistsqali Rivers. Superficial deposits are divided based on their origin:

- Alluvial deposits; and
- Colluvial deposits (including landslide material).

The main characteristics and broad distribution of these deposits is described below.

Alluvial deposits

The alluvial deposits are highly variable in vertical and lateral extent. In the boreholes from the two other adjacent schemes the deposits were typically recovered as a medium dense to dense subangular to subrounded silty sandy gravel with variable proportions of cobbles and boulders. Fines are estimated at varying between 5% to 20% with gravel content ranging from 40% to 70%. It is noted that the deposit has a silty sandy matrix which was probably largely washed out during drilling, therefore a higher fines fraction should be expected.

A fine grained alluvial deposit was encountered within boreholes undertaken on the Skhalta and Koromkheti schemes. Although no evidence for such a deposit was encountered at the surface of the Khertvisi scheme it is considered possible for significant thicknesses of such deposits to be present on the Khertvisi scheme. The material encountered on the other schemes include very loose gravelly, silty fine to sand (typically 60% sands, 20% gravel, 20% fines) to soft sandy clayey silt (typically 35% sand 65% fines) and firm to stiff sandy silty clay (up to 96% fines, 10% sand).

Alluvium is a variable deposit and layers and lenses of clays, sands and boulders should be anticipated.

Colluvial deposits

Colluvial deposits are formed by transport of material down slope under gravity. Colluvium comprises a variable mixture of both rock and soil of varying sizes and shapes, mainly coarse and angular grains. In most cases the colluvial deposits comprise subangular to angular gravel with cobbles and boulders within a silty sandy matrix. The size of the boulders generally range from 20cm to 1m, however boulders up to 5m in size are present. Rare fine grained deposits are present in colluvial deposits, and are typically described as stiff sandy silty gravelly clay.

11.4.5 Landslide hazards

11.4.5.1 Introduction

The Adjara region is known to historically experience landslides such as the Tsablana landslide in the Skhalta River valley which killed 19 families. As a result it is also the principal concern of many of the local inhabitants and as such this has been a principal focus of the geotechnical feasibility study.
From the site reconnaissance undertaken it is evident that the landslide masses are often coincident with the most populated areas. The morphology of the landslides tends to create a flatter lobe in the mid slope of the affected hillside which is therefore attractive for development. Owing to the greater depth to rockhead it is also likely that the landslip masses provide more fertile soil conditions. The severity of the impact of a landslide event will be greater in populated areas. The severity is also related to the size of the landslide, whether it is a deep seated failure or a shallow surface movement, and whether a slow creep movement or rapid slide/flow. The morphology, mass movement processes and engineering geological properties of the landslides must therefore be understood to adequately assess the hazard and risk.

Section 1.2.4 discussed the approach adopted for assessing the baseline landslide hazards for the Adjaristsqali Hydropower Cascade while Sections 1.3.2.2 to 1.3.2.5 summarise the baseline for each of the site locations as the baseline for each area is different.

11.4.5.2 Skhalta Scheme

Chirukhistsqali Weir

The weir site has been moved throughout the geomorphological investigations in order to remove the landslide hazard observed downstream. At the current site, a large terrace of alluvial material is present on the left bank of the weir site and there are areas of made ground associated with the existing hydropower plant located just upstream of the proposed weir. The right bank of the weir site is Tuff and dyke bedrock. Landslide hazard mapping at the Chirukhistsqali weir site is presented as MM drawing number MMD-290039-MNC-SHU-02-112 (Appendix E1). The weir site and surrounding slopes have been given a 'negligible to minor' hazard rating and are not considered susceptible to significant landslides. Minor rockfalls occur on the right bank.

Skhalta Powerhouse

Skhalta powerhouse is located within the dam structure for Skhalta Dam in the Shuakhevi Scheme, see Section 11.4.5.3 for details on the landslide hazards in the area.

11.4.5.3 Shuakhevi Scheme

Skhalta Dam and reservoir

Landslide hazard mapping in the Skhalta valley is presented on MM drawing number MMD-290039-MNC-SHU-02-122 (Appendix E1). With respect to landslide hazards, slopes either side of the dam and reservoir have been assessed as 'minor' hazard. Shallow surface failures in colluvium are considered likely on the left bank and minor rockfalls are considered likely on the right bank. Both of these hazards are considered to be acceptable to the scheme and will have negligible impact on the local population. Geomorphological and hazard mapping identified less stable slopes upstream of the dam on both the right bank and the left bank. These features were rated 'moderate' to 'critical' risk and have been used to define the limit to the upstream extent of the reservoir.

The causal effects of the Tsablana landslide that occurred in 1989 downstream of the dam site are discussed in more detail in the Geotechnical and Geological Report (MM report reference: 290039/MNC/CHY/011/A). The Tsablana catchment area and the catchment area of other tributary valleys on the left bank in the dam and reservoir area have been compared and it is concluded that a similar failure further upstream is highly unlikely to be instigated by construction or operation of the dam and reservoir.

Didachara Dam and reservoir

Landslide hazard mapping around the Didachara dam site is presented on MM drawing number MMD-290039-MNC-SHU-02-132 (Appendix E1).

The left bank near the dam site is formed of a ridge of faulted Andesite-Basalt interbedded with Andesite-Basalt Breccia. The ridge of bedrock has channelled slipped material from a large landslide above the left bank (landslide ID 29 on the hazard maps in Appendix E1) to a location downstream of the dam site. The slopes directly above the dam site are classed as 'Minor' risk. Just downstream of the dam but raised above the valley floor, the left bank slopes are classed as 'Moderate' risk. The landslide is discussed in detail in the Geotechnical and Geological Report (MM report reference: 290039/MNC/CHY/011/A) and not considered to affect or likely to be affected by the scheme.

The right bank comprises bedrock overlain by a variable thickness of colluvium considered to be related to a large landslide complex raised above the valley floor. The slopes in the dam and reservoir area are classified as 'Minor' or 'Moderate' risk associated with the large landslide complex. It is considered that given the thickness of the colluvium typically found to be present on the slopes in the area of the dam and reservoir, mitigation measures including excavation of colluvium and localised slope stabilisation measures can be implemented during construction, and monitoring of the landslide during operation will allow the hazard to be effectively and safely managed. In the remainder of the reservoir area the slopes have been classified as 'Minor' or 'Moderate' risk.

Shuakhevi Powerhouse

Landslide hazard mapping around the powerhouse area is presented on MM drawing number MMD-290039-MNC-SHU-02-142 (Appendix E1). Slopes above the proposed powerhouse location are classified as 'Minor' landslide risk. The slopes are generally considered to have a shallow colluvial cover directly overlying bedrock. Planar rock slope failure is postulated to have occurred to form slopes angles of around 45° above parts of the powerhouse site. As part of normal design procedures the designer will consider the failure mechanisms to ensure slopes are stable throughout construction and operation. Minor rockfall will occur but could be managed during construction and operation of the Scheme.

11.4.5.4 Koromkheti Scheme

Khichauri Dam and reservoir

The landslide mapping has indicated no large scale failures in the location of the dam site. The main hazards are localised rockfall and surface soil movement from the roadside cutting on both the right and left bank where bedrock is exposed. Where the left bank is vegetated mapping showed few localised areas of shallow movement which would have minimal impact should they fail into the reservoir. The risk for these slopes has therefore been classified as 'Minor'.

Chvanistsqali Weir

The left bank side slopes upstream and downstream of the dam site location are bedrock slopes, however, at the current location there is no bedrock exposed. The thickness of the colluvial material is unknown, and therefore the left side slopes have a risk rating of 'Minor' or 'Moderate' with respect to landslides. The width and height above the weir level indicates it is likely to only be a shallow feature. There is little movement at present, and excavation into the toe of the slope is envisaged to be required for construction, this may cause some small instabilities in the immediate vicinity, however this can be managed and mitigated with good engineering design and practice. On the right bank there is a retaining wall for a marshy flat area, thought to be a relict river terrace, behind this are bedrock slopes with only thin colluvial covering and occasional rockfall deposits. This area has therefore been classified as 'Negligible' and 'Minor' risk.

Akavreta Weir

Access was not possible directly to the weir site however both upstream and downstream of the location either side are steep bedrock slopes. There is a relict landslide on the right bank which will not be affected by the weir or ancillary structures as the river level appears to have cut down below the level of the basal slip plane. Therefore it is designated as a risk rating of Minor with respect to landslides.

Koromkheti Powerhouse

The powerhouse is located underground within a spur of bedrock with tunnels exiting the slopes immediately northeast of a small tributary valley. In this area there is a small colluvial fan which is used for arable land and a small dwelling. The switchyard area is proposed to be constructed on a raised platform in front of these slopes which will act as a toe berm and help to stabilise the area. Rockfall and shallow creep of the surface soils are the main hazards identified on the spur itself and are classified on the maps as being a landslide risk of 'Minor'.

11.4.5.5 Khertvisi Scheme

Khertvisi Dam and reservoir

Khertvisi dam is located in a wide section of the Adjarsitsqali River valley between two bedrock outcrops. There are no relict landslides observed in the dam site area only local shallow colluvial failures and local small rockfall events which are shown to be of ‘Minor’ landslide risk. The side slope of the proposed reservoir is within bedrock slopes with thin colluvial covering. On the left bank at the end of the reservoir there is a colluvial wedge, its thickness is unknown and there is little evidence of movement presently. The presence of the reservoir may cause some small instability in the immediate vicinity, however this can be managed and mitigated with good engineering design and practice, therefore this area has been given a ‘Moderate’ landslide risk.

Machakhlistsqali Weir

At the weir site, bedrock is exposed on both sides of the river and there is little evidence of instability in the side slopes, except for where farmers have diverted streams for drainage. This has caused some small (<5 m wide by <1 m deep) slips above the road cutting. There is continual shallow creep movement in the soils on steep slopes, however these are not envisaged to be large magnitude events and therefore are identified as ‘Minor’ landslide risk with mitigation and good engineering practice.

Khertvisi Powerhouse

The Khertvisi powerhouse is to be located underground within a bedrock spur at the intersection between the Adjaristsqali and Chorokhi Rivers. Rockfall in locally oversteepened slopes, i.e. above road cuttings, do occur infrequently and are normally low magnitude events. Where there is no bedrock exposed the soil cover does show signs of shallow slope movement where the slopes are steep, however there is no evidence of large scale landslide events resulting in a ‘Minor’ landslide risk rating. The surge shaft location is coincident with landslide ID 55 on the landslide hazard maps (Appendix E1). This is identified as a ‘Major’ risk with respect to landslides due to it being a potentially complex block detachment and further work to identify the risk associated with this and the depth of colluvial overburden will be required for detailed design.

11.4.6 Seismic Hazards

The maximum design earthquake (MDE) peak horizontal ground acceleration (PGA) is assessed to be 0.35g based on data available in literature and the Map of the Probabilistic Seismic Hazard Assessment Program of UN (1999). The Institute of Earth Science at Illia State University of Georgia has carried out monitoring of a micro seismic network from 15 August 2011 to 15 Decemeber 2011. After the report was received on 15 March the PGA of MDE has been reassessed for the detail design stage. Based on the results of the observations it can be inferred that the hazard of a tectonic fault break of ground surface at the location of the scheme is not great, however the observations of the micro seismicity should continue until the end of the detailed design stage.

Presently there is no confirmation that an active tectonic fault could break ground surface at the locations of the structures in the future. The results of micro seismic observations confirm this.

11.4.7 Construction

During the construction phase of the project there is potential for large volumes of bedrock to be excavated for the tunnels, and smaller volumes of soils removed from side slopes to increase stability and provide a bedrock foundation for the dam abutments. There will be access roads required (both temporary for the construction works and permanent to locally realign roads that would be flooded by the proposed reservoirs) which may involve both excavation and placement of arisings material. The main impacts on landslides, geology and seismicity from these activities are as follows:

- Blasting of tunnels where they come close to the surface may cause shockwaves which could activate landslides. The method of blasting will be in order to minimise shockwaves. An assessment of the energy associated with blasting activities compared to the energy likely to induce landslides indicates that this impact is of **minor adverse significance**.
- Spoil arising from the tunnelling activities can be placed according to good engineering practice and design at the toe areas of identified landslide features acting to improve stability and reduce the risk of future landsliding. This impact is deemed to have a **minor to moderate positive significance**.
- Decreased slope stability due to cuttings for road construction or other temporary works is a well known issue where the cuttings are not supported resulting in local small scale landslides, mudslides and rockfalls. This is likely to increase in wetter months. It is considered that the unmitigated impact of this is **minor adverse significance**, if the cuttings are adequately supported / inclined according to good engineering practice.
- Decreased slope stability due to deforestation – deforestation allows increased infiltration leading to wetter soils and importantly it also removes the slope support provided by the root systems of trees. Any resulting slope failures are not likely to be large magnitude events due to the relatively thin nature of the surface soils, and the impact is therefore a **minor adverse significance**.
- Almost all project works will involve excavation of natural rocks, cutting of formations, moving and or dumping spoil. During tunnel excavations extensive blasting for the bedrock may be required. All these activities will disturb the existing geological formations. This is an **insignificant** impact.
- The excavation of materials from the tunnels and dam footprints will provide a local source of aggregate which may be of use in other construction activities whether related to the proposed project or not. This impact is of **minor positive significance.**
- No change (+/-) in the impact of seismology risk of the area is expected during the project construction phase as none of the project activities is expected to be of such a powerful extent to influence the tectonic risk. However, the low seismic potential of the region can disrupt the project construction activities at any time during construction. For example causing liquefaction in the alluvial soils, ground failure and surface rupture. Based on the current information available, this impact is deemed of **Minor to moderate adverse significance**. The significance of this impact will be better defined following completion of the micro-seismic monitoring.

11.4.8 Operation

During the operational phase of the Adjaristsqali Hydropower Cascade some of the reservoir levels will fluctuate. This will have a negative effect on the side slope stability changing the porewater pressure regime. The dam structures and reservoirs have been cautiously located away from areas at risk of a high magnitude landslide event, therefore the fluctuating reservoir levels may cause only shallow localised slips into the reservoir where the impact will be negligible. This impact is deemed as **minor adverse significance**.

During normal operation the flow in the sections of river between the dam and the powerhouse will be reduced and therefore there will be a reduction in erosion of areas where the river is currently undercutting the slopes. Flushing of the dams will occur during high flow but the river flows will be equivalent to the natural high flows currently experienced. Where reservoirs are present the erosive potential of the river will also have been eliminated. This impact is of **minor positive significance.**

Roads within the valley are regularly affected by rockfalls and small landslide events. The realigned roads will be designed to eliminate this hazard and will bring increased mobility to the local populations. This will be a **minor positive significance**.

Should an earthquake occur that causes the dam to fail / seiche wave to occur due to resonance, the impact would be potentially major. The impacts are considered fully as part of the dam break analysis (a summary of the dam break analysis is included in Appendix C2). It is currently not deemed likely to occur within the lifetime of the scheme and therefore is given a **minor adverse significance**.

11.4.9 Decommissioning

Decommissioning of the project is likely to improve the stability of the side slopes in the reservoir areas as the groundwater levels will cease their fluctuations thereby causing an impact with **minor positive significance**.

The sediments that have accumulated over time within the reservoir will be normally consolidated and likely to be more prone to liquefaction in the event of a significant earthquake. These areas would also be prone to ongoing degradation (erosion and localised debris slides/slips) as the river re-equilibrates with levels downstream of the decommissioned dam site. These areas should be restricted landuse, limiting to agricultural use would result in an impact with **minor adverse significance.**

11.4.10 Cumulative Impacts

Local practices of tree felling for firewood and farmers realigning surface streams for crop drainage occurs in many locations across the site. These are generally small scale local activities and may cause negligible impacts on their own. However, if their scale increased and were to be undertaken on vulnerable slopes around the reservoirs then the cumulative impact may cause larger scale slope instabilities increasing the impact significance rating to minor or moderate.

Unplanned landuse changes or construction activities have the potential to increase the severity of all slope related impacts.

11.5 Mitigation and Enhancement Measures

11.5.1 Overview

The main impacts on the landslides and geology for all aspects of the project are considered to be the potential to cause slope movement and/or ground disturbance. The final scheme layout has been determined with due consideration to the presence of landslides and a risk based assessment of their likely consequence to the scheme. Large deep seated relic landslide features will be avoided by the engineering design, except where it can be demonstrated that a given landslide will not be affected by the scheme.

The mitigation measures identified below are incorporated into the following sections of the assessment to identify any residual impacts after mitigation. Appropriate construction phase mitigation measures for the minimisation of landslide hazards will also be identified for inclusion within the Construction Environmental and Social Management Plan. Construction techniques will be selected with due consideration to the possible impact on landslides.

Following the results and analysis of the micro-seismic network, the scheme and structures will be designed to the correct seismic conditions.

11.5.2 Generic Mitigation and Monitoring Measures

Where feasible the following hierarchy of mitigation measures will be applied to reduce, where possible, the significance of impacts to acceptable levels:

- Mitigation / elimination through design
- Site / technology choice
- Application of best practice.

Shallow or minor landslide features that are not considered to affect the feasibility of the scheme will be considered in the detailed design yet to be undertaken. At that stage, further intrusive investigation and sampling would be undertaken to enable stability analyses and detailed stabilisation design as required. The following generic engineering options are envisaged for mitigating landslide risk during construction and operation:

- Excavation of the landslip mass back to stable in-situ ground
- Buttressing structure at the toe of a landslip
- Drainage measures to control and monitor the groundwater regime
- Soil anchoring or piles
- Toe protection structures where undercutting by the river is identified as a risk
- Placement of material at the toe of a landslip to act as a berm.

11.5.3 Specific Mitigation Measures

Specific mitigation measures to be implemented by the project are listed below:

- Position tunnel portals away from landslide areas rated as Major or Critical risk
- Position dam and reservoirs away from landslide areas rated as Major or Critical risk
- Follow good engineering design and construction practice for temporary and permanent works excavations
- Land purchase in areas such as the Didachara right bank which show signs of shallow movement
- Designs to be appropriate to seismic conditions
- Use low energy explosives for blasting in areas of low overburden
- Reduce where possible the amount of tree felling.

11.6 Summary of Impacts, Mitigation and Residual Significance

The significance of identified and assessed impacts can change through the implementation of mitigation enhancement measures. The residual effects of the project on the geology, landslides and seismicity are identified in Table 11.8.

11.6.1 Residual Impacts

Table 11.8: Summary of Key Significant Impacts and Mitigations

Activity	Potential Impact	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation	Residual Significance
Blasting of tunnels	Where the tunnels come close to the surface may cause shockwaves which could activate landslides.	Medium	Minor	Minor	Position tunnel portals away from landslide areas. Use low energy explosives in areas of low overburden. The method of blasting to minimise shockwaves.	**Insignificant**
Spoil deposition arising from the tunnelling activities	The spoil may be placed according to good engineering practice and design at the toe areas of vulnerable slopes in order to improve stability and used as a source of local aggregate source	Positive Low / Medium	Positive Moderate	Positive Minor to Moderate	n/a	**Positive Minor**
Excavation of natural rocks, cutting of formations moving and or dumping spoil. During tunnel excavations extensive blasting of the bedrock.	Disturb the existing geological formations and consequently the physical features of the local geological formations of the project area will be damaged in some places	Negligible	Major	Insignificant	These activities are an integral part of the project and cannot be avoided.	**Insignificant**
Deforestation / tree felling (during construction) required for access, for road construction for stripping the slopes of the reservoir.	It may also act to reduce soil slope strengths by increasing infiltration from rainfall increasing the short term pore pressures and reducing surface soil strengths and removing the roots which aid to bind the soil.	Low-Medium	Minor	Minor	Reduce where possible the amount of tree felling, reinstate tree cover following decommissioning.	**Insignificant**
Fluctuating reservoir levels during operation.	Decreased slope stability resulting in small scale local failures and rockfalls.	Low	Minor-Moderate	Minor	These activities are integral to the running of the scheme, however where slope instabilities are of concern, then good engineering practice shall be undertaken to mitigate or manage slope movements so as to reduce the impact on the Project and local community.	**Insignificant**
Cuttings for road construction	Decreased slope stability, resulting in local small scale landslides, mudslides and	Low	Minor-Moderate	Minor	The cuttings must be adequately supported / inclined according to good engineering practice.	**Insignificant**

Activity	Potential Impact	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation	Residual Significance
	rockfalls.					
Construction and operational phase	Seismic event causing damage and failure of structures due to liquefaction or ground failure, potentially causing flooding downstream of the dam location / overtopping of the dam causing large scale destruction and casualties.	High	Minor	Moderate	Design for seismic conditions, potential to increase dam freeboard etc. Ongoing monitoring of micro seismic network	**Insignificant**
During normal operation the flow in the sections of river between the dam and the powerhouse will be reduced	A reduction in erosion of areas where the river is currently undercutting the slopes.	Minor	Moderate	Positive Minor	n/a	**Positive Minor**
Decommissioning of the project – removal of the reservoir	Cause lowering of the groundwater table and decrease in porewater pressures so an increase in slope stability.	Positive Low	Positive Minor	Positive Minor	n/a	**Positive Minor**
Decommissioning of the project – removal of the reservoir	The sediments that have accumulated over time within the lake will be normally consolidated and likely to be more prone to liquefaction so for re-settlement of dwellings may cause casualties.	Medium	Minor	Moderate	Prevent settlements in these areas by remaining owners of the land	**Insignificant**
Decommissioning of the project – removal of the reservoir	If this area is to be farmed / built upon it is weaker ground and this combined with the erosion by the river in the normally consolidated materials may cause mudslides	High	Minor	Moderate	Landuse restrictions	**adverse minor impact**

11.7 Proposed Monitoring and Reporting

The Micro-Seismic Network monitoring is ongoing and results will be presented in March 2012. It will then be determined if this should be monitored throughout the construction phase.

Monitoring requirements for specific landslide features during construction will be determined during detailed design.

Due to the knowledge that the landslide and slope environment is a dynamic one, walkovers by suitable qualified engineering geomorphologists of the reservoir areas should be undertaken on a bi-annual basis for the first 10 years of operation to confirm the landslide risk has not changed. Changes in slope conditions attributed to the project should be identified and prevention measures implemented via the mitigation measures identified in Section 1.5. A report should be prepared identifying any areas of instability which may cause a major adverse impact with appropriate recommendations for mitigation.

11.8 Statement of Significance and Compliance

There are no national or international standards specifically relating to development in landslide prone areas to comply with.

This chapter has assessed the impacts of the project on the geology, landslides and seismicity in the project area. The dam and reservoirs, weir sites and powerhouse locations have been located in areas where there is a low adverse affect from landslides during construction and operation of the project. It is identified therefore that the project is unlikely to have a significant impact on landslides as the locations identified are shown to be in areas of Minor or Negligible landslide risk. Where there are areas of Moderate landslide risk, it is likely that minimal mitigation measures will be required and these will be subject to detailed design. The project is not thought to have an impact on seismicity, however the project itself can be impacted by seismicity at any time and will be designed in accordance to the seismic conditions of the region. The geology of the region is not thought to be negatively impacted by the project.

12. Materials and Waste Management

12.1 Introduction

This Section outlines information about raw materials and key waste arisings expected during the construction, operation and decommissioning phases of the three principal Schemes of the Project; The Suakhevi, The Koromkheti and The Khertvisi, and recommendations for its management.

Waste management is a key aspect to be assessed by the Project in order to achieve minimisation of raw material consumption and ensure that any final treatment or disposal of wastes generated by the Project is conducted in an environmentally sound manner, particularly for hazardous wastes.

12.1.1 General Approach

The scope of this chapter is limited to material usage and all solid wastes and those liquid wastes that are not treated via wastewater treatment works. The Section is structured as follows:

- A brief overview of the relevant international waste management best practice requirements
- A description of the material usage and expected waste arising as a result of the Project
- An outline of existing local and regional waste management infrastructure
- The methodology employed in assessing the significance of impacts associated with the generation of waste from the Project
- An assessment is made of the significance of impacts associated with materials usage and waste arisings from the principal component parts of the Project
- A series of mitigation measures for the appropriate management of materials and waste
- A strategy for the storage, handling and use of raw materials
- A proposed waste management strategy
- A summary and statement of the significance of any residual impacts is made.

12.2 Methodology and Assessment Criteria

12.2.1 International Requirements

12.2.1.1 International Finance Corporation (IFC)

IFC Performance Standard 3 on Pollution Prevention and Abatement requires reference to be made to the relevant EHS Guidelines; these are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The following IFC EHS Guidelines contain relevant information related to waste management for the Project:

- The IFC EHS Guidelines for Construction Materials Extraction (2007)
- The IFC General EHS Guidelines (2007).

The IFC EHS Guidelines for Construction Materials Extraction state that rock waste and removed topsoil overburden are the main inert wastes typically produced by materials extraction. Hazardous wastes maybe generated from impurities and trace components included in the exploited (waste) rocks (e.g. asbestos or heavy metals or minerals that could result in acidic runoff). The recommended prevention and control methods to reduce material extraction wastes include the following:

- Operational design and planning should include procedures for the reduction of waste production (e.g. blending high-quality rock with poor rock)

- Topsoil, overburden, and low-quality materials should be properly removed, stockpiled near the site, and preserved for rehabilitation
- Hazardous and non-hazardous waste management plans should be developed and adopted during the design and planning phase. Impacts associated with specific chemical and / or physical properties of extracted materials should be considered during the design phase, and impacts from waste rock impurities should be adequately controlled and mitigated by covering waste disposals with non-contaminated soil.

In a general sense, all waste material arisings (regardless of the stage of the Project) should be segregated into non-hazardous and hazardous wastes for consideration for re-use, recycling, or disposal. Waste management planning should establish a clear strategy for wastes that will be generated including options for waste elimination, reduction or recycling or treatment and disposal, before any wastes are generated. A Project specific waste management plan documenting the waste strategy, storage (including facilities and locations) and handling procedures should be developed and should include a clear waste tracking mechanism to track waste consignments from the originating location to the final waste treatment and disposal location.

These guidelines have been used to frame the waste management approach for the Project and assess the Project's ability to meet GIIP.

With respect to material usage, IFC Performance Standard 3 requires the Project to implement technically and financially feasible measures for improving efficiency in the consumption of material inputs. This applies across all Project phases.

12.2.1.2 European Bank for Reconstruction and Development (EBRD)

With respect to waste management, Performance Requirement 3: Pollution Prevention and Abatement is the most relevant and states that Projects should avoid or minimise the generation of hazardous and non-hazardous waste materials and reduce harmfulness as far as practicable. Where waste generation cannot be avoided but has been minimised, the Project should seek to reuse, recycle or recover waste, or use it as a source of energy. Where recovery or reuse is not feasible, the Project is to treat, destroy, and dispose of it in an environmentally sound manner.

If the generated waste is considered hazardous, the Project should explore commercially available alternatives for environmentally sound disposal. When waste disposal is conducted by third parties, the Project should seek to use contractors that are reputable and legitimate enterprises licensed by the relevant regulatory agencies.

12.2.2 Methodology

12.2.2.1 Determining Sensitivity, Magnitude and Significance

Impact significance as a result of waste arisings from the Project has been determined based on a function of the expected sensitivity of the receiving environment / receptor(s) to waste related impacts and the resultant magnitude of any identified impact on the receiving environment / receptor(s).

There are a range of impacts which can occur from the mismanagement of waste arising from the construction and operation of run of river hydropower schemes. Therefore materials and waste handling impact assessment is primarily about identifying waste streams and adopting an appropriate best practice management approach which seeks to avoid the generation of waste in the first instance, rather than mitigating potential impacts to a defined baseline environment.

Nevertheless, the sensitivity and magnitude approach has been adopted in order to demonstrate the different expected outcomes and impacts associated with waste arisings in the non-management / management strategy scenarios.

The criteria for determining sensitivity and magnitude are defined in Table 12.1 and Table 12.2 respectively.

Table 12.1: Criteria for Determining Sensitivity

Magnitude (positive or negative)	Definition (considers duration of the impact, spatial extent, reversibility and ability of comply with legislation)
High	Waste and / or materials handling related incident impacts on a vulnerable receptor (human or ecological) with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.
Medium	Waste and / or materials handling related incident impacts on a vulnerable receptor (human or ecological) with limited capacity to absorb proposed changes or limited opportunities for mitigation.
Low	Waste and / or materials handling related incident impacts on a vulnerable receptor (human or ecological) with some capacity to absorb proposed changes or moderate opportunities for mitigation.
Negligible	Waste and / or materials handling related incident impacts on a vulnerable receptor (human or ecological) with good capacity to absorb proposed changes or and good opportunities for mitigation.

Table 12.2: Criteria for Determining Magnitude

Magnitude (positive or negative)	Definition (considers duration of the impact, spatial extent, reversibility and ability of comply with legislation)
Major	Mismanagement of waste arising and / or materials results in a significant incident which potentially causes a fundamental change to the specific environmental conditions assessed resulting in long term or permanent change, typically widespread in nature (regional national and international), would require significant intervention to return to baseline; exceed national standards and limits.
Moderate	Mismanagement of waste arising and / or materials results in an incident that causes a detectable change to the specific environmental conditions assessed resulting in non-fundamental temporary or permanent change.
Minor	Mismanagement of waste arising and / or materials results in an incident that causes a detectable but minor change to the specific environmental conditions assessed.
Negligible	Mismanagement of waste arising and / or materials results in an incident that causes no perceptible change to the specific environmental conditions assessed.

The significance has been determined by the interaction between the magnitude of impacts and the sensitivity of receptors affected, as depicted in the significance matrix shown in Section 5.3.4.4.

12.2.3 Data Limitations

All waste streams presented in this Chapter are based on current plans for the Project. They are subject to confirmation once an EPC contractor has been engaged and the exact construction methodology is determined.

However, the principal waste streams are believed to have been identified and therefore the waste management protocols and philosophy presented in this chapter would not be expected to change significantly as a result of relatively minor modifications to the actual waste streams which are ultimately generated as a result of the Project.

12.3 Baseline Description

12.3.1 National Overview

Waste management in Georgia has a low level of regulation and there is an absence of an overall, national waste management strategy and a weak legislative framework. Many landfill sites implement limited safe disposal practices and apply few engineered environmental protection measures.

There is often no separation made between contaminated and non-contaminated waste streams, such as household and commercial types of waste. Due to ongoing problems associated with poorly engineered landfills site, the Tbilisi City Government decided to construct a new landfill for the City of Tbilisi. This landfill was designed to meet environmental standards at the national level, as well as taking into account wider EU requirements and global UNEP experience related to landfills and waste disposal practices.

In the Adjara Region, most waste is managed through landfill sites which are poorly managed and rarely compliant with the waste permitting system. All landfills within Georgia were required to obtain an official permit by 2010 according to the national law, but many of them failed to do so, including Batumi landfill. The closest landfill to the Adjara Region which holds an official permit is in Ozurgeti (Guria Region), however, this landfill is considered to be in a poor condition.

A summary of the current waste management infrastructure in each of the municipalities covered by the Project is presented in the following sections.

12.3.1.1 Batumi

Batumi has had a functioning landfill site since 1969 but it currently operates without a permit. The Batumi landfill and surrounding area covers 19 h, or which 11 h is being operated and the rest is closed. Until now, 3.5 billion tones of waste have been disposed of there and the landfill is located around 100-150 m from the Sea. The Batumi landfill serves a range of towns in the Adjara Region, including Khulo.

12.3.1.2 Khulo

The Khulo Municipality does not have its own hazardous waste landfill so instead hazardous waste and hospital waste is collected three times a week and transported to the Batumi landfill. Construction waste in Khulo is used for road construction, new buildings or as fill. As construction waste is generated in relatively small quantities, it is generally re-used locally.

12.3.1.3 Qeda

The Qeda Municipality does not have its own landfill and all hazardous waste is collected three times a week and transported to Batumi landfill. All construction waste generated in Qeda is buried in Dzendzma Village, and all hospital waste is collected from the Hospital by the "Sandasuptaveba" organisation which has a contract with Qeda municipality.

12.3.1.4 Shuakhevi

The Shuakhevi Municipality does not have their own landfill site. All hazardous waste is collected three times per week and transported to Batumi Landfill. With regards to construction waste, it is up to the waste generator to handle and dispose of the waste. Regarding hospital waste streams, Qeda Municipality has a contract with the "Sandasuptaveba" who collect the waste and dispose of it.

12.3.2 Existing Waste Management Operations

There are no existing waste management activities in relation to the Project as it represents three new build Schemes and hence planned infrastructure and all waste arisings associated with the Project will occur in the future.

12.4 Assessment of Impacts

12.4.1 Introduction

Potential impacts associated with the handling and use of raw materials includes the following;
- Use of potentially finite and / or scarce resources
- Handling and storage of hazardous materials. Spills and leakages of hazardous materials which lead to an environmental incident
- Embedded CO_2 emissions associated with the production of concrete.

Wastes will be generated during both the construction and operational phases and at the eventual decommissioning of the Project for which appropriate waste management, minimisation and disposal practices will need to be established. The likely waste types from both the construction and operational phases of the Project include solid, liquid, hazardous, non hazardous and inert wastes.

Potential hazardous waste materials generated during construction across the Project sites include: oils and solvents (including empty containers, oily rags, clean up materials, hydraulic fluids, lubricants, etc.); paints; coatings; contaminated ground (potentially from leakage and spillage); used batteries; etc. Management of these hazardous wastes will require particular consideration, particularly any final treatment or disposal options.

The principal potential impacts which can arise from the generation of waste from all phase of the Project are as follows:
- Contamination of receiving environments (particularly surface watercourses, groundwater and the ground) due to leakage and spillage of wastes associated with poor waste handling and storage arrangements
- Fugitive emissions, such as dust and odour, associated with the handling and storage of some waste streams
- The use of landfill, where waste re-use or recovery is not feasible, which is a finite resource;
- Disposal of spoil and excavation material which results in land take
- Visual amenity impacts associated with poor storage of waste
- Increased waste miles from transporting waste materials from the Project site.

12.4.2 Construction

12.4.2.1 Overview

Construction waste is expected to be generated as part of the development of new roads and bridges and the components of each of the three Schemes which constitute the Project. There will also be significant quantities of raw materials consumed as part of this phase.

This Section aims to characterise the raw materials to be consumed and the waste streams which are envisaged to arise from all directly related construction activities associated with the development of the Project.

12.4.2.2 Materials Use

The principal materials that are expected to be required / consumed as part of the construction specific components of each Scheme and the Project are summarised in Table 12.3.

Table 12.3: Estimated construction phase materials

Activity / Scheme component	Material
Concrete works	Cement (TS19, PC42.5)
	Concrete (sand-gravel, crushed material pumped, crushed material pumped reinforced, slurry, RCC concrete)
	Shotcrete additives
	Shotcrete underground
	Crushed material pumped underground
Drainage works	PVC Waterstops
	Concrete drainage pipe
	PVC drainage pipe
	Backfill
	Waterproofing
Formwork and reinforcement	Fi 14 or larger reinforcement steel
	Trashracks and steel gates
	Radial gates and embedded parts
	Penstocks, steel supports and valves
	Steel fibres
	Steel roof truss
	Howell-Burger valve
	Anchorage steel
Clearing and stabilisation works	Concrete
	Anchorage steel
	Fill
Grouting works	Fi 14 or larger reinforcement steel
	Diaphragm wall
	Grouting
	Contact grouting in tunnel/gallery
	Cement (TS19, PC 42.5)
	Bentonite

Activity / Scheme component	Material
Hauling and transportation	Fill material
	Excavation material
	Concrete aggregates
	Rock material
	Cement and additives
	Bentonite
	Steel
Transportation	Precast access bridge
Other	Furniture and architectural finishes

Source: AGL

The most significant material which is expected to be used as part of the construction phase is the various grades of concrete, shotcrete and cement which are required. The primary environmental impact associated with the use of concrete is the embedded CO_2 associated with the chemical process and heat input required for its production. This is considered further as part of Chapter 17.

It is not envisaged that any pesticides will be required as part of the construction phase of the Project. Pests may include rodents associated with ongoing waste management. These will be controlled through good housekeeping of waste management areas and non-chemical methods of eradicating rodents if required.

12.4.2.3 Waste Generation

For the purposes of the construction phase it is envisaged that there will be the following project staff quarters / facilities and maintenance / construction areas;

- Shuakhevi Scheme
  - Staff quarters located near Shuakhevi Powerhouse for 400 families
  - Staff quarters at Chirukhi weir, Skhalta powerhouse and barrage and Didachara dam, each sized to house 150 families
  - Site facilities, which will include a concrete batching plant and mixing plant, main stores and a workshop located at Chirukhi weir, Skhalta powerhouse and barrage and Didachara dam
  - Site offices located at Diakonidze Adit, Adit 1, Adit 2 and Surge Shaft Adit.
- Koromkheti
  - Staff quarters located near Koromkheti Powerhouse for 400 families
  - Staff quarters at Chvanistsqali weir sized to house 150 families
  - Site facilities, which will include a concrete batching plant and mixing plant, main stores and a workshop located at Chvanistsqali weir, Koromkheti powerhouse, Adit 4, Akavreta Adit, Surge Shaft Adit
  - Site offices located at Adit 4, Akavreta Adit and Surge Shaft Adit.
- Khertvisi
  - Staff quarters located near Khertvisi Powerhouse for 300 families
  - Staff quarters at Khertvisi concrete barrage sized to house 120 families
  - Site facilities, which will include a concrete batching plant and mixing plant, main stores and a workshop located at Khertvisi concrete barrage, Machakhela weir, Khertvisi powerhouse and the adits of the two headrace tunnels
  - Site offices located at the adits of the two headrace tunnels.

Considering the proposed facilities and construction works, the following waste streams are expected to be generated as part of the construction phase of each scheme:

- Excavation spoil associated with tunnelling and creating foundations for dams and other buildings
- Concrete and concrete washings from concrete batching plants required for the construction of dams and weirs
- Iron and steel scrap associated with weirs and other construction
- Non-ferrous scrap associated with weirs and other construction
- Bricks and tiles from constructing buildings
- Waste oil and lubricants from turbine installation and vehicle maintenance / repair
- Oil contaminated cloths from turbine installation and vehicle maintenance / repair
- Packaging and pallets from deliveries
- Domestic waste, including glass, plastics, paper and cardboard
- Batteries
- Fluorescent tubes
- Timber
- Paints and chemicals
- Tyres.

By far the most significant waste stream (in terms of volume) which will be generated as a result of the construction phase of the Project is spoil due to tunnelling activities. Table 12.4 presents the spoil arising which is envisaged to be generated as a result the construction phase of each scheme.

Table 12.4: Spoil arisings from the construction phase of the schemes

Scheme / Activity	Source	Estimated Quantity (m^3)
Shuakhevi		
Construction of Chirukhi weir, sediment trap and river intake	Foundation excavation	80,000
Construction of 5.7 km unlined transfer / headrace tunnel to Skhalta Reservoir / Skhalta Powerhouse	Tunnelling	142,000
Construction of Skhalta Concrete Barrage and Skhalta Powerhouse	Foundation excavation	144,000
Construction of 8.5 km unlined transfer tunnel	Tunnelling	450,000
Construction of Didachara dam	Foundation excavation	70,000
Construction of 16.87 km unlined headrace tunnel	Rock and tunnel excavation	990,000
	Adits	225,000
	Surge Shaft Adit	244,000
	Pressure Shaft	78,000
Construction of Shuakhevi Powerhouse	Foundation excavation	8,000
	TOTAL FOR SHUAKHEVI	**2,431,000**
Koromkheti		
Construction of Chvanistsqali weir, sediment trap and run of river intake	Foundation excavation	5,000
Construction of 1 km unlined transfer tunnel	Tunnelling	50,000
Construction of Khichauri concrete barrage	Foundation excavation	198,000
Construction of 23.9 km concrete lined headrace tunnel	Rock and tunnel excavation	1,570,000
	Adits	104,000

Scheme / Activity	Source	Estimated Quantity (m^3)
	Pressure Shaft	8,000
	Surge Shaft Adit	150,000
Construction of Akavreta weir, sediment trap and intake	Foundation excavation	6,000
Construction of Koromkheti Powerhouse	Foundation excavation	12,000
	Cavern and tunnel excavation	195,000
	TOTAL FOR KOROMKHETI	**2,298,000**
Khertvisi		
Construction of Khertvisi concrete barrage	Foundation excavation	123,000
Construction of 11.7 km concrete lined headrace tunnel	Tunnelling	960,000
	Adits	23,000
	Khertvisi Surge Shaft	170,000
Construction of Machakhela weir, sediment trap and river intake	Foundation excavation	91,000
Construction of 2 km concrete lined headrace tunnel	Tunnelling	183,000
Construction of Khertvisi Powerhouse	Foundation excavation	385,000
	TOTAL FOR KHERTVISI	**1,935,000**

Source: AGL

The potential environmental impact, proposed handling / storage and off site disposal methods for each of the waste streams highlighted above and in Table 12.4 are presented in Table 12.5.

Table 12.5: Potential environmental impact, proposed handling / storage and off site disposal methods

Waste Type	Potential Impact	Potential Significance	Handling / Storage Method	Disposal Method
Excavation spoil	• Contamination of receiving environments • Fugitive emissions • Disposal of spoil and excavation material which results in land take	Major	No storage. If quality permits, spoil material will be used for concrete formation and establishing foundations (e.g. crushed material pumped concrete, road aggregate etc). Excess material will be disposed of in spoil disposal sites.	Spoil disposal site. This is discussed further in Section 12.5.3.2.
Concrete	• Fugitive emissions • The use of landfill, where waste re-use or recovery is not feasible • Increased waste miles from transporting waste materials from the Project site	Major	Segregated according to European Waste catalogue (EWC) code and suitably stored in a waste management area.	Further investigation required by AGL in conjunction with the EPC Contractor. Collection by competent carrier for crushing and re-use. Potential uses include road developments and as aggregate.
Concrete washings	• Contamination of receiving environments	Moderate	Wash water which can't be immediately reused is to be stored in an open lined pit or open tanks so as to aid evaporation.	Concrete wash water to be reused on site wherever possible. On site concrete batching should include wash water recirculation. Remaining wash water to be stored and allowed to

Waste Type	Potential Impact	Potential Significance	Handling / Storage Method	Disposal Method
				evaporate. Any remaining wash water to be fully treated (fine solids removed by filtration or settlement and pH corrected to 6-9) before being discharged to surface water only (i.e. not to bare ground).
Iron and steel scrap	• The use of landfill, where waste re-use or recovery is not feasible • Visual amenity impacts associated with poor storage of waste • Increased waste miles from transporting waste materials from the Project site.	Moderate	Segregated according to EWC code and suitably stored in a waste management area.	Further investigation required by AGL in conjunction with the EPC Contractor. Collected by competent carrier for recycling.
Non-ferrous scrap	• The use of landfill, where waste re-use or recovery is not feasible • Visual amenity impacts associated with poor storage of waste • Increased waste miles from transporting waste materials from the Project site.	Moderate	Segregated according to EWC code and suitably stored in a waste management area.	Further investigation required by AGL in conjunction with the EPC Contractor. Collected by competent carrier for recycling.
Bricks and tiles	• The use of landfill, where waste re-use or recovery is not feasible	Moderate	Segregated according to EWC code and suitably stored in a waste management area.	Recovery and re-use options to be fully explored. Collected by a competent carrier. Where recovery and re-use is not feasible then disposal in a licensed facility.
Oils and lubricants	• **Hazardous**. Contamination of receiving environments • The use of landfill, where waste re-use or recovery is not feasible	Major	**Hazardous**. Collected in bunded, segregated drums within a waste management area.	Recovery and re-use options to be fully explored. Collected by a competent carrier. Where recovery and re-use is not feasible then disposal in a licensed facility.
Oil contaminated cloths	• **Hazardous**. Contamination of receiving environments • The use of landfill, where waste re-use or recovery is not feasible	Major	**Hazardous**. Segregated according to EWC code and suitably stored in a waste management area.	Further investigation required by AGL in conjunction with the EPC Contractor. Collected by competent carrier to be disposed of in a licensed facility.
Packaging	• The use of landfill,	Minor	Segregated according to EWC	Further investigation

Waste Type	Potential Impact	Potential Significance	Handling / Storage Method	Disposal Method
	where waste re-use or recovery is not feasible • Visual amenity impacts associated with poor storage of waste • Increased waste miles from transporting waste materials from the Project site.		code and suitably stored in a waste management area.	required by AGL in conjunction with the EPC Contractor. Collected by a competent carrier for recycling.
Pallets	• The use of landfill, where waste re-use or recovery is not feasible • Increased waste miles from transporting waste materials from the Project site.	Minor	Segregated according to EWC code and suitably stored in a waste management area.	Further investigation required by AGL in conjunction with the EPC Contractor. Collected by a competent carrier for recovery and re-use.
General domestic waste	• The use of landfill, where waste re-use or recovery is not feasible • Visual amenity impacts associated with poor storage of waste • Increased waste miles from transporting waste materials from the Project site.	Moderate	Segregated according to EWC code and suitably stored in a waste management area.	Collected by a competent carrier for disposal to landfill. This may need to be transported to Tblisi due to the low quality of landfills immediately surrounding the Project area. Further investigation required by AGL in conjunction with the EPC Contractor.
Glass	• The use of landfill, where waste re-use or recovery is not feasible • Increased waste miles from transporting waste materials from the Project site.	Minor	Segregated according to EWC code and suitably stored in a waste management area.	Further investigation required by AGL in conjunction with the EPC Contractor. Collected by a competent carrier for recycling.
Plastics	• The use of landfill, where waste re-use or recovery is not feasible • Visual amenity impacts associated with poor storage of waste • Increased waste miles from transporting waste materials from the Project site.	Minor	Segregated according to EWC code and suitably stored in a waste management area.	Further investigation required by AGL in conjunction with the EPC Contractor. Collected by a competent carrier for recycling.
Paper and cardboard	• The use of landfill, where waste re-use or recovery is not feasible • Visual amenity impacts associated	Minor	Segregated according to EWC code and suitably stored in a waste management area.	Further investigation required by AGL in conjunction with the EPC Contractor. Collected by a competent carrier for recycling.

Waste Type	Potential Impact	Potential Significance	Handling / Storage Method	Disposal Method
	with poor storage of waste • Increased waste miles from transporting waste materials from the Project site.			
Batteries	• **Hazardous**. Contamination of receiving environments • The use of landfill, where waste re-use or recovery is not feasible	Major	**Hazardous**. Segregated according to EWC code and suitably stored in a waste management area.	Recycling options to be fully explored. Collected by a competent carrier. Where recycling is not feasible then disposal in a licensed facility.
Fluorescent tubes	• **Hazardous**. Contamination of receiving environments • The use of landfill, where waste re-use or recovery is not feasible	Major	**Hazardous**. Segregated according to EWC code and suitably stored in a waste management area.	Further investigation required by AGL in conjunction with the EPC Contractor. Collected by a competent carrier for recovery and re-use.
Timber	• The use of landfill, where waste re-use or recovery is not feasible	Minor	Segregated according to EWC code and suitably stored in a waste management area.	Further investigation required by AGL in conjunction with the EPC Contractor. Collected by a competent carrier for recycling.
Paints and chemicals	• **Hazardous**. Contamination of receiving environments • The use of landfill, where waste re-use or recovery is not feasible	Major	**Hazardous.** Collected in bunded, segregated drums within a waste management area.	Recovery and re-use options to be fully explored. Collected by a competent carrier. Where recovery and re-use is not feasible then disposal in a licensed facility.
Tyres	• The use of landfill, where waste re-use or recovery is not feasible • Visual amenity impacts associated with poor storage of waste; and	Minor	Segregated according to EWC code and suitably stored in a waste management area.	Further investigation required by AGL in conjunction with the EPC Contractor. Collected by a competent carrier for recycling.

Source: AGL

A review is currently being undertaken of the locally available re-use, recycling and disposal options to ensure that they will be available to accept the relevant waste streams during the construction phase of the Project.

As noted in Section 12.3.1, the general quality of landfill sites immediately surrounding the Project area is considered to be low. Therefore, there maybe the requirements to transport non-useable / recyclable / recoverable wastes to Tblisi which has an engineered and permitted landfill site that offers better environmental protection.

12.4.3 Operation

12.4.3.1 Materials Use

During the operational phase it is envisaged that the following materials will be used:
- Cement and concrete during maintenance and outage activities
- Chemical, paints, oils and fuels
- Wood and timber
- Ferrous and non-ferrous metals
- Fluroescent tubes
- Batteries
- Plastic
- Glass
- Paper and cardboard.

Exact quantities will be dependent upon the optimised operating regime of each scheme and the frequency of maintenance / outage activities.

It is not envisaged that any pesticides will be required as part of the operational phase of the Project. Pests may include rodents associated with ongoing waste management. These will be controlled through good housekeeping of waste management areas and non-chemical methods of eradicating rodents if required.

12.4.3.2 Waste Generation

Once each scheme becomes operational the volumes of waste generated are expected to emanate primarily from the worker's facilities, offices and any maintenance related activities. It will however be significantly less than that generated during the construction phase. Table 12.6 presents the waste arisings which are envisaged to be generated as a result the operational phase of the Project.

Table 12.6: Overview of the operational phase waste handling strategy for the Project

Waste	Source	Potential environmental Impact	Potential significance	Disposal method	Compliance with IFC EHS Guidelines
Fluorescent tubes	Associated with routine and on-going maintenance in facilities and workshops	• **Hazardous** • Fluorescent tubes contain mercury • Use of finite landfill resource	Major	Further investigation required by AGL in conjunction with the EPC Contractor and options then carried over to the operational phase. Collected by a competent carrier for recovery and re-use.	Yes – Recycling or re-use of waste streams where possible instead of disposal is considered best practice
Contaminated packaging	Primarily associated with any chemical deliveries	• **Hazardous** • Unknown contaminants and potential contamination of receiving environments • Use of finite landfill resource	Major	Further investigation required by AGL in conjunction with the EPC Contractor and options then carried over to the operational phase. Collected by a competent carrier for recovery and re-use.	Yes – Recycling or re-use of waste streams where possible instead of disposal is considered best practice
Waste oil	Associated with routine and on-going maintenance in the facility and outages	• **Hazardous** • Potential contamination of receiving environment	Major	Recovery and re-use options to be fully explored. Collected by a competent carrier. Where recovery and re-use is not feasible then disposal in a licensed facility.	Yes – Recycling or re-use of waste streams where possible instead of disposal is considered best practice
Oil contaminated cloths	Associated with routine and on-going maintenance in the facility and outages	• **Hazardous** • Potential contamination of receiving environment	Major	Recovery and re-use options to be fully explored. Collected by a competent carrier. Where recovery and re-use is not feasible then disposal in a licensed facility.	Yes – Recycling or re-use of waste streams where possible instead of disposal is considered best practice
Paints and chemicals	Associated with routine and on-going maintenance in the facility and outages	• **Hazardous** • Potential contamination of receiving environment	Major	Recovery and re-use options to be fully explored. Collected by a competent carrier. Where recovery and re-use is not feasible then disposal in a licensed facility.	Yes – Recycling or re-use of waste streams where possible instead of disposal is considered best practice
Batteries	Associated with routine and on-going maintenance in the facility and outages	• **Hazardous** • Potential contamination of receiving environment	Major	Recycling options to be fully explored. Collected by a competent carrier. Where recycling is not feasible then disposal in a licensed facility.	Yes – Recycling or re-use of waste streams where possible instead of disposal is considered best practice
Waste Electronics and Electrical Equipment	Maintenance and replacement of electrical equipment	• **Hazardous** • Potential contamination of receiving environment • May contain heavy metals	Major	Recycling options to be fully explored. Collected by a competent carrier. Where recycling is not feasible then disposal in a licensed facility.	Yes – Recycling or re-use of waste streams where possible instead of disposal is considered

Waste	Source	Potential environmental Impact	Potential significance	Disposal method	Compliance with IFC EHS Guidelines
(WEEE)		depending on the item			best practice
Concrete	Associated with outages and maintenance	• Recovery potential • Visual amenity impacts • Use of finite landfill resource	Major	Further investigation required by AGL in conjunction with the EPC Contractor and options then carried over to the operational phase. Collected by a competent carrier for recovery and re-use.	Yes – Recycling or re-use of waste streams where possible instead of disposal is considered best practice
Concrete washings	Associated with outages and maintenance	• Potential contamination of receiving environment	Major	Concrete wash water to be reused on site wherever possible. On site concrete batching should include wash water recirculation. Remaining wash water to be stored and allowed to evaporate. Any remaining wash water to be fully treated (fine solids removed by filtration or settlement and pH corrected to 6-9) before being discharged to surface water only (i.e. not to bare ground).	Yes – This approach is in accordance with The IFC EHS Guidelines for Construction Materials Extraction (2007) and The IFC General EHS Guidelines (2007).
General domestic waste	Kitchen and workers facilities	• Potential contamination of receiving environment. • Visual amenity impacts • Use of finite landfill resource	Minor	Recyclable components to be fully segregated (see the following rows). Residual waste to be disposed of to landfill. **Note. Most landfill sites in the Adjara region are not appropriately engineered or licensed. This material may need to be taken to Tbilisi for fin al disposal.**	Yes – Recycling or re-use of waste streams where possible instead of disposal is considered best practice
Paper and Cardboard	From packaging and deliveries etc	• Potential contamination of receiving environment. • Visual amenity impacts	Minor	Recycling options to be fully explored. Collected by a competent carrier. Where recycling is not feasible then disposal in a licensed facility.	Yes – Recycling or re-use of waste streams where possible instead of disposal is considered best practice
Plastic	From packaging and deliveries etc	• Potential contamination of receiving environment. • Visual amenity impacts	Minor	Recycling options to be fully explored. Collected by a competent carrier. Where recycling is not feasible then disposal in a licensed facility.	Yes – Recycling or re-use of waste streams where possible instead of disposal is considered best practice
Glass	Maintenance, deliveries, workers facilities	• Potential contamination of receiving environment. • Recycling potential.	Minor	Recycling options to be fully explored. Collected by a competent carrier. Where recycling is not feasible then disposal in a licensed facility.	Yes – Recycling or re-use of waste streams where possible instead of disposal is considered best practice
Iron and steel	Associated with	• Potential contamination of	Moderate	Further investigation required by AGL in conjunction with	Yes – Recycling or re-use

Waste	Source	Potential environmental Impact	Potential significance	Disposal method	Compliance with IFC EHS Guidelines
scrap	outages and maintenance	receiving environment. • Visual amenity impacts. • Recycling potential.		the EPC Contractor and options then carried over to the operational phase. Collected by a competent carrier for recovery and re-use.	of waste streams where possible instead of disposal is considered best practice
Non-ferrous scrap	Associated with outages and maintenance	• Potential contamination of receiving environment. • Visual amenity impacts. • Recycling potential.	Moderate	Further investigation required by AGL in conjunction with the EPC Contractor and options then carried over to the operational phase. Collected by a competent carrier for recovery and re-use.	Yes – Recycling or re-use of waste streams where possible instead of disposal is considered best practice
Pallets	Associated with deliveries	• Potential contamination of receiving environment. • Visual amenity impacts	Minor	Further investigation required by AGL in conjunction with the EPC Contractor and options then carried over to the operational phase. Collected by a competent carrier for recovery and re-use.	Yes – Recycling or re-use of waste streams where possible instead of disposal is considered best practice
Timber	Associated with routine and on-going maintenance in the facility and outages	• Recycling potential.	Minor	Further investigation required by AGL in conjunction with the EPC Contractor and options then carried over to the operational phase. Collected by a competent carrier for recovery and re-use.	Yes – Recycling or re-use of waste streams where possible instead of disposal is considered best practice
Green waste	From the surrounding settlements and the facility	• Potential contamination of receiving environment • Composting potential	Minor	Collected and stored. To be re-used as low grade compost material for landscaping.	Yes – Recycling or re-use of waste streams where possible instead of disposal is considered best practice

Source: MML / GEG

A review is currently being undertaken of the locally available re-use, recycling and disposal options to ensure that they will be available to accept the relevant waste streams during the operational phase of the Project.

12.4.4 Decommissioning

The principal pieces of infrastructure which will require removal as part of the decommissioning phase are as follows;

- Weirs and sediment traps
- Lined and unlined transfer and headrace tunnels
- Concrete weirs and dams
- Powerhouse (including installed turbines and generators)
- Switchgear and overhead transmission line infrastructure
- Buildings (offices and accommodation) and workshops.

From a waste management perspective the principal waste stream likely to be generated during decommissioning is the large volumes of concrete associated with the weirs, dams, tunnels and the powerhouse. The turbines and associated components will also be of significance.

Advanced planning will be required in order to categorise each waste stream and identify a potential re-use / recovery option. This will be particularly important for concrete given the large quantities likely to be generated.

Prior to decommissioning, an appropriate contractor will be appointed who will be required to prepare a decommissioning environmental management plan (DEMP). This will document current best practice at the time for decommissioning concrete dams, weirs, headrace tunnels and other associated infrastructure. The DEMP will need to include a section on waste management detailing the environmental protection controls which will be put in place for the storage, safe handling arrangements of each waste stream and the recovery / re-use / recycling pathways, or disposal methods for those wastes which can't be recovered, re-used or recycled.

12.4.5 Transboundary Impacts

All waste is expected to be handled, transported and subsequently treated / disposed within Georgia. Therefore, no transboundary impacts associated with waste are deemed to be applicable to this Project.

12.4.6 Cumulative Impacts

It is believed that a significant proportion of the waste arisings from this Project can be re-used or recycled and that there are a number of enterprises within Georgia with the capability to process these waste streams accordingly. However, these opportunities need to be investigated further by AGL in conjunction with the Contractor, prior to the construction phase commencing.

Cumulative effects in relation to waste arising from the Project are likely to be the extra demand placed on local re-use and recycling facilities. This would obviously reduce the availability of these facilities for other users currently in the area or who may move into the region in the future.

Aside from this, the lack of suitable landfill sites within the Adjara Region as a whole (as discussed in Section 12.3) make landfill a resource which should be avoided as a final disposal option wherever possible. It is likely that any waste which needs to be disposed off in a landfill will need to go to Tbilisi. This further incentivises AGL to re-use or recycle every waste stream for which it is technically and commercially feasible to do so.

12.5 Mitigation and Enhancement Measures

12.5.1 Overview

General waste management will be managed for the construction and operational phases as follows;

- Detailed construction phase materials storage, handling and use plan and waste management plan and which will form part of the construction phase ESMP. A framework for a combined materials storage, handling and use plan and waste management plan has been provided in the ESMP which is included a Volume IV of this ESIA.
- Operational phase materials storage, handling and use procedures and a waste management procedure which will both form part of an overall Environmental and Social Management System. The waste management procedure will include a Site Waste Management Plan (SWMP).

12.5.2 Materials Storage, Handling and Use

Best practice waste management begins with waste prevention and minimisation which is achieved through the efficient storage, handling and use of raw materials. To achieve this aim for the Project in both construction and operational phases, the following material use and handling measures will be considered and imbedded into the construction ESMP and operational phase procedures as appropriate.

- Re-using materials on site wherever possible. The most significant opportunity in the construction phase is with respect to excavated spoil;
- Instituting good housekeeping and operating practices, including inventory control to reduce the amount of waste resulting from materials that are out-of-date, off-specification, contaminated, damaged, or excess to plant needs;
- Instituting procurement measures that recognise opportunities such as ordering the correct amount of materials to be delivered when needed, reducing the amount of packaging used by suppliers and establishing a take back system with suppliers;
- Seeking ways to reduce raw material consumption through efficiency audits in the operational phase; and
- Substituting raw materials or inputs with less hazardous or toxic materials wherever economically and technically feasible.

Material handling and storage areas will be established during the construction phase and then a number of these will be retained for the operational phase. These will be specifically designed giving due consideration to the following requirements;

- Located away from sensitive receptors
- Not at risk from theft or vandalism
- Prevention of being spoiled by the elements
- Easily accessible in a safe manner
- Well ventilated
- Unlikely to be damaged
- Located next to any required PPE (as necessary for irritants and hazardous materials)
- Bunded and located next to spill kits (as necessary for hazardous liquids).

The construction ESMP and operational procedures will include reference to the control measures in order to minimise the likelihood of incidents associated with materials storage, handling and use. This will include the following:

- Identification of the necessary PPE requirements
- Identification of the necessary bunding and spill kit requirements
- Details of the correct procedure for handling and storing any hazardous materials
- A map showing the material storage locations
- Training requirements (as necessary) with respect to materials handling procedures
- The correct procedure for reporting any environmental incidents related to spills / leakages and how to deal with any spills / leakages
- The specific regulatory reporting requirements as they relate to materials storage.

12.5.3 Construction Phase Waste Management

12.5.3.1 Management Plans and Procedures

The primary consideration for the waste management plan will be the handling and disposal of excavation spoil which is discussed further in Section 12.5.3.2. The final waste management plan will identify likely waste arisings, appropriate handling, reuse and recycle opportunities and, as a last resort, disposal methods. The waste management plan will be prepared in accordance Georgian waste regulations and the IFC EHS Guidelines for Construction Materials Extraction (2007) and The IFC General EHS guidelines (2007).

Key considerations for inclusion in the construction phase waste management plan are expected to be as follows;

- The best practice waste handling and final treatment options (i.e. re-use, recycling, recovery or disposal) for each waste stream as described in Table 12.5;
- The procedures for the reduction of waste production. In particular the secondary use of excavated material for concrete batching or as a substitute for other construction materials as appropriate (quality permitting);
- The correct methodology for establishing the spoil disposal sites (i.e. topsoil, overburden, and low-quality materials should be properly removed, stockpiled near the site, and preserved for rehabilitation);
- Control measures for impacts associated with specific chemical and / or physical properties of extracted materials and waste rock impurities (as applicable based on the quality of material extracted);
- A description of the control measures at each spoil disposal site (such as spot checking of spoil loads) to ensure that only material excavated from each of the schemes is deposited there;
- Contractor training requirements with respect to waste handling procedures;
- Waste generation data collection for each waste stream by volume. This should include the proportion of each waste stream going for reuse, recycling or disposal. Any unusual waste volumes should be investigated;
- Any waste monitoring as deemed to be necessary;
- An audit schedule which details the frequency of waste management audits and those responsible for undertaking them;
- A mechanism by which to routinely track waste consignments from the originating location to the final waste treatment and disposal location;
- The correct procedure for reporting any environmental incidents related to waste; and
- The specific regulatory reporting requirements as they relate to waste.

12.5.3.2 Spoil Disposal Sites

The principal waste stream which will be generated during the construction phase is excavation material / spoil. It is noted from Table 12.5 that the where possible this material will be used a construction material and for concrete batching. For material which can't be re-used in this fashion, the disposal method will be in spoil disposal sites which have been identified at a number of locations within the Project area.

A bespoke analysis has been prepared by AGL in order to identify appropriate locations for each of the spoil disposal sites. In determining the potential options, consideration has been given to three alternatives as follows:

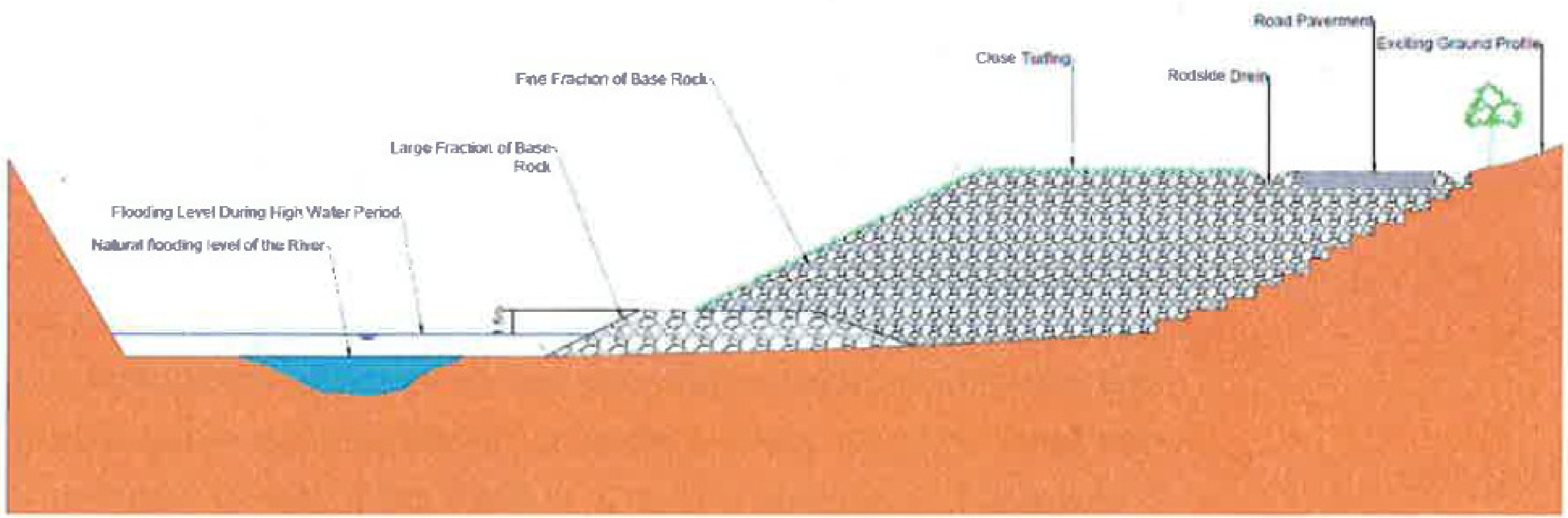
- Alternative 1 - Transportation and permanent deposit of spoil at the bank of the Rivers Chirukhistsqali, Skhalta, Adjaristsqali, Akavreta and Machakhela;
- Alternative 2 – Transportation and permanent deposit of spoil close to the Black Sea at the confluence with the River Chorokhi. It is feasible that inert material can be used as construction material along the Black Sea coast. However, this is potentially costly due to associated transport costs; and
- Alternative 3 – Using permanent and temporary spoil deposit areas in the Adjaristsqali valley. This material can be used at a latter date for infrastructure programmes in the mountainous areas of the Adjara region.

At this stage preference has been given to Alternative 1 options, but this doesn't preclude the consideration of additional options later in the detailed design process. In choosing potential spoil deposit areas under Alternative 1, consideration has been given to the following;

- Impact on agricultural areas. It is considered possible that areas currently cultivated can be improved from a flood reduction perspective by building up the banks using inert spoil;
- Protection from erosion and landslip processes. The spoil deposit area has the potential to strengthen any eroded banks thereby decreasing the risk of landslip;
- Flooding. Deposit of spoil material along the river bank can increase the potential for downstream flooding;
- Impact on existing infrastructure; and
- Impact on landscape. Spoil deposit areas not to block valleys and avoidance impact on existing landscape values.

A general cross sectional profile of the proposed spoil deposit areas to be located along the river banks (Alternative 1 sites) is given in Figure 12.1.

Figure 12.1: General cross sectional profile of the proposed spoil deposit areas



Source: GEG

In accordance with The IFC EHS Guidelines for Construction Materials Extraction, the topsoil and overburden will be carefully removed from each of the proposed spoil disposal sites and stockpiled nearby and preserved for eventual use as rehabilitation material once the spoil disposal sites are no longer required.

The capacity of each proposed spoil disposal site is provided in Table 12.7. Also stated is the Alternative type which the spoil deposit area represents.

Table 12.7: Spoil Disposal Sites

Scheme	Disposal Site Location	Alternative	Capacity (m^3)
Shuakhevi	Site 1 - River Chirukhistsqali for Chiruki weir	Alternative 1	150,000
	Site 2 - River Skhalta for Skhalta Concrete Barrage	Alternative 1	350,000
	Site 3 - River Adjaristsqali for Didachara dam	Alternative 3	315,000
	Site 4 - River Adjaristsqali for Adit 1	Alternative 3	1,200,000
	Site 5 - River Adjaristsqali	Alternative 3	250,000
	Site 6 - River Adjaristsqali for Adit 2	Alternative 3	380,000
	Site 7 - River Adjaristsqali for Adit to Surge Shaft	Alternative 3	500,000
		TOTAL	**3,145,000**
Koromkheti	Site 8 - River Adjaristsqali for Chvanistsqali weir	Alternative 1	1,600,000
	Site 9 - River Akavreta for Adit 4	Alternative 1	500,000
	Site 10 - River Adjaristsqali for Adit 5	Alternative 1	400,000
	Site 11- River Adjaristsqali for Adit 6	Alternative 1	320,000
	Site 12 - River Adjaristsqali for Adit Surge Shaft	Alternative 1	550,000
		TOTAL	**3,370,000**
Khertvisi	Site 12a - River Adjaristsqali for Khertvisi concrete barrage site	Alternative 1	350,000
	Site 13 - River Adjaristsqali for Adit 7	Alternative 1	1,500,000
	Site 14 - River Adjaristsqali for Adit 8	Alternative 1	200,000
		TOTAL	**2,050,000**

Source: AGL

From the data presented in Table 12.7 it is noted that the total expected volumes of spoil generation for each scheme are estimated to be as follows:

- Shuakhevi = 2,431,000 m^3
- Koromkheti = 2,298,000 m^3
- Khertvisi = 1,935,000 m^3

Therefore assuming all spoil is disposed of (i.e. all of the material is unable to be used in the construction process) then the spoil disposal sites identified in Table 12.7 will be of sufficient capacity to securely handle the quantities which are expected to be generated.

Since the intention is to use some of the excavated material for concrete mixing and the formation of foundations, then it is proposed that geological composition testing will occur prior to commencing excavation. This composition testing will also confirm whether the material is inert and can be safely disposed of within the Project site. Depending upon the results of the geo-chemical testing, consideration will be given to the development of hazardous and non-hazardous waste management plans for adoption adopted during the detailed design phase. Should the potential for impacts from waste rock impurities be identified, it will be controlled and mitigated by covering waste disposals with non contaminated soil.

The principal contractor will put in place control measures at each spoil disposal site (such as spot checking of spoil loads) to ensure that only material excavated from each of the schemes is deposited there. This will be a key mitigation measure which will be required to prevent contamination with other, potential non-inert material.

12.5.4 Operational Phase Waste Management

For the operational phase, the production of a detailed waste management procedure for all operations at the Project is going to be fundamental to ensuring best practice waste management is undertaken and becomes embedded into the operational philosophy of the Project. The waste management procedure will provide the following;

- Highlight the relevant policy and legislation of Georgia
- A Site Waste Management Plan (SWMP) which will contain:
  - The establishment of a waste management hierarchy philosophy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes (making reference to the recommendations regarding materials storage, handling and use given in Section 12.5.2)
  - A map showing each temporary waste storage location for the Project
  - A description of each waste generated by the operation of the facility, the appropriate handling methodology, the correct approach for temporary storage and the correct route for removal/disposal off site (as shown in Table 12.6)
  - Staff training requirements with respect to waste handling procedures
  - Waste generation data collection for each waste stream by volume. This should include the proportion of each waste stream going for reuse, recycling or disposal. Any unusual waste volumes should be investigated
  - Any waste monitoring as deemed to be necessary
  - An audit schedule which details the frequency of waste management audits and those responsible for undertaking them
  - A section related to continuous improvement and corrective actions where audit findings can be recorded and incorporated into the waste management procedure. This will also highlight any new and feasible reuse or recycling opportunities which may arise over time
  - A mechanism by which to routinely track waste consignments from the originating location to the final waste treatment and disposal location
  - The correct procedure for reporting any environmental incidents related to waste
  - The specific regulatory reporting requirements as they relate to waste.

In addition, a valid copy of all waste carriers' licences will be kept on site. All transfer notes related to waste uplifts will be completed in full and contain an accurate description of the waste and be signed by the producer and carrier before waste leaves the site.

The expected pollution prevention design criteria for temporary waste storage and handling facilities are presented in Section 12.5.5.

It is expected that the control measures described herein will be largely sufficient in avoiding the potential environmental impacts typically associated with waste generation.

12.5.5 Temporary Waste Storage and Handling

Temporary waste storage facilities will be provided for the construction and operational phases. They will be initially located next to each site facility (as presented in Section 12.4.2.3). It is envisaged that these will be scaled down once the Project moves into the operational phase.

These are intended as a secure, short term store for all waste streams generated on site prior to them being collected by relevant waste carriers for final disposal. They will be designed to include the following:

- Separate storage areas for hazardous and non-hazardous wastes
- Separate skips for each waste stream to allow segregation in order to maximise re-use and recycling opportunities
- All skips to have a suitable cover
- Liquid wastes/oil/chemicals to be stored in tanks or drums located in bunded areas which can hold 110% of the total storage volume
- Spill kits to be available at all times.

12.6 Compliance International Requirements

12.6.1 Overview

This Section demonstrates how the Project meets the compliance requirements with respect to waste management for international financing institutions.

12.6.2 IFC Performance Standards and EBRD Environmental and Social Policy

12.6.2.1 IFC Performance Standards

Compliance with PS3 on Pollution Prevention and Abatement in relation to waste management is achieved by implementing GIIP measures as described in the IFC EHS General Guidelines (2007) and The IFC EHS Guidelines for Construction Materials Extraction (2007).

A demonstration of compliance with the waste management provisions of each of these guidelines documents is presented in Table 12.8.

Table 12.8: IFC Requirements and Associated Project Compliance

Requirement	How Project Compliance will be Achieved
IFC EHS General Guidelines	
General Waste Management	
Waste Management Planning Effective planning and implementation of waste management strategies should include: • Review of new waste sources during planning, siting, and design activities, including during equipment modifications and process alterations, to identify expected waste generation, pollution prevention opportunities, and necessary treatment, storage, and disposal infrastructure • Collection of data and information about the process and waste	**Compliant:** The source of all waste streams from the Project has been identified and characterised along with the proposed final disposal option. Data on waste generation (by waste stream) will be collected throughout the construction and operational phases. Wastes which can be potentially recovered, re-used and/or recycled have been identified for construction and operational phases and a

Requirement	How Project Compliance will be Achieved
streams in existing facilities, including characterization of waste streams by type, quantities, and potential use/disposition • Establishment of priorities based on a risk analysis that takes into account the potential EHS risks during the waste cycle and the availability of infrastructure to manage the waste in an environmentally sound manner • Definition of opportunities for source reduction, as well as reuse and recycling • Definition of procedures and operational controls for onsite storage • Definition of options / procedures / operational controls for treatment and final disposal.	framework for waste reduction (through resource efficiency) will be put in place. Procedures and controls for temporary onsite waste storage and waste collection and disposal are defined and will be put in place.
Waste Prevention Processes should be designed and operated to prevent, or minimise, the quantities of wastes generated and hazards associated with the wastes generated in accordance with the following strategy: • Substituting raw materials or inputs with less hazardous or toxic materials, or with those where processing generates lower waste volumes • Applying manufacturing process that convert materials efficiently, providing higher product output yields, including modification of design of the production process, operating conditions, and process controls • Instituting good housekeeping and operating practices, including inventory control to reduce the amount of waste resulting from materials that are out-of-date, off specification, contaminated, damaged, or excess to plant needs • Instituting procurement measures that recognize opportunities to return usable materials such as containers and which prevents the over ordering of materials • Minimizing hazardous waste generation by implementing stringent waste segregation to prevent the commingling of non-hazardous and hazardous waste to be managed.	**Compliant:** Opportunities to prevent waste production in the first instance will be identified wherever possible. The material use and handling measures identified in Section 12.5.2 will be considered and embedded into the construction ESMP and operational waste management procedures as appropriate.
Recycling and Reuse In addition to the implementation of waste prevention strategies, the total amount of waste may be significantly reduced through the implementation of recycling plans, which should consider the following elements: • Evaluation of waste production processes and identification of potentially recyclable materials • Identification and recycling of products that can be reintroduced into the manufacturing process or industry activity at the site • Investigation of external markets for recycling by other industrial processing operations located in the neighbourhood or region of the facility (e.g., waste exchange) • Establishing recycling objectives and formal tracking of waste generation and recycling rates • Providing training and incentives to employees in order to meet objectives	**Compliant:** Waste reuse and recycling opportunities have been identified for both the construction and operational phases. Investigations into suitable facilities that can process such waste streams are ongoing. The operational waste management philosophy will be embedded into the Project through the development of a detailed waste management procedure for the operational phase which will form part of an overall Environmental and Social Management System. The waste management procedure will include a Site Waste Management Plan (SWMP).
Treatment and Disposal If waste materials are still generated after the implementation of feasible waste prevention, reduction, reuse, recovery and recycling measures, waste materials should be treated and disposed of and all measures should be taken to avoid potential impacts to human health and the environment.	**Compliant:** Where re-use or recycling is not feasible or possible, appropriate treatment and/or final disposal options have been identified for all waste streams. Investigations into these facilities to check for their suitability are ongoing.

Requirement	How Project Compliance will be Achieved
Selected management approaches should be consistent with the characteristics of the waste and local regulations, and may include one or more of the following: • On-site or off-site biological, chemical, or physical treatment of the waste material to render it non-hazardous prior to final disposal • Treatment or disposal at permitted facilities specially designed to receive the waste. Examples include: composting operations for organic non-hazardous wastes; properly designed, permitted and operated landfills or incinerators designed for the respective type of waste; or other methods known to be effective in the safe, final disposal of waste materials such as bioremediation.	
Hazardous Waste Management: • Waste Storage; Temporary waste storage areas have been identified and designed according to industry best practice • Transportation; All waste containers designated for off-site shipment will be secured and appropriately labelled with loading overseen by competent and trained employees • Treatment and Disposal; Where re-use of recycling is not feasible or possible, appropriate treatment and/or final disposal options have been identified for all waste streams, including those considered to be hazardous • Monitoring; Procedures for waste tracking will be developed. In addition there will be routine audits of internal waste management practices to ensure ongoing compliance throughout the life of the Project. Any recommendations for improvements in the waste management practices of the Project will form part of ongoing operational reporting.	**Compliant:** All waste streams will be segregated according to their EWC code. This includes those which are considered hazardous. A SWMP will be prepared and will include for the following provisions with regards to hazardous waste management; • Appropriate and safe waste handling which includes overseeing the process by trained staff • Identification of appropriate treatment and/or final disposal options for all waste streams, including those considered to be hazardous • Audit of waste management procedures including a corrective action process which allows improvements and amendment to be made as necessary.
The IFC EHS Guidelines for Construction Materials Extraction	
Rock waste and removed topsoil overburden are the main inert wastes produced by quarrying activities. Hazardous wastes may be generated from impurities and trace components included in the exploited (waste) rocks (e.g. asbestos or heavy metals or minerals that could result in acidic runoff).	**Compliant.** Topsoil and overburden will be carefully removed from each of the proposed spoil disposal sites and stockpiled nearby and preserved for eventual use as rehabilitation material once the spoil disposal sites are no longer required.
The recommended prevention and control methods to reduce wastes include the following: • Operational design and planning should include procedures for the reduction of waste production (e.g. blending high-quality rock with poor rock) • Topsoil, overburden, and low-quality materials should be properly removed, stockpiled near the site, and preserved for rehabilitation • Hazardous and non- hazardous waste management plans should be developed and adopted during the design and planning phase. Impacts associated with specific chemical and / or physical properties of extracted materials should be considered during the design phase, and impacts from waste rock impurities should be adequately controlled and mitigated by covering waste disposals with non-contaminated soil.	**Compliant.** The intention is to use some of the excavated material for concrete mixing and the formation of foundations. It is proposed that geological composition testing will occur prior to commencing excavation. The topsoil and overburden will be carefully removed from each of the proposed spoil disposal sites and stockpiled nearby and preserved for eventual use as rehabilitation material once the spoil disposal sites are no longer required. Depending upon the results of the geo-chemical testing, consideration will be given to the development of hazardous and non-hazardous waste management plans for adoption adopted during the detailed design phase.
Management of other waste generated during extraction site operations (e.g. oily debris and contaminated soils recovered from lubricants or fuel spills, metal scraps, demolition materials) is discussed in the General EHS Guidelines.	Compliance with the General EHS Guidelines is discussed above.

It is believed that the Project is able to achieve compliance with all relevant provisions for waste management as provided in the IFC EHS Guidelines.

12.6.2.2 EBRD Environmental and Social Policy

A demonstration of compliance with the waste management provisions given within Performance Requirement 3: Pollution Prevention and Abatement is presented in Table 12.9.

Table 12.9: EBRD Performance Requirement 3: Pollution Prevention and Abatement and Associated Project Compliance

Requirement	How Project Compliance will be Achieved
Wastes 12. The client will avoid or minimise the generation of hazardous and non-hazardous waste materials and reduce its harmfulness as far as practicable. Where waste generation cannot be avoided but has been minimised, the client will reuse, recycle or recover waste, or use it as a source of energy; where waste can not be recovered or reused, the client will treat, destroy, and dispose of it in an environmentally sound manner. If the generated waste is considered hazardous, the client will explore commercially reasonable alternatives for its environmentally sound disposal considering the limitations applicable to its transboundary movement. When waste disposal is conducted by third parties, the client will use contractors that are reputable and legitimate enterprises licensed by the relevant regulatory agencies.	**Compliant:** Measures to avoid waste generation will be implemented in the first instance. These have been discussed in Section 12.5.2. The source of all waste streams from the Project has been identified and characterised along with the proposed final disposal option. Data on waste generation (by waste stream) will be collected throughout the construction and operational phases. Wastes which can be potentially recovered, re-used and/or recycled have been identified for construction and operational phases and a framework for waste reduction (through resource efficiency) will be put in place. Procedures and controls for temporary onsite waste storage and waste collection and disposal are defined and will be put in place.
Safe use and management of hazardous substances and materials 13. The client will seek to avoid, reduce or eliminate the use of hazardous substances and materials, and consider the use of less hazardous substitutes for such substances and materials so as to protect human health and the environment from their potential harmful impacts. Where avoidance is not feasible, the client will consider the safety of their uses and apply appropriate risk management measures in order to minimise or control the release of such substances/materials into air, water and/or land resulting from their production, transportation, handling, storage, use and disposal relating to project activities. The client will avoid the manufacture, trade, and use of hazardous substances and materials subject to international bans or phase-outs due to their high toxicity to living organisms, environmental persistence, potential for bio-accumulation, or potential for depletion of the ozone layer.	**Compliant:** The material use and handling measures identified in Section 12.5.2 will be considered and embedded into the construction ESMP and operational waste management procedures as appropriate. This includes substituting raw materials or inputs with less hazardous or toxic materials wherever economically and technically feasible.
Pesticide use and management 20. The client will formulate and implement an integrated pest management (IPM) and/or integrated vector management (IVM) approach for pest management activities. The client's IPM and IVM programme will entail coordinated use of pest and environmental information along with available pest control methods, including cultural practices, biological, genetic and, as a last resort, chemical means to prevent unacceptable levels of pest damage. When pest management activities include the use of pesticides, the client will strive to reduce the impacts of pesticides on human health and the environment and, more generally, to achieve a more sustainable use of pesticides as well as a significant overall reduction in the risks and uses of pesticides consistent with the necessary crop protection. The sustainable use of pesticides shall include: • minimising or, where possible, elimination of the use of pesticides minimising the hazards and risks to health and environment from the use of pesticides • reducing the levels of harmful active substances by replacing the	**Compliant:** It is not envisaged that any pesticides will be required as part of the construction or operational phases of the Project. Pests may include rodents associated with ongoing waste management. These will be controlled through good housekeeping of waste management areas and non-chemical methods of eradicating rodents if required.

Requirement	How Project Compliance will be Achieved
most dangerous with safer (including non-chemical) alternatives • selecting pesticides that are low in human toxicity, known to be effective against the target species, and have minimal effects on non-target species and the environment • using low-input or pesticide-free crop farming • minimising damage to natural enemies and preventing the development of resistance pests.	
21. The client will handle, store, apply and dispose of pesticides in accordance with good international industry practice such as the Food and Agriculture Organization (FAO) International Code of Conduct on the Distribution and Use of Pesticides.	
22. The client will not use products that fall in World Health Organization Recommended Classification of Pesticides by Hazard Classes 1a (extremely hazardous) and 1b (highly hazardous); or Class II (moderately hazardous), if the project host country lacks restrictions on distribution and use of these chemicals, or if they are likely to be accessible to personnel without proper training, equipment, and facilities to handle, store, apply, and dispose of these products properly.	

It is believed that the Project is able to achieve compliance with all relevant provisions for materials storage, handling and use and waste management as provided in the EBRD Environment and Social Policy (2008).

12.7 Summary Impacts, Mitigation and Residual Significance

A tabulated summary of the residual impacts associated with waste are given in Table 12.10 highlighting the specific scheme and the phase of development (construction, operation, etc.) within which the impact will potentially occur.

Table 12.10: Summary of Residual Impacts for the Project

Activity	Project Phase	Potential Impact	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation	Residual Significance
Use of raw materials	• Construction • Operation • Decommissioning	Use of potentially finite and / or scarce resources.	Low	Moderate	Minor	Material use and handling measures will be considered and imbedded into the construction ESMP and operational phase procedures as appropriate. • Re-using materials on site wherever possible. The most significant opportunity in the construction phase is with respect to excavated spoil • Instituting good housekeeping and operating practices, including inventory control to reduce the amount of waste resulting from materials that are out-of-date, off-specification, contaminated, damaged, or excess to plant needs • Instituting procurement measures that recognise opportunities such as ordering the correct amount of materials to be delivered when needed, reducing the amount of packaging used by suppliers and establishing a take back system with suppliers • Seeking ways to reduce raw material consumption through efficiency audits in the operational phase • Substituting raw materials or inputs with less hazardous or toxic materials wherever economically and technically feasible.	**Insignificant**
Materials handling and storage	• Construction • Operation • Decommissioning	Spills and leakages of hazardous materials which lead to an environmental incident.	Medium	Moderate	Moderate	Material handling and storage areas will be established and specifically designed giving due consideration to the following requirements; • Located away from sensitive receptors • Not at risk from theft or vandalism	**Insignificant**

Activity	Project Phase	Potential Impact	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation	Residual Significance
						• Prevention of being spoiled by the elements • Easily accessible in a safe manner; • Well ventilated • Unlikely to be damaged • Located next to any required PPE (as necessary for irritants and hazardous materials) • Bunded and located next to spill kits (as necessary for hazardous liquids). The construction ESMP and operational procedures will include measures and controls to minimise the likelihood of incidents associated with materials storage, handling and use.	
Embedded CO_2 emissions associated with the production of concrete.	• Construction	CO_2 emissions and associated climate change impact.	**This is addressed in Chapter 17**	**This is addressed in Chapter 17**	**This is addressed in Chapter 17**	**This is addressed in Chapter 17**	**This is addressed in Chapter 17**
Waste generation, handling and storage	• Construction • Operation • Decommissioning	Contamination of receiving environments (particularly surface watercourses, groundwater and the ground) due to leakage and spillage of wastes associated with poor waste handling and storage arrangements.	Medium	Moderate	Moderate	Construction phase waste management plan which will form part of the construction phase ESMP will be developed Waste management procedure for the operational phase will be developed and will form part of an overall Environmental and Social Management System. The waste management procedure will include a SWMP. For the decommissioning phase, a DEMP will be prepared and include a section on waste management detailing the environmental protection controls which will be put in place. This will	**Insignificant**
		Fugitive emissions, such as dust and odour, associated with the handling and storage of some waste streams.	Low	Moderate	Minor		**Insignificant**
		Visual amenity impacts associated with poor storage	Low	Minor	Insignificant		**Insignificant**

Activity	Project Phase	Potential Impact	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation	Residual Significance
		of waste.				incorporate best practice at the time. Both the onsite and offsite waste storage facilities will be designed to include the following: • Separate storage areas for hazardous and non-hazardous wastes • Separate skips for each waste stream to allow segregation in order to maximise re-use and recycling opportunities • All skips to have a suitable cover • Liquid wastes/oil/chemicals to be stored in tanks or drums located in bunded areas which can hold 110% of the total storage volume • Spill kits to be available at all times.	
Spoil handling and disposal	• Construction	Disposal of spoil and excavation material which results in land take.	Medium	Major	Major	As stated Table 12.5 where possible, spoil material will be used as a construction material and for concrete batching. For material which can't be re-used, the disposal method will be in spoil disposal sites which have been identified at a number of locations within the Project area. Topsoil and overburden will be carefully removed from each of the proposed spoil disposal sites and stockpiled nearby and preserved for eventual use as rehabilitation material once the spoil disposal sites are no longer required. Geological composition testing will occur prior to commencing excavation. This composition testing will confirm whether the material is inert and can be safely disposed of within the Project site. Depending upon the results of the geo-chemical testing, consideration will be	**Minor**

Activity	Project Phase	Potential Impact	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation	Residual Significance
						given to the development of hazardous and non-hazardous waste management plans for adoption adopted during the detailed design phase. Should the potential for impacts from waste rock impurities be identified, it will be controlled and mitigated by covering waste disposals with non contaminated soil. Control measures at each spoil disposal site (such as spot checking of spoil loads) to ensure that only material excavated from each of the schemes is deposited there.	
Choice of final waste disposal option	• Construction • Operation • Decommissioning	The use of landfill, where waste re-use or recovery is not feasible, which is a finite resource.	Medium	Moderate	Moderate	Characterise each waste stream as either hazardous or non-hazardous. Seek to minimise waste production in the first instance in accordance with the material use and handling measures. Where waste streams are unavoidable, highlight potential re-use, recycling and recovery (in that order) opportunities according to current best practice. Review the locally available re-use, recycling, recovery and disposal facilities from a capacity and quality perspective. Undertake this during detailed design. Landfill is to be avoided wherever possible due to the general low level of environmental protection afforded by landfill sites within the Adjara region.	**Minor**
		Increased waste miles from transporting waste materials from the Project site.	Low	Moderate	Minor	Potential waste handling facilities in close proximity to the Project have been identified for the construction and operational phase waste streams. Review the locally available re-sue, recycling, recovery and disposal facilities from a capacity and quality perspective. Undertake this during detailed design.	**Insignificant**

12.7.1 Residual Impacts

On consideration of the expected impacts and proposed mitigation and management measures the following residual impacts are expected to remain:

- The use of landfill, where waste re-use or recovery is not feasible, which is a finite resource
- Disposal of spoil and excavation material which results in land take.

It should be noted that the residual significance of these impacts are both minor, however due cognisance must be given the generally poor quality of landfill sites within the Adjara region and use of these should be avoided wherever possible. The next best alternative is to use the landfill site in Tbilisi which has been more adequately engineered and affords greater pollution prevention and overall environmental protection.

The use of landfill as a disposal option for some waste streams is expected to persist throughout the life of the Project with notable peaks expected during the construction and decommissioning phases. The use of spoil disposal sites will occur during the construction phase however their presence will change the nature and topography of the surrounding landscape in the areas where they are located. Although, there is no specific reason why the land could not be put into productive use at some point in the future once construction has finished and the spoil disposal sites have been rehabilitated.

12.8 Proposed Monitoring and Reporting

AGL in conjunction with its contractors will set out a programme for materials usage and waste management monitoring programs to address all activities that have been identified to have potentially significant impacts on the environment during construction and operation. The procedures for monitoring the effectiveness of mitigation proposed within this Chapter and the framework waste management plan in the ESMP will be incorporated within the detailed waste management plans to be developed for the Project.

The monitoring will be sufficient to provide representative data for the parameter being monitored, and conducted by trained individuals following monitoring and record-keeping procedures. Monitoring data will be analysed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken.

12.9 Statement of Significance and Compliance

The most significant need for the Project is to ensure that operational controls are used to minimise materials wastage and waste production in the first instance wherever possible. Where waste avoidance is not possible then AGL will maximise re-use and recycling opportunities. This will be achieved through the identification of suitable third parties to take specific waste streams who operate in the region.

The quantities of spoil and excavated material expected to be generated during the construction phase is also a significant consideration. However, it is shown in this Chapter that the initial priority is re-use of this material wherever possible and that in the unlikely event that it all needs to be disposed of, then sufficient disposal volume exists and has been identified.

It is believed that sufficient operational controls, such as the establishment of a waste management plan, can be enacted during all phases of the Project such that any direct risk posed to the environment from the handling and temporary storage of waste in and around the Project site will be insignificant.

13. Traffic and Transportation

13.1 Introduction

This Chapter considers the potential traffic and transport impacts associated with construction, operation and decommissioning of the Adjaristsqali Hydropower Cascade Project (the Project). It considers the receptors external to the project sites which may potentially be sensitive to the operational, safety and environmental impacts of staff and truck movements, and the significance of these impacts.

This assessment considers the potential impacts of construction and operational movements by road only. The number of vehicle movements wholly internal to the project sites has not been investigated here; the impact assessment has focused on the impacts of vehicle movements on the external highway network.

13.1.1 General Approach

Likely traffic and transport effects for the construction, operational and decommissioning phases of the development will be assessed with the assessment including:

- Forecasting the number and profile of two-way vehicle movements during each phase and percentage increases in traffic flow
- Assessment of increases as a percentage of baseline flows against criteria from recognised guidance[32]
- Appraisal of potential environmental and social effects arising from the increased traffic on road network (e.g. increased dust)
- Assessment of cumulative traffic effects arising from other readily known developments in construction phase.

For each transport impact, significance will attributed taking into account the magnitude of the impact and the sensitivity of the receptor. The magnitude of transport impacts is, to a degree, subjective. Determination of magnitude will therefore also be based upon professional judgement taking into account the sensitivity of the receiving environment.

Appropriate construction phase mitigation measures for the minimisation of traffic and transport related effects will be identified. Where there is the potential for aspects of the Project to cause cumulative traffic and transport related effects, or where other existing or proposed developments may lead to cumulative effects, the assessment will consider the combined effects and identify applicable mitigation measures.

13.2 Methodology and Assessment Criteria

13.2.1 Legislative Background

In respect of traffic and transport, the principles of the assessment have been developed from IFC Performance Standard 1 (Assessment and Management of Environmental and Social Risks and Impacts) and Performance Standard 4 (Community Health, Safety and Security). The main policy and legislative

[32] In the absence of local guidance, the sensitivity of the routes will be assessed with due regard to IEMA Guidelines for the Environmental Assessment of Road Traffic (1993) on receptors/locations and stakeholder perceptions.

objectives of each document which are relevant to this assessment chapter are summarized in Table 13.1 below.

Table 13.1: IFC Performance Standard Requirements

Performance Standard	Key Policy and Legislative Objectives
Performance Standard 1 (Assessment and Management of Environmental and Social Risks and Impacts)	• To identify and assess social and environment impacts, both adverse and beneficial, in the project's area of influence • To avoid, or where avoidance is not possible, minimize, mitigate, or compensate for adverse impacts on workers, affected communities, and the environment • To ensure that affected communities are appropriately engaged on issues that could potentially affect them • To promote improved social and environment performance of companies through the effective use of management systems
Performance Standard 4 (Community Health, Safety and Security)	• To avoid or minimize risks to and impacts on the health and safety of the local community during the project life cycle from both routine and non-routine circumstances • To ensure that the safeguarding of personnel and property is carried out in a legitimate manner that avoids or minimizes risks to the community's safety and security

In the absence of local guidelines which consider the impacts of traffic, assessment guidance has been obtained from the Institution of Highways and Transportation (IHT) Guidelines for Traffic Impact Assessment and The Institute of Environmental Assessment Guidelines for the Assessment of Road Traffic in the UK.

13.2.2 Methodology

13.2.2.1 Introduction

The assessment has been undertaken through a desk-top study. Methodologically the assessment can be summarised as follows:

- **Establishment of Baseline** – existing traffic and transport conditions have been evaluated using existing traffic flow data provided by the Gama Consulting and photographs of the local road network taken by Mott MacDonald staff;
- **Trip Generation** – with respect to the hydropower scheme, estimates of traffic generation have been made based on the construction programme, details of construction material volumes and anticipated construction and operational staffing levels.
- **Predictions of Impacts –** significance criteria have been adopted for the prediction of impacts within this ESIA. These are outlined in the following section.

As described in Section 5.4 of the ESIA, the significance of potential impacts is a function of the presence and sensitivity of receptors, and magnitude (duration, spatial extent, reversibility, likelihood and threshold) of the impact. The magnitude of transport impacts is, to a degree, subjective. Determination of magnitude is therefore partially based on professional judgement taking into account the sensitivity of the receiving environment.

The Project is formed of three distinct elements, as identified below:

- Shuakhevi Scheme – 185 MW. The first phase to be developed, commencing in early 2013 with a construction programme of 3 years (36 months);

- Koromkheti Scheme – 150 MW. The second phase to be developed, commencing in early 2015 with a construction programme of 5 years (60 months); and
- Khertvisi Scheme – 65 MW. The first phase to be developed, commencing in early 2017 with a construction programme of 4 years (48 months).

The construction programme and the Project elements are reviewed in full detail in Chapter 2 of this ESIA. Within this assessment the potential impact of each construction phase has been considered separately.

The most probable traffic route(s) to be used for the construction, operational and decommissioning phases of the development will be determined. These are typically those routes which link construction worksites to significant generators of traffic as determined (e.g. excavation, concrete batching plant) via the most appropriate roads.

Baseline traffic and transport surveys have been undertaken on key existing access routes within the project area in order to characterise the baseline.

Main roads, local roads and specially constructed tracks will be utilised as required during construction dependent upon the point of origin of plant/materials etc. Sensitive receptors will include the settlements and communities adjacent to traffic routes to be used by construction vehicles. In identifying proposed access routes for staff and truck movements, the areas likely to be impacted by the proposed scheme have been identified. Professional judgement has again been used to consider whether any residual impacts are of significance.

The assessment of effects and identification of residual significant effects will take account of any incorporated mitigation measures adopted by the Project, and will be largely dependent on the extent and duration of change, the number of people or size of the resource affected and their sensitivity to the change.

13.2.2.2 Determining Sensitivity, Magnitude and Significance

The criteria for determining significance are specific for each environmental and social aspect but generally for each impact the magnitude is defined (quantitatively where possible) and the sensitivity of the receiving environment with reference to that impact defined.

Sensitivity is generally site specific and criteria have been developed from baseline information gathered. The sensitivity of a receptor will be determined based on review of the population (proximity / numbers / vulnerability) and presence of features local to the site or in the surrounding area which may be sensitive to a change from the baseline conditions.

Table 13.2: Criteria for Determining Sensitivity

Magnitude (positive or negative)	Definition (considers duration of the impact, spatial extent, reversibility and ability of comply with legislation)
High	Vulnerable receptor (human or infrastructure) with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.
Medium	Vulnerable receptor (human or infrastructure) with limited capacity to absorb proposed changes or limited opportunities for mitigation.
Low	Vulnerable receptor (human or infrastructure) with some capacity to absorb proposed changes or moderate opportunities for mitigation
Negligible	Vulnerable receptor (human or infrastructure) with good capacity to absorb proposed changes or and good opportunities for mitigation

The general approach has been to determine impact magnitude by reference to percentage change in total traffic flows. In the absence of local guidelines the criteria levels have been obtained from the IHT Guidelines for Traffic Impact Assessment and The Institute of Environmental Assessment Guidelines for the Assessment of Road Traffic.

Table 13.3: Criteria for determining Magnitude

Magnitude (positive or negative)	Definition (considers duration of the impact, spatial extent, reversibility and ability of comply with legislation)
Major	Fundamental change to the specific environmental conditions assessed resulting in long term or permanent change, typically widespread in nature (regional national and international), would require significant intervention to return to baseline; exceed national standards and limits. This includes any road link where there is a >30% traffic flow change.
Moderate	Detectable change to the specific environmental conditions assessed resulting in non-fundamental temporary or permanent change. This includes any road link where there is a +/-10 to 30% traffic flow change.
Minor	Detectable but minor change to the specific environmental conditions assessed. This includes any road link where there is a +/- 5 to 10% traffic flow change.
Negligible	No perceptible change to the specific environmental conditions assessed. This includes any road link where there is up to +/- 5% traffic flow change.

Impacts arising from any abnormal load deliveries are not quantified but are assessed qualitatively, also on the basis of expert judgement.

The significance has been determined by the interaction between the magnitude of impacts and the sensitivity of receptors affected, as depicted in the significance matrix shown in Section 5.3.4.4.

13.2.3 Data Limitations

The information used within this assessment has the following limitations:

- Comprehensive baseline traffic data is unavailable. The information collected has been reviewed and traffic estimates have been developed where it is not possible to determine the accuracy of the flows provided
- Road safety information is unavailable and therefore a review of road accident trends cannot be undertaken
- Full details of the delivery volumes to the construction sites have been estimated using information provided in the project Infrastructure Report.

13.3 Baseline Description

13.3.1 Overview

The proposed Project area on the Adjaristsqali River is located approximately 400-500 km away from Tbilisi. The closest railway route is in Batumi city which is also the location of the nearest harbour to the Project. The Project sites are linked to Batumi city via international, national and local highway routes. The highway network is shown in Table 13.1.

For the purposes of this assessment, the local routes have been sub-divided into study links and these are described in Table 13.4 below.

Table 13.4: Assessment Highway Links

Highway Number	Link Name	Route Description	Highway Type
I-2 (also designated as the E70)	A	From Batumi Harbour / Rail Head to S-1	International Standard Highway Route Paved surface Majority of the route is through an urban environment (Batumi City)
S-1	B	From I-2 to Adjaristsqali (junction with S-45)	National Standard Highway Route Paved surface Challenging alignment in places Some direct residential access
S-1	C	From Adjaristsqali (junction with S-45) to Keda (junction with S-74)	National Standard Highway Route Paved surface Challenging alignment in places Some direct residential access
S-1	D	From Keda (junction with S-74) to Khichauri (junction with S-78)	Paved surface Challenging alignment along length Some direct residential access
S-1	E	From Khichauri (junction with S-78) to Shuakhevi (junction with S-77)	Paved surface Challenging alignment along length Some direct residential access
S-1	F	From Shuakhevi (junction with S-77) to Zomoleti (junction with S-75)	Paved surface Challenging alignment along length Some direct residential access
S-1	G	From Zomoleti (junction with S-75) to the Project Site	Paved surface with some bound (gravel) sections beyond Khulo Challenging alignment along length Limited residential access
S-45	H	From S-1 at Adjaristsqali to Machaakhela Access	Paved surface Challenging alignment along length Some direct residential access
Machakhela Access	I	From S-45 to the Project Site	Bound (gravel) surface Challenging alignment along length
S-74	J	From S-1 at Keda to the Project Site	Bound (gravel) surface Challenging alignment along length Limited residential access
S-78	K	From S-1 at Khichauri to the Project Site	Right
S-77	L	From S-1 at Shuakhevi to the Project Site	Bound (gravel) surface Challenging alignment along length Limited residential access
S-75	M	From S-1 at Zomoleti to the Project Site	Bound (gravel) surface Challenging alignment along length Limited residential access

The routes are considered in more detail in Section 13.3.3.

13.3.2 Existing Rail and Harbour Access

The existing harbour and railhead in Batumi City includes provisions for:

- Unloading and storage facilities for heavy machinery and equipment
- Covered and uncovered storage for electrical and other equipment
- Storage of about 1000 t of cement
- Space for parking, loading and unloading.

As required by the Project, these facilities will be used to transport materials from international locations and from other parts of Georgia.

13.3.3 Route Descriptions

13.3.3.1 Overview

The project sites are accessible to motor vehicles and harbour by an all weather road from the nearest rail head. A major all-weather road connects Batumi and the village of Didadjara, a distance of 92 km. The access route from Batumi to the Project sites is via International Highway I-2, state S-1 highway and local S-45, S-74, S-75, S-77 and S-78 highways. These routes will be used to transport plant, equipment and construction material. The State Highway which connects to the powerhouse via the village of Adjaristsqali will have to be improved to transport heavy equipment to the powerhouse.

A description of the roads included within the study area is provided in the following sections.

13.3.3.2 I-2 (also designated as the E70) – Link A

The I-2 route (also designated as the E70) connects the city of Batumi with the Turkish border to the south. Within the study area, the I-2 is predominantly urban as it runs through the centre of Batumi. There are a significant number of residential and commercial properties which are accessed directly from the route and there are a number of road junctions. Significant traffic flows on the route are expected, as a high percentage of heavy vehicle movements.

The I-2 provides access from Batumi Harbour and rail head to all components of the Project. Due to the nature of the route, it would have a **medium** sensitivity to changes in traffic flows.

13.3.3.3 S-1 – Links B-G

The S-1 Batumi-Akhaltsikhe highway is a road of national significance, which is also the main connecting highway of the administrative centres of the municipalities and other populated areas included within the Project area. Therefore, the S-1 highway is characterised by relatively high intensity of vehicle movements.

Over the length of the route, a significant number of residential and commercial properties take direct access from this highway. Livestock is also known to roam freely along the route and can be a hazard to motorists. The geometry of the route is challenging in places and many parts of the route would be sensitive to changes in the number of vehicle movements, especially a change in heavy vehicles.

The S-1 provides access between the I-2 and all components of the Project. Due to the importance of the route, the presence of sensitive receptors and the existing geometry, it would have a **high** sensitivity to changes in traffic flows.

13.3.3.4 S-45 – Link H

The S-45 is paved and provides access to the communities south of Adjaristsqali. The S-45 provides access between the S-1 and the Machakhela Dam element of the Project.

Due to the existing geometry, the presence of sensitive receptors and road width, the route would have a **high** sensitivity to changes in traffic flows.

13.3.3.5 Machakhela Access – Link I

This route provides access between the S-45 and the Machakhela Dam element of the Project. The route is partially paved and provides access to a number of small residential settlements.

Due to the existing geometry, the presence of sensitive receptors and road surface, the route would have a **high** sensitivity to changes in traffic flows.

13.3.3.6 S-74 – Link J

The S-74 is unpaved and provides access to the communities north of Keda. The S-74 provides access between the S-1 and the Goderdzistsqali weir and Akavreta weir elements of the Project.

Due to the existing geometry, the presence of sensitive receptors and road surface, the route would have a **high** sensitivity to changes in traffic flows.

13.3.3.7 S-78 – Link K

The S-78 is unpaved and provides access to the communities north of Khichauri. The S-78 provides access between the S-1 and the Chvanistsqali Dam element of the Project.

Due to the existing geometry, the presence of sensitive receptors and road surface, the route would have a **high** sensitivity to changes in traffic flows.

13.3.3.8 S-77 – Link L

The S-77 is unpaved and provides access to the communities south of Shuakhevi. The S-77 provides access between the S-1 and the Chirukhi Dam element of the Project.

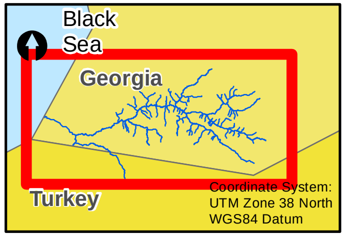
Due to the existing geometry, the presence of sensitive receptors and road surface, the route would have a **high** sensitivity to changes in traffic flows.

13.3.3.9 S-75 – Link M

The S-75 is unpaved and provides access to the communities south of Zomoliti. The S-75 provides access between the S-1 and the Skhalta Dam element of the Project.

Due to the existing geometry, the presence of sensitive receptors and road surface, the route would have a **high** sensitivity to changes in traffic flows.

Location Map



Legend

Road Section Name

- A
- B
- C
- D
- E
- F
- G
- H
- I
- J
- K
- L
- M

Meters

Road Section Name	Road Name	Description
A	I-2 (E70)	From Batumi Harbour / Rail Head to S-1
B	S-1	From I-2 to Adjaristsqali (junction w ith S-45)
C	S-1	From Adjaristsqali (junction w iith S-45) to Keda (junction w ith S-74)
D	S-1	From Keda (junction w ith S-74) to Khichauri (junction w ith S-78)
E	S-1	From Khichauri (junction w ith S-78) to Shuakhevi (junction w ith S-77)
F	S-1	From Shuakhevi (junction w ith S-77) to Zamleti (junction w ith S-75)
G	S-1	From Zamleti (junction w ith S-75) to the Project Site
H	S-45	From S-1 at Adjaristsqali to Machakhela Access Road
I	Machakhela Road Access	From S-45 to the Project Site
J	S-74	From S-1 at Keda to the Project Site
K	S-78	From S-1 at Khichauri to the Project Site
L	S-77	From S-1 at Shuakhevi to the Project Site
M	S-75	From S-1 at Zomoleti to the Project Site

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	27/01/2012	For Information	WJG	JG	VH

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Gamma Consulting Limited
9, Merab Aleksidze Street,
Tbilisi 0193, Georgia

Drawing Title

Adjaristsqali Hydropower
Cascade Project
Transport Access

Scale @ A4	MM Project No.	Status
1:400,000	290039	PRE

GIS File
20120127_Transport.mxd

Drawing No.	Rev
MMD-290039-MNC-GEN-003	P1

13.3.4 Highway Alterations and Bridge Conditions

13.3.4.1 Introduction

Due to the nature of the Adjaristsqali River basin and the Project requirements, some alterations will be required to the existing highway network and a comprehensive review of the bridge conditions within the study area is required. The S-1 (from Batumi to Akhaltsikhe) is currently undergoing a comprehensive upgrade with surface and geometry improvements along its length. This route upgrade has and will continue to bring the S-1 highway to a standard more suitable for use by heavy vehicles.

Additional improvements to the local highway routes and bridge infrastructure are described in the following sections.

13.3.4.2 Highway Improvements

In addition to the works already committed to the S-1 highway route, the Project will require the changes to the local highway network and these will be undertaken as part of the Project enabling works. The highway works required to support the Shuakhevi Scheme is summarised in Table 13.5 below.

Table 13.5: Shuakhevi Highway Improvements

Scheme Element	Route Description	State Highway (km)	Dirt Road (km)
Power house	(S-1)-Village Kldisubani	-	0.3
Surge Tank	(S-1)-village Akhaldaba	-	4.0
Dam on the river Diakonidze	(S-1)-Villages Dekanashvilebi - Duadzeebi	-	3.3
Dam on the river Chirukhistsqali	Village Makhlakidzeebi (S-77)	19.0	-
Dam on the river Skhalta	Village Tsipari (S-1; S-75)	13.4	1.0
Adit 2	Village Chanchkhalo (S-1)	-	2.4
	Total	**32.4**	**11.0**

Source: Project Infrastructure Report

The works will be completed prior to the commencement of the site construction works. In addition, the proposed Scheme reservoir will cause submergence of 2.5 km of the S-1 highway, which will have to be realigned.

The highway works required to support the Koromkheti Scheme is summarised in Table 13.6 below.

Table 13.6: Koromkheti Highway Improvements

Scheme Element	Route Description	State Highway (km)	Improved Dirt Road (km)	Dirt Road (km)
Power house	(S-1)-Village Pirveli Maisi	-	0.3	-
Surge Tank	(S-1)- Village Pirveli Maisi	-	2.3	-
Dam on the river Chvana	(S-1)-Village Khichauri	-	-	0.1

Scheme Element	Route Description	State Highway (km)	Improved Dirt Road (km)	Dirt Road (km)
Dam on the river Akavreta	Keda-Merisi (S-74)	6.2	-	1.0
Dam on the river Goderdzistsqali	keda-Village Medzibna (S-74)	0.2	1.7	2.6
Adit 4	(S-1)-Village Tskhmorisi	-	-	0.6
Adit 5	(S-74)-Village Inasharidzeebi	0.2	1.7	3.2
Adit 6	(S-74)-Village Shavaburi	0.2	1.7	-
	Total	**6.8**	**7.7**	**7.5**

Source: Project Infrastructure Report

The works will be completed prior to the commencement of the site construction works. In addition, the proposed Scheme reservoir will cause submergence of 1.5 km of S-1 between Khichauri and Kldisubani, which will have to be realigned.

The highway works required to support the Khertvisi Scheme is summarised in Table 13.7 below.

Table 13.7: Khertvisi Highway Improvements

Scheme Element	Route Description	State Highway (km)	Highway (km)	Improved Dirt Road (km)	Dirt Road (km)
Power house	(S-45)- Village Adjaristsqali				0.05
Dam on the river Adjaristsqali	Village Machakhelipiri – Village Kedkedi – Village Adjaristsaghmarti (S-45)		3.3	2.3	
Dam on the river Machakhela	(S-1)- Village Bzubzu	1.5			
Adit 7	(S-1)- Village Machakhela			0.9	
	Total	**1.5**	**3.3**	**3.2**	**0.05**

Source: Project Infrastructure Report

The works will be completed prior to the commencement of the site construction works.

13.3.4.3 New Highway Connections

In addition to the improvements to the existing highway connections, new links will be required to access the project construction sites. The sites of all the major components of the projects, i.e. dam, intakes, headrace tunnel, surge shaft and tunnel, pressure shaft, powerhouse, tailrace tunnel and associated structures will be require to be connected to the existing road system by new access roads. It is envisaged that these access roads will have a formation width of 5 m with 3 m of metalling. Road links will also be provided across each of the dams.

The new highway required to support the Shuakhevi Scheme is summarised in Table 13.8 below.

Table 13.8: Shuakhevi Scheme New Highway Connections

Scheme Element	Route Description	State Highway (km)	Dirt Road (km)
Powerhouse	Village Kldisunabi	-	0.3
Surge Tank	Village Akhaldaba	-	2.3
Dam on the river Adjaristsqali	Village Didadjara	0.5	-
Dam on the river Chirukhistsqali	Village Makhalakidzeebi	-	-
Dam on the river Skhalta	Village Tsipari	-	0.6
Adit 1	(S-1)-Village Oktomberi	0.7	-
Adit 2	(S-1)-Village Chanchkhalo	-	0.2
Adit portal	Village Akhaldaba	-	1.25
	Total	**1.2**	**4.65**

Source: Project Infrastructure Report

The works will be completed prior to the commencement of the site construction works.

The new highway required to support the Koromkheti Scheme is summarised in Table 13.9 below.

Table 13.9: Koromkheti Scheme New Highway Connections

Scheme Element	Route Description	State Highway (km)	Dirt Road (km)
Powerhouse	Village Pirveli Maisi	-	1.05
Surge tank	Village Pirveli Maisi	-	0.75
Dam on the river Adjaristsqali	Village Khichauri	0.05	-
Dam on the river Chvana	Village Khichauri	0.5	-
Dam on the river Akavreta	Merisi	-	0.75
Dam on the river Goderdzistsqali	Village Medzibna	-	0.95
Adit Portal	Village Koromkheti	-	0.5
Adit 3	Village Dandalo	0.1	-
Adit 4	Village Tskhmorisi	-	-
Adit 5	Village Inasharidzeebi	-	1.22
Adit 6	Village Shavaburi	-	-
Spoil Deposit -12	Village Koromkheti	-	1.45
	Total	**0.65**	**6.67**

Source: Project Infrastructure Report

The works will be completed prior to the commencement of the site construction works.

The new highway required to support the Khertvisi Scheme is summarised in Table 13.10 below.

Table 13.10: Khertvisi Scheme New Highway Connections

Scheme Element	Route Description	Dirt Road (km)
Power house	Village Adjaristsqali	0.05
Surge tank	Village Adjaristsqali	0.15
Dam on the river Adjaristsqali	Village Kvedamakhuntseti	1.08
	Total	**1.28**

Source: Project Infrastructure Report

The works will be completed prior to the commencement of the site construction works.

13.3.4.4 Existing Bridge Rehabilitation and New Infrastructure

It is important to consider rehabilitation of existing bridges as well as construction of new ones, including access roads to adits and construction sites. **Appendix F** gives information about the capacities of the existing bridges and pipe bridges, which has been prepared based on the site visit and desk study.

The illustrative materials of the main bridges and pipe bridges are given in **Appendix F**.

13.3.5 Existing Traffic Flow

In order to assess the intensity and characteristics of the vehicle movement in the project area, traffic counts have been conducted in July and September of 2011. The selection of the traffic count sites was guided by preliminary Project details and the likelihood of impacts on particular highway routes. The location of the count location sites and geographical coordinates are given in Table 13.11.

Table 13.11: Traffic Count Site Locations

Point N	Location of the Point	Coordinates of the Point	Traffic Directions
1	Traffic node of village Acharistskali	X=727652 Y=4602761	Batumi-Akhaltsikhe; Acharistskali-Kirnati.
2	Traffic node of town Keda	X= 745011 Y= 4609598	Batumi-Akhaltsikhe; Keda-Merisi community..
3	Traffic node of town Shuakhevi	X= 265222 Y= 4612120	Batumi Akhaltsikhe; Shuakhevi-Oladauri community.
4	Traffic node of town Khulo	X= 276261 Y= 4613595	Batumi-Akhaltsikhe; Center of town Khulo.
5	The road in direction of the slope of village Achara	X= 732985 Y= 4600237	Achara slope-Machakhlispiro
6	Traffic node near the village Kveda Makhunceti	X= 736150 Y= 4605370	Batumi-Akhaltsikhe; Kveda Makhuntseti-Bzubzu.
7	Traffic node near the village Inasharidzeebi	X= 748915 Y= 4607633	Village Inasharidzeebi-town Keda
8	Traffic node near the village Chvana	X= 263049 Y= 4617351	Chvana-Varjanauli
9	Traffic node near the village Kvatia	X= 283036 Y= 4605873	Kvatia-Batumi-Akhaltsikhe road
10	Traffic bridge near the village Lomanauri	X= 271166 Y= 4607320	Paposhvilebi-Shuakhevi

Traffic counts were conducted twice, in July and September of 2011, and were undertaken by Gamma Consulting personnel, who have previously undergone appropriate training. Counts were undertaken at all control points twice a day, in the morning and in the evening.

The traffic counts provided for use in this assessment are an average of the morning and evening peaks which were recorded on two separate days. The traffic count results for the separate control points are given in Table 13.12.

Table 13.12: Traffic Count Data (peak hour, average of 2011 counts)

Point N	Direction of Motion	Passenger Cars	Mini-bus	Bus	2-3 axis trucks	4+- axis trucks	Motorcycle	Total, car/hr	Non-Motorized
1	Batumi-Akhaltsikhe	116	26	7	22	3	4	178	0
	Acharistskali-Kirnati	37	8	0	14	0	0	59	0
2	Batumi-Akhaltsikhe	72	23	3	11	0	1	110	0
	Keda-Merisi community	21	4	0	13	0	0	38	1
3	Batumi-Akhaltsikhe	87	17	4	21	1	0	130	0
	Shuakhevi-Oladauri community	21	4	0	6	0	0	31	0
4	Batumi-Akhaltsikhe	87	17	4	21	1	0	130	0
	Shuakhevi-Oladauri community	21	4	0	6	0	0	31	0
5	Achara slope-Machakhlispiri	12	3	1	5	0	0	21	6
6	Batumi-Akhaltsikhe	78	24	6	17	0	0	125	0
	Kveda Makhuntseti-Bzubzu	9	1	0	7	0	0	17	2
7	Inarashidzeebi-Keda	21	6	1	9	0	0	37	7
8	Chvana-Varjanauli	13	2	0	6	0	0	21	3
9	Village Kvatia-Batumi Akhaltsikhe highway	11	4	0	7	0	0	22	5
10	Paposhvilebi-Shuakhevi	14	7	2	5	0	0	28	6

As Table 13.12 shows the traffic flows on the local highway network are usually very low.

The peak hour traffic flows, as presented in Table 13.12, have been assigned to each of the study links and this is shown in Table 13.13 below. The data from Sites 3 and 4 appear to be the same and have been used for links E, F and G. Having reviewed the recorded flows on other parts of the S-1 the use of these flows on these links does not appear to be unreasonable.

Table 13.13: Study Links – Peak Hour Flows 2011

Highway Number	Link	Route Description	Traffic Count Site	Average Peak Hour Flow	Average Truck[33] Peak Hour Flow
I-2 (also designated as the E70)	A	From Batumi Harbour / Rail Head to S-1	No Count Available	N/A	N/A
S-1	B	From I-2 to Adjaristsqali (junction with S-45)	Site 1	178	32
S-1	C	From Adjaristsqali (junction with S-45) to Keda (junction with S-74)	Site 6	125	23
S-1	D	From Keda (junction with S-74) to Khichauri (junction with S-78)	Site 2	110	14
S-1	E	From Khichauri (junction with S-78) to Shuakhevi (junction with S-77)	Site 3	130	26
S-1	F	From Shuakhevi (junction with S-77) to Zomoleti (junction with S-75)	Site 3	130	26
S-1	G	From Zomoleti (junction with S-75) to the Project Site	Site 4	130	26
S-45	H	From S-1 at Adjaristsqali to Machaakhela Access	Site 1	59	14
Machakhela Road Access	I	From S-45 to the Project Site	Site 5	21	6
S-74	J	From S-1 at Keda to the Project Site	Site 7	37	10
S-78	K	From S-1 at Khichauri to the Project Site	Site 8	21	6
S-77	L	From S-1 at Shuakhevi to the Project Site	Site 10	28	7
S-75	M	From S-1 at Zomoleti to the Project Site	Site 9	22	7

The peak hour flows have been adjusted to generate average daily traffic flows. With no other local counts available and no national guidance, the peak hour flows have been factored by 10 to create average daily flows. This factor is based on professional judgement and experience from other similar projects.

Traffic movement is obstructed in direction of Akhaltiskhe (pass of Goderdzi is characterized with high snow cover) in the winter period (from November to April) and vehicle movement on the highway is reduced by 35-40% at these times. Therefore to reflect this and to calculate average annual daily flows a factor of 0.8 has been applied to the annual flows.

33 Includes buses and all vehicles defined as "trucks"

The average daily traffic flows for each of the links included within the study are presented in Table 13.14 below.

Table 13.14: Study Links – Average Daily Flows 2011

Highway Number	Link	Route Description	Traffic Count Site	Estimated Daily Flow	Estimated Daily Truck Flow	Estimated Truck Percentage
I-2 (also designated as the E70)	A	From Batumi Harbour / Rail Head to S-1	No Count Available	N/A	N/A	N/A
S-1	B	From I-2 to Adjaristsqali (junction with S-45)	Site 1	1,424	256	18.0%
S-1	C	From Adjaristsqali (junction with S-45) to Keda (junction with S-74)	Site 6	1,000	184	18.4%
S-1	D	From Keda (junction with S-74) to Khichauri (junction with S-78)	Site 2	880	112	12.7%
S-1	E	From Khichauri (junction with S-78) to Shuakhevi (junction with S-77)	Site 3	1,040	208	20.0%
S-1	F	From Shuakhevi (junction with S-77) to Zomoleti (junction with S-75)	Site 3	1,040	208	20.0%
S-1	G	From Zomoleti (junction with S-75) to the Project Site	Site 4	,040	208	20.0%
S-45	H	From S-1 at Adjaristsqali to Machaakhela Access	Site 1	472	112	23.7%
Machakhela Road Access	I	From S-45 to the Project Site	Site 5	168	48	28.6%
S-74	J	From S-1 at Keda to the Project Site	Site 7	296	80	27.0%
S-78	K	From S-1 at Khichauri to the Project Site	Site 8	168	48	28.6%
S-77	L	From S-1 at Shuakhevi to the Project Site	Site 10	224	56	25.0%
S-75	M	From S-1 at Zomoleti to the Project Site	Site 9	176	56	31.8%

The information presented in Table 13.14 above has been used as the baseline and future Project scenarios have been assessed against these flows. No traffic growth has been applied to the baseline traffic data.

13.3.6 Sensitive Receptors

A review of baseline information for the local area has revealed a number of receptors sensitive to the potential operational, safety and environmental impacts of staff and truck movements. Air quality receptors are addressed in Chapter 15, and noise and vibration receptors are addressed in Chapter 14. Receptors sensitive to operational and safety impacts, together with consideration of the possible effects, are identified in Table 13.15 below.

Table 13.15: Receptors sensitive to transport impacts

Potential Impact	High Sensitivity	Medium Sensitivity	Low Sensitivity	Negligible Sensitivity
Safety	Highways S-1, S-45, S-74, S-75, S-77, S-78 (Links B, C, D, E, F, G, H, J, K, L, M) Pedestrians/ cyclists in local settlements – temporary exposure to increased traffic flows on local road network during construction	Highway I-2 (Link A) Pedestrians/ cyclists in local settlements – temporary exposure to increased traffic flows on local road network during construction	-	-
Highway; delay to other road users	Highways S-1, S-45, S-74, S-75, S-77, S-78 (Links B, C, D, E, F, G, H, J, K, L, M) Roads crossed by project – temporary delays to traffic from pipeline works Roads – temporary delays due to abnormal load movements	Highway I-2 (Link A) Roads crossed by project – temporary delays to traffic from pipeline works Roads – temporary delays due to abnormal load movements	-	-
Highway; 'wear and tear' to existing infrastructure	Highways S-1, S-45, S-74, S-75, S-77, S-78 (Links B, C, D, E, F, G, H, J, K, L, M) Local road network – reduction in 'physical quality' i.e. breaking up of road surfaces from deliveries of construction materials including abnormal loads	Highway I-2 (Link A) Local road network – reduction in 'physical quality' i.e. breaking up of road surfaces from deliveries of construction materials including abnormal loads**	-	-

** Abnormal load vehicles are categorised as such where weight exceeds 80,000kgs and/or width exceeds 2.9m and/or length exceeds 18.65m.

The summary provided in Table 13.15 identifies that all of the highway links included within the study area will be sensitive to traffic flow changes. In particular, due to the road geometry and presence of multiple receptors, the state highways (Links B to M) will be highly sensitive to changes in traffic flow.

13.4 Assessment of Impacts

13.4.1 Construction

13.4.1.1 Introduction

There are a number of construction activities that could potentially impact the highway network within the study area. The construction activities and the associated traffic generation levels are reviewed in the following sections.

13.4.1.2 Construction Programme

The construction programme is planned to be completed over a period of 9 years, and in three separate stages. The Project is formed of three distinct elements, as identified below:

- Shuakhevi Scheme – 185 MW. The first phase to be developed, commencing in early 2013 with a construction programme of 3 years (36 months);
- Koromkheti Scheme – 150 MW. The second phase to be developed, commencing in early 2015 with a construction programme of 5 years (60 months); and
- Khertvisi Scheme – 65 MW. The first phase to be developed, commencing in early 2017 with a construction programme of 4 years (48 months).

It is expected that the Shuakhevi Scheme will be delivered without any significant overlap, although there is potential for the Koromkheti and Khertvisi Scheme construction periods to overlap in 2018 and 2019. Details of the traffic movements associated with each phase are reviewed in the following sections.

It is expected that construction activity will occur 24 hours per day, 7 days per week, with an average of 30 working days per month.

13.4.1.3 Personnel Movements

A significant number of personnel will be employed directly or indirectly during each of the construction phases, although this number will vary depending on the scheme stage. The peak number of personnel associated with each Project Scheme phase is reviewed in Table 13.16 below.

Table 13.16: Scheme Construction Personnel (per Project phase)

Project Scheme	Construction Staff	Support Staff (incl. medics, security and catering)	Total
Pre-Construction	737	70	807
Early Construction	800	70	870
Mid Construction	863	70	933
Late Construction	656	70	726
Scheme Commissioning	102	70	172

It is anticipated that the largest personnel peak will be approximately 933 personnel in the mid-construction period of each Scheme (a period of approximately 24-48 months).

The majority of personnel will be recruited from the local area and others will be housed in sites adjacent to the construction areas. It is not expected that a significant number of staff would use private vehicles to travel to and from the project sites, and alternatively bus transport will be used to take workers from the local communities to the construction areas

At this stage it is only possible to estimate the number of buses that will be required to move locally based workers. Considering the number of construction workers required, it is possible that up to 15 bus trips per day (30 movements) will be needed to transfer workers from local communities. It is assumed that each bus movement can carry 40 passengers.

By providing transport for personnel living locally and accommodation facilities onsite for those living further afield, the number of vehicle movements associated with personnel travel will be kept to a minimum. Due to the provision of worker transport, it is assumed that there will be no more than 50 daily private car movements associated with the project. It is assumed that half of these trips will be generated locally with the remainder traveling to or from Batumi.

13.4.1.4 Project Construction Truck Movements

The number of truck movements has been identified using the material quantities identified for each phase of the Project schemes. For the assessment process, it has been assumed that each truck movement can carry 12 m^3 or 20 tons of material. As described in Chapter 12, a significant amount of material will be sourced and deposited in locations immediately adjacent to the Project sites. This reduces the number of vehicle movements that would have to travel on the local highway network and it is these movements that have been assessed in the following sections.

Excavated material will be recycled and reused on site for foundation construction and suitable structural filling wherever possible. However, excess material will be transported to spoil sites local to each of the construction sites. Assuming a worst-case scenario where no excavated material can be reused on site, a load volume capacity of 12 m^3 per truck has been used.

A variety of construction materials will be delivered during the construction period. These materials and the estimated number of movements will vary depending on the construction scheme; these are reviewed in the following sections. The truck movements are expected to originate from either Batumi Port or rail head and travel direct to the site, or vice versa.

The Scheme construction period is expected to occur over a period of approximately 9 years. There will, however, be peaks during this period and the information provided in the following sections demonstrates how truck movements are expected to fluctuate over the Scheme construction period.

Project Enabling Works

Subject to the correct approvals being in place, enabling works for the Shuakhevi will take place in the autumn (September through to November) of 2012, and this will include the construction of the following elements.

- Improvements to existing highway route
- Rehabilitation of bridges on the highway routes
- Construction of new highway links connecting the construction sites to the wider highway network.

It is expected that the scale of the enabling works will be significantly smaller than the construction of the Project, and therefore these enabling works have not been assessed in isolation. Any mitigation measures applied to the full construction phase of the Project would also need to be implemented for the Enabling Works phase.

Shuakhevi Scheme Construction

The Shuakhevi Scheme construction works will take place over a period of 36 months from early 2013 to 2015. The number of construction movements (including deliveries and return trips) associated with each element of the Scheme is summarised in Table 13.17 below.

Table 13.17: Shuakhevi Scheme Construction Truck Movements

Project Ref	Phase	Total Truck Movements
ADJ-7	Didachara Dam and Intake	12,747
SKH-1	Skhalta Dam and Intake	26,255
SKH-1	Skhalta HPP	44
CHI-1	Chirukhistqali Weir and Desilting Basin	13,279
CHI-1	Chirukhistsqali Transfer Tunnel	23,789
SKH-1	Skhalta Transfer Tunnel - Drill and Blast	127
SKH-1	Skhalta Transfer Tunnel - TBM	74,625
ADJ-5B	Shuakhevi Headrace Tunnel	165,182
ADJ-5B	Shuakhevi Headrace Tunnel Adits	37,455
ADJ-5B	Shuakhevi Surge Shaft	40,668
ADJ-5B	Shuakhevi Pressure Shaft	12,989
ADJ-5B	Shuakhevi HPP	1,789
	Total Movements	**408,823**

The information presented in Table 13.17 does not include the truck movements that are expected to be required to transport construction materials (such as aggregate) and spoil within the construction site boundaries. The totals do not include movements associated with enabling works.

The truck movements identified in Table 13.17 are expected to originate from either local quarries, spoil disposal sites, Batumi Port or rail head and travel direct to the site, or vice versa.

The Scheme construction period is expected to occur over a period of 36 months, and therefore the number of truck per day would be an average of 379 truck movements. There will, however, be peaks of movement within this period and the information provided in Table 13.18 demonstrates how truck movements are expected to fluctuate over the Scheme construction period.

Table 13.18: Shuakhevi Scheme Construction Truck Movements

Project Ref	Phase	Peak Construction Period	Peak Average Daily Truck Movements
ADJ-7	Didachara Dam and Intake	24 months	19
SKH-1	Skhalta Dam and Intake	24 months	39
SKH-1	Skhalta HPP	24 months	0
CHI-1	Chirukhistqali Weir and Desilting Basin	24 months	20
CHI-1	Chirukhistsqali Transfer Tunnel	21 months	36
SKH-1	Skhalta Transfer Tunnel - TBM	24 months	113
ADJ-5B	Shuakhevi Headrace Tunnel	21 months	250
ADJ-5B	Shuakhevi Headrace Tunnel Adits	21 months	57
ADJ-5B	Shuakhevi Surge Shaft	21 months	62
ADJ-5B	Shuakhevi Pressure Shaft	21 months	20
ADJ-5B	Shuakhevi HPP	24 months	3
		Peak Daily Average	**619**

As shown in Table 13.18, the period of greatest truck movements is expected to be an average of 619 movements per day.

In addition to the truck movements on the wider highway network, a significant number of truck movements within the Scheme construction area are expected. These movements are predominantly related to the transfer of spoil and aggregate materials. In particular the excavation within the construction phase of Didachara and Skhalta Dams will result in a significant number of truck movements. Due to these truck movements not being routed on the highway network, these movements have not been included within the impact assessment.

Koromkheti Scheme Construction

The Koromkheti Scheme construction works will take place over a period of 60 months from 2015 to 2019. The number of construction movements (including deliveries and return trips) associated with each element of the Scheme is summarised in Table 13.19 below.

Table 13.19: Koromkheti Scheme Construction Truck Movements

Project Ref	Phase	Total Truck Movements
ADJ-2A	Koromkheti Drill and Blast Headrace Tunnel - Option - 1	277,662
ADJ-2A	Koromkheti Construction Adits - Option - 1	17,344
ADJ-2A	Koromkheti Surge Shaft - Option -1	24,846
ADJ-2A	Koromkheti Pressure Shaft - Option - 1	1,311
CHV-1	Chavanistsqali Transfer Tunnel	8,169
ADJ-2A	Koromkheti Powerhouse - Access and Cable Tunnels	13,981
ADJ-2A	Koromkheti Powerhouse - Transformer and Powerhouse Caverns	18,591
ADJ-2A	Koromkheti HPP	2,520
ADJ-5A	Khichauri Dam and Intake	34,917
CHV-1	Chvanistsqali Dam and Intake	1,034
AKA-2	Akavreta Dam and Intake	1,219
	Total Movements	**401,592**

The information presented in Table 13.19 does not include the truck movements that are expected to be required to transport construction materials (such as aggregate) and spoil within the construction site boundaries. The totals do not include movements associated with enabling works.

The truck movements identified in Table 13.19 are expected to originate from either local quarries, spoil disposal sites, Batumi Port or rail head and travel direct to the site, or vice versa.

The Scheme construction period is expected to occur over a period of 60 months, and therefore the number of truck per day would be an average of 223 truck movements. There will, however, be peaks of movement within this period and the information provided in Table 13.20 demonstrates how truck movements are expected to fluctuate over the Scheme construction period.

Table 13.20: Koromkheti Scheme Construction Truck Movements

Project Ref	Phase	Peak Construction Period	Peak Average Daily Truck Movements
ADJ-2A	Koromkheti Drill and Blast Headrace Tunnel - Option - 1	48 months	193
ADJ-2A	Koromkheti Construction Adits - Option -	48 months	12

Project Ref	Phase	Peak Construction Period	Peak Average Daily Truck Movements
	1		
ADJ-2A	Koromkheti Surge Shaft - Option -1	48 months	17
ADJ-2A	Koromkheti Pressure Shaft - Option - 1	48 months	1
CHV-1	Chavanistsqali Transfer Tunnel	48 months	6
ADJ-2A	Koromkheti Powerhouse - Access and Cable Tunnels	48 months	10
ADJ-2A	Koromkheti Powerhouse - Transformer and Powerhouse Caverns	48 months	13
ADJ-2A	Koromkheti HPP	48 months	2
ADJ-5A	Khichauri Dam and Intake	48 months	26
CHV-1	Chvanistsqali Dam and Intake	48 months	1
AKA-2	Akavreta Dam and Intake	48 months	1
		Peak Daily Average	**281**

As shown in Table 13.20, the period of greatest truck movements is expected to be an average of 281 movements per day.

In addition to the truck movements on the wider highway network, a significant number of truck movements within the Scheme construction area are expected. These movements are predominantly related to the transfer of spoil and aggregate materials. Due to these truck movements not being routed on the highway network, these movements have not been included within the impact assessment.

Khertvisi Scheme Construction

The Khertvisi Scheme construction works will take place over a period of 48 months from 2017 to 2020. The number of construction movements (including deliveries and return trips) associated with each element of the Scheme is summarised in Table 13.21 below.

Table 13.21: Khertvisi Scheme Construction Truck Movements

Project Ref	Phase	Total Truck Movements
ADJ-1	Khertvisi Headrace Tunnel (TBM)	169,925
ADJ-1	Khertvisi Surge Shaft	28,383
MAC-1	Machakhlistsqali Transfer Tunnel	31,499
CHO-1	Khertvisi HPP	64,833
CHO-1	Surge Adit	3,807
ADJ-1	Khertvisi Dam and Intake	22,397
MAC-1	Machakhlistsqal Dam and Intake	15,735
	Total Movements	**323,722**

The information presented in Table 13.21 does not include the truck movements that are expected to be required to transport construction materials (such as aggregate) and spoil within the construction site boundaries. The totals do not include movements associated with enabling works.

The truck movements identified in Table 13.21 are expected to originate from local quarries, spoil disposal sites, Batumi Port or rail head and travel direct to the site, or vice versa.

The Scheme construction period is expected to occur over a period of 48 months, and therefore the number of truck per day would be an average of 225 truck movements. There will, however, be peaks of movement within this period and the information provided in Table 13.22 demonstrates how truck movements are expected to fluctuate over the Scheme construction period.

Table 13.22: Koromkheti Scheme Construction Truck Movements

Project Ref	Phase	Peak Construction Period	Peak Average Daily Truck Movements
ADJ-1	Khertvisi Headrace Tunnel (TBM)	36 months	157
ADJ-1	Khertvisi Surge Shaft	36 months	26
MAC-1	Machakhlistsqali Transfer Tunnel	36 months	29
CHO-1	Khertvisi HPP	36 months	60
CHO-1	Surge Adit	36 months	4
ADJ-1	Khertvisi Dam and Intake	36 months	21
MAC-1	Machalistsqali Dam and Intake	36 months	15
		Peak Daily Average	**312**

As shown in Table 13.22, the period of greatest truck movements is expected to be an average of 312 movements per day.

In addition to the truck movements on the wider highway network, a significant number of truck movements within the Scheme construction area are expected. These movements are predominantly related to the transfer of spoil and aggregate materials. Due to these truck movements not being routed on the highway network, these movements have not been included within the impact assessment.

Scheme Construction Assessment Period

As described above, there will be a number of peaks in terms of construction traffic and due to the wide study area, there are likely to be range of impacts on different sensitive receptors. Accordingly, as assessment of the impacts in each of the Scheme (Shuakhevi, Koromkheti and Khertvisi) has been considered. In addition, in the period 2018-19 it is expected that the Koromkheti and Khertvisi Schemes will both be under construction. These impacts are assessed cumulatively.

13.4.1.5 Other Truck Movements

In addition to the truck movements associated specifically with the construction of each Scheme (Shuakhevi, Koromkheti and Khertvisi) there will be regular movements to service and supply the construction sites and support areas. The number of truck movements associated with this are considered the following sections.

Fuel and Supply Deliveries

It is estimated that there will be an average of 100 deliveries per month, or 25 per week. t is assumed that all supplies will be transported from destinations in Batumi.

Solid Waste Disposal

Solid wastes in the plant can be classified as domestic wastes, package wastes, waste oils, herbal oil waste, battery and accumulators, medical wastes, treatment sludge and end-of-life tyres. All of these wastes will be determined, collected, stored, recycled and discharged according to local waste codes

It is anticipated that waste collection will take place by truck at the following intervals:
- Domestic wastes – weekly
- Package wastes – weekly
- Waste oils – weekly
- Battery and accumulators – monthly
- Medical wastes – weekly
- End of life tyres – monthly.

It is estimated that there will be an average of 100 waste collections per month, or 25 per week. It is assumed that all wastes will be transported to destinations in Batumi.

13.4.1.6 Abnormal Load Movements

Various abnormal loads, weighing from 80 to more than 300 tonnes, will be transported to the development site by road during the construction period. Approximately 100 abnormal load movements are anticipated to take place during the construction programme, comprising mainly of bridge structures and electrical power equipment. Abnormal loads will include among others the following equipment:
- Three 3-phase transformers (without oil) with an estimated weight of between 55 and 90 tonnes each (depending on size and scheme)
- pre-assembled Pelton unit with an approximate weight of 50 to 60 tonnes
- Twelve 3-boom drilling jumbo approximate weight 40 tonnes
- TBM head and main bearing
- D8 dozers approximately 40 tonnes

13.4.1.7 Construction Trip Distribution

The following trip distribution assumptions have been used to assess the impact of construction traffic on the local highway network where average daily flows have been recorded:
- Personnel – 50% of car movements from Batumi, the remainder generated locally. All bus movements will have local origins/destinations
- Aggregate / spoil – see Chapter 12 for detail of the locations
- Plant movements – 100% to Batumi Port and / or railhead
- Foundation/excavation works – 100% to Batumi Port and / or railhead
- Roads, parking, walkways – 100% to Batumi Port and / or railhead
- Steel, concrete – 100% to Batumi Port and / or railhead
- Buildings – 100% to Batumi Port and / or railhead
- Fuel deliveries – 100% to Batumi Port and / or railhead
- Solid wastes – 100% to Batumi Port and / or railhead
- Abnormal loads – 100% to Batumi Port and / or railhead.

13.4.1.8 Accidents

Formal road traffic accident analysis has not been undertaken due to a lack of reliable data. There are road safety concerns throughout the study area and site visits have identified a number of memorials along the length of the S-1 Batumi-Akhaltsikhe Highway. The highway routes pass through a number of settlements and the I-2 highway passes directly through the centre of Batumi. This area is heavily populated and there are intense pedestrian and vehicle movements along the length of the route. Significant adverse impacts on the local population are considered to be a possibility and are assessed within this chapter.

13.4.1.9 Assessment of Construction Impacts

Three peaks in construction traffic flows have been assessed (covering the impacts of the Shuakhevi, Koromkheti and Khertvisi Scheme construction periods). The most pronounced peak is anticipated to occur during years 2018 and 2019 of the construction period, as both the Koromkheti and Khertvisi Schemes construction periods are underway. The number of two-way vehicle movements per day during this period is estimated at 791, with 691 of these being truck movements.

A summary of the flow changes identified for each of the road links included within the study area are provided in Table 13.23 below. The changes in truck movements are presented in Table 13.24.

Table 13.23: Construction Phase Traffic Flow Change (all vehicles)

Road Number	Road Link Reference	Shuakhevi Construction Phase		Koromkheti Construction Phase		Khertvisi Construction Phase		Combined Koromkheti / Khertvisi Construction Phase	
		Increase in vehicles	% Increase	Increase in vehicles	% Increase	Increase in vehicles	% Increase	Increase in vehicles	% Increase
I-2 (also designated as the E70)	A	48	Not available	57	Not available	53	Not available	110	Not available
S-1	B	48	3.4%	57	4.0%	53	3.7%	110	7.7%
S-1	C	113	11.3%	209	20.9%	242	24.2%	451	45.1%
S-1	D	113	12.8%	112	12.7%	0	0.0%	112	12.7%
S-1	E	196	18.8%	46	4.4%	0	0.0%	46	4.4%
S-1	F	147	14.1%	0	0.0%	0	0.0%	0	0.0%
S-1	G	253	24.3%	0	0.0%	0	0.0%	0	0.0%
S-45	H	0	0.0%	0	0.0%	76	16.0%	76	16.0%
Machakhela Access	I	0	0.0%	0	0.0%	76	45.0%	76	45.0%
S-74	J	0	0.0%	81	27.3%	0	0.0%	81	27.3%
S-78	K	0	0.0%	32	19.1%	0	0.0%	32	19.1%
S-77	L	64	28.7%	0	0.0%	0	0.0%	0	0.0%
S-75	M	83	47.3%	0	0.0%	0	0.0%	0	0.0%

Table 13.24: Construction Phase Traffic Flow Change (trucks)

Road Number	Road Link Reference	Shuakhevi Construction Phase		Koromkheti Construction Phase		Khertvisi Construction Phase		Combined Koromkheti / Khertvisi Construction Phase	
		Increase in trucks	% Increase	Increase in trucks	% Increase	Increase in trucks	% Increase	Increase in trucks	% Increase
I-2 (also designated as the E70)	A	23	Not available	32	Not available	28	Not available	60	Not available
S-1	B	23	8.9%	32	12.6%	28	10.9%	60	23.5%
S-1	C	63	34.1%	159	86.6%	209	113.4%	368	200.0%
S-1	D	63	56.0%	88	78.2%	0	0.0%	88	78.2%
S-1	E	146	70.1%	34	16.5%	0	0.0%	34	16.5%
S-1	F	123	59.2%	0	0.0%	0	0.0%	0	0.0%
S-1	G	241	115.9%	0	0.0%	0	0.0%	0	0.0%
S-45	H	0	0.0%	0	0.0%	59	52.3%	59	52.3%
Machakhela Access	I	0	0.0%	0	0.0%	59	122.1%	59	122.1%
S-74	J	0	0.0%	67	83.5%	0	0.0%	67	83.5%
S-78	K	0	0.0%	20	41.8%	0	0.0%	20	41.8%
S-77	L	52	93.5%	0	0.0%	0	0.0%	0	0.0%
S-75	M	71	127.3%	0	0.0%	0	0.0%	0	0.0%

The increase in traffic movements during construction compared with the baseline situation is moderate for the majority of the construction period. The peak impact is likely to be in the later phases of the development when the Koromkheti and Khertvisi scheme construction phases will overlap for a period of approximately 24 months in about 2018 and 2019.

The sensitivity of each link included within the study area has been considered with the magnitude of impacts presented in Table 13.23 and Table 13.24. The process is described in Section 5.4.3.3. The significance of the impacts on each of the links included within the study area is presented in Table 13.25 below.

Table 13.25: Construction Phase Impact Summary

Road Number	Road Link Ref	Shuakhevi Construction Phase	Koromkheti Construction Phase	Khertvisi Construction Phase	Combined Koromkheti / Khertvisi Construction Phase
I-2 (also designated as the E70)	A	Minor	Minor	Minor	Moderate
S-1	B	Moderate	Insignificant	Insignificant	Moderate
S-1	C	Major	Major	Major	Critical
S-1	D	Major	Major	Insignificant	Major
S-1	E	Major	Major	Insignificant	Insignificant
S-1	F	Major	Insignificant	Insignificant	Insignificant
S-1	G	Major	Insignificant	Insignificant	Insignificant
S-45	H	Insignificant	Insignificant	Major	Major
Machakhela Access	I	Insignificant	Insignificant	Critical	Critical
S-74	J	Insignificant	Major	Insignificant	Major
S-78	K	Insignificant	Major	Insignificant	Major
S-77	L	Major	Insignificant	Insignificant	Insignificant
S-75	M	Critical	Insignificant	Insignificant	Insignificant

The impacts of the construction activities, as shown in Table 13.25, are summarized in the following sections.

13.4.1.10 Summary of Construction Impacts

A summary of the construction activity impacts on the study highway links is provided in the following sections.

I-2 (also designated as the E70)

Due to the regional importance of the route and the significant number of residential and commercial properties accessed directly from the highway, the I-2 is sensitive to changes in traffic flow. There are also a number of important road junctions along the route and each of these would also be sensitive to traffic flow increases.

As traffic flow information is not available for the route, a qualitative assessment has been made for this study link. Using the matrix provided in Section 5.3.4.4, it is expected that the impact of the Project would be **minor** through each of the Scheme construction phases. However, the combined effect of the Koromkheti / Khertvisi Construction Phases would result in a **moderate** impact

S-1

As discussed in Section 2.3.2, due to the importance of the route, the presence of sensitive receptors and the existing geometry, it would have a high sensitivity to changes in traffic flows.

Using the matrix provided in Section 5.3.4.4, it is expected that the impact of the Project would be **major** on the majority of the route through the early construction phases. The combined effect of the Koromkheti / Khertvisi Construction Phases would result in a **critical** impact on Link C (from Adjaristsqali (junction with S-45) to Keda (junction with S-74)). The existing baseline traffic flows are low and the Project will result in a significant increase in the number of vehicles travelling on the route. The large increase in truck movements will have a particular impact on local communities and road users.

Following the completion of the Shuakhevi scheme there are no adverse impacts expected on the upper sections of the S-1 route (Links F and G).

Other Study Links

Due to the presence of sensitive receptors and the existing geometry, the other links included within the study area would have a high sensitivity to changes in traffic flows. These links are only affected by an increase in traffic flows in one of the construction phases.

Using the matrix provided in Section 5.3.4.4, it is expected that the impact of the Project would be **major** (the S-74, S-77 and S-78) or **critical** (Machakhela Access and S-75) through parts of the construction phase. The existing baseline traffic flows are low and the Project will result in a significant increase in the number of vehicles travelling on the route. The large increase in truck movements will have a particular impact on local communities and road users. Given the significant increase in the number of truck movements associated with the development and the nature of the local routes, it is considered that the impacts on each of these routes should be classified as **critical**.

Following the completion of the Shuakhevi scheme there are no adverse impacts expected on the S-75 and S-77 routes (Links M and L). The S-74 and S-78 (Links J and K) are affected in the Koromkheti scheme construction phase only, and the S-45 and Machakhela Access (Links H and I) will experience a change only when the Khertvisi scheme is undergoing construction.

13.4.2 Operation

Following the completion of the Project, regular truck movements to and from the site will be limited to the weekly collection of various solid wastes, or approximately 10 two-way movements per week. In addition, occasional deliveries of materials will be made for plant maintenance purposes.

Approximately 60 personnel are expected to be employed during the operational phase of the Project. Most of these personnel are expected to live in the surrounding settlements. The Project will be in operation 24 hours per day, seven days per week. Accordingly the personnel will adopt a shift-based working pattern, likely to comprise two 12-hour shifts or three eight-hour shifts per day. Therefore, even if a worst case scenario is assumed, i.e. all personnel driving to work alone, the magnitude of the increase in traffic is expected to be negligible. The overall impact of operational traffic generated by the proposed development is expected to be **insignificant** in terms of the capacity of the highway network.

13.4.3 Decommissioning

It is anticipated that the Project will have an operational life of 45 years. The closure of the Project is therefore expected to take place in 2060, following which buildings will be dismantled and filling material used for site reclamation, so that the site will be assimilated into the surrounding topography. At this stage it is difficult to assess the impact of decommissioning on the local highway network, as it is not possible to make a reliable forecast of road traffic growth to the year 2060. Other developments will undoubtedly have taken place in the local area in the intervening period and improvements to the local highway network are likely.

However, the increase in traffic movements during decommissioning is anticipated to be no greater than that during construction, and could be reduced if the need for the import/export of materials is minimised in the design of any future alternative use for the site, and/or if building structures were retained.

For the above reasons the operational and safety impacts of traffic movements associated with decommissioning are assumed to be no greater than those associated with construction.

13.4.4 Cumulative Impacts

There are a number of cumulative impacts that could influence traffic movements in the Project study area. A list of potential developments is summarised below:

- Ski resorts at the following locations:
  - Goderdzi Pass Ski Resort (Khulo Municipality)
  - Gomarduli Ski Resort (Shuakhevi Municipality, Gomarduli Village)
  - Goma Mountain Ski Resort (Shuakhevi and Keda Municipalities)
- River Chorokhi HPP Cascade - Three steps runoff river cascades (Kirnati, Khelvachauri 1 and Khkelvachauri 2) will have 105.4 MW capacities.

It is expected that each of the projects will commence in 2012 and construction is likely to continue for a further five years. Once the ski resorts are operational it is expected that the sites will generate trips at all times of the year, however, the greatest traffic levels will occur in the winter months for the ski season.

Details of the cumulative developments are currently limited and further information is required with regard to the land use details and construction phasing of the above development proposals before a robust assessment of the likely cumulative impacts can be undertaken.

However, based on their close proximity to the Project, it is considered that the proposals could potentially have a significant impact on the local highway network. The cumulative impact could be especially pronounced if the construction programmes of these developments overlap with the Project peak construction traffic generation.

Once further information is available with regard to these development proposals, there is a need to develop a coordination plan with the input of all key stakeholders, to include site developers, the local Municipality and Police. This plan would coordinate the construction of the various development proposals and identify suitable physical and traffic management measures to mitigate the impacts of construction traffic on the capacity of the local highway network and the amenity of local residents.

13.5 Mitigation and Enhancement Measures

13.5.1 Overview

A range of measures are proposed to mitigate the adverse impacts of traffic movements associated with construction of the Project, including both physical and management measures.

Proposed physical measures include:

- Rehabilitation of existing tracks connecting the Project sites to the wider highway network
- Construction of new site access roads
- Financial contribution to the construction of new roads around the hydropower plants as foreseen by the local municipality
- Roads that will connect the Project sites to the main transportation network will be rehabilitated.

The proposed management measures have been brought together within a draft framework Traffic Management Plan (TMP) summarised in the following section. This draft framework TMP represents a starting point for further discussion between the lead contractor and the local municipality. It will be need to be developed in greater detail in partnership with the local municipality and other relevant authorities, and refined as access routes are confirmed and the timing and type of abnormal loads become known. However, the TMP provides a guide as to the type of measures which will be needed to mitigate the impact of construction traffic movements on the local highway network and on the local community.

Given the insignificant impact of operational traffic on highway capacity and safety, no mitigation measures are considered to be necessary during the operational phase.

13.5.2 Generic Mitigation and Monitoring Measures

Appointed contractors must agree temporary traffic management measures then adopt and monitor an appropriate way of working in consultation with the local municipality and police.

A framework Traffic Management Plan (TMP) has been included within the ESMP Volume IV (Section 3.8), it proposes generic mitigation measures to enhance the efficient transport of hydropower plant components and materials to site, whilst minimising congestion and disruption which might affect general traffic and in particular the emergency services. Wear and tear on the public roads which will constitute the construction vehicle routes to site is also considered. This document represents a commitment to satisfy roads and transport commitments and will be finalised as agreed between the contractor and the relevant stakeholders prior to commencement on-site.

13.5.3 Specific Mitigation Measures

The following specific mitigation measures will be applied throughout the Project:

Table 13.26: Summary of Traffic Mitigation Measures

Objective	Activity	Mitigation / Enhancement	Standards	Responsibility	Timescales	Cost estimate
To reduce the number of vehicle movements on local highway network, particularly truck movements	Re-use of excavated materials on site	Mitigation	Not applicable	Contractor	Throughout project	To be confirmed
	Traffic Management Plan (TMP)	Mitigation	Not applicable	Contractor	Throughout project	To be confirmed
	Construction of personnel accommodation on site	Mitigation	Not applicable	Contractor	Throughout project	To be confirmed
	Provision of bus/minibus services for personnel living in nearby settlements	Mitigation	Not applicable	Contractor	Throughout project	To be confirmed

13.6 Summary of Impacts, Mitigation and Residual Significance

13.6.1 Overview

A summary of overall effects associated with the construction phase of the Project, both before and after proposed mitigation measures, is provided in Table 13.27 below. More specific summaries of impacts before and after mitigation for the individual projects within the scheme on the different parts of the road network are contained in Table 13.28 to Table 13.31 below.

Table 13.27: Summary of construction effects for the Project

Likely effect	Significance	Mitigation	Residual Effect
Increase in general traffic (cars and trucks) volumes causing delays on the local highway network	Major	Re-use of excavated materials on site TMP Construction of personnel accommodation on site Provision of bus/minibus services for personnel living in nearby settlements	Moderate
Abnormal loaded vehicles causing delay on provincial road S-1 and the S-45, S-77 and S-78	Major	TMP	Moderate
Increase in general traffic (cars and trucks) volumes causing conflicts with vulnerable road users (pedestrians and cyclists) on the local highway network	Critical	TMP Construction of personnel accommodation on site Provision of bus/minibus services for personnel living in nearby settlements	Major
Physical effects (wear and tear) of trucks (including abnormal loads) on local highway infrastructure	Major	TMP Pre-construction road survey	Moderate

In accordance with the defined significance criteria, impacts of major or moderate significance are considered significant, therefore the traffic and transport impacts of the proposed Project are assessed as significant.

13.6.2 Residual Impacts

Due to the scale of the project and the sensitivity of the local highway routes and communities, without mitigation measures the scheme construction would have an adverse and significant impact across the study area. The influence of the mitigation measures and the residual impacts are summarised in the following tables.

Table 13.28: Summary of Key Shuakhevi Significant Impacts and Mitigations

Road Link	Key Impacts	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation	Residual significance
Link A - I-2 (also designated as the E70)	Pedestrians/ cyclists in local settlements – temporary exposure to increased traffic flows on local road network during construction Roads crossed by project – temporary delays to traffic from pipeline works Roads – temporary delays due to abnormal load movements Local road network – reduction in 'physical quality' i.e. breaking up of road surfaces from deliveries of construction materials including abnormal loads	Medium	Not available	Minor	Re-use of excavated materials on site TMP Construction of personnel accommodation on site Provision of bus/minibus services for personnel living in nearby settlements	Minor
Link B - S-1		High	Minor	Moderate		Moderate
Link C - S-1		High	Moderate	Major		Moderate
Link D - S-1		High	Moderate	Major		Moderate
Link E - S-1		High	Moderate	Major		Moderate
Link F – S-1		High	Moderate	Major		Moderate
Link G- S-1		High	Moderate	Major		Moderate
Link H - S-45		High	Negligible	Insignificant		Insignificant
Link I - Machakhela Road Access		High	Negligible	Insignificant		Insignificant
Link J - S-74		High	Negligible	Insignificant		Insignificant
Link K - S-78		High	Negligible	Insignificant		Insignificant
Link L - S-77		High	Moderate	Major		Moderate
Link M - S-75		High	Major	Critical		Major

Table 13.29: Summary of Key Koromkheti Significant Impacts and Mitigations

Road Link	Key Impacts	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation	Residual significance
Link A - I-2 (also designated as the E70)	Pedestrians/ cyclists in local settlements – temporary exposure to increased traffic flows on local road network during construction Roads crossed by project – temporary delays to traffic from pipeline works Roads – temporary delays due to abnormal load movements Local road network – reduction in 'physical quality' i.e. breaking up of road surfaces from deliveries of construction materials including abnormal loads	Medium	Not available	Minor	Re-use of excavated materials on site	Minor
Link B - S-1		High	Negligible	Insignificant	TMP Construction of personnel accommodation on site Provision of bus/minibus services for personnel living in nearby settlements	Insignificant
Link C - S-1		High	Moderate	Major		Moderate
Link D - S-1		High	Moderate	Major		Moderate
Link E - S-1		High	Moderate	Major		Moderate
Link F – S-1		High	Negligible	Insignificant		Insignificant
Link G- S-1		High	Negligible	Insignificant		Insignificant
Link H - S-45		High	Negligible	Insignificant		Insignificant
Link I - Machakhela Road Access		High	Negligible	Insignificant		Insignificant
Link J - S-74		High	Moderate	Major		Modate
Link K - S-78		High	Moderate	Major		Moderarte
Link L - S-77		High	Negligible	Insignificant		Insignificant
Link M - S-75		High	Negligible	Insignificant		Insignificant

Table 13.30: Summary of Key Khertvisi Significant Impacts and Mitigations

Road Link	Key Impacts	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation	Residual significance
Link A - I-2 (also designated as the E70)	Pedestrians/ cyclists in local settlements – temporary exposure to increased traffic flows on local road network during construction Roads crossed by project – temporary delays to traffic from pipeline works Roads – temporary delays due to abnormal load movements Local road network – reduction in 'physical quality' i.e. breaking up of road surfaces from deliveries of construction materials including abnormal loads	Medium	Not available	Minor	Re-use of excavated materials on site Traffic Management Plan (TMP) Construction of personnel accommodation on site Provision of bus/minibus services for personnel living in nearby settlements	Minor
Link B - S-1		High	Negligible	Insignificant		Insignificant
Link C - S-1		High	Moderate	Major		Moderate
Link D - S-1		High	Negligible	Insignificant		Insignificant
Link E - S-1		High	Negligible	Insignificant		Insignificant
Link F – S-1		High	Negligible	Insignificant		Insignificant
Link G- S-1		High	Negligible	Insignificant		Insignificant
Link H - S-45		High	Moderate	Major		Moderate
Link I - Machakhela Road Access		High	Major	Critical		Major
Link J - S-74		High	Negligible	Insignificant		Insignificant
Link K - S-78		High	Negligible	Insignificant		Insignificant
Link L - S-77		High	Negligible	Insignificant		Insignificant
Link M - S-75			Negligible	Insignificant		Insignificant

Table 13.31: Summary of Key Koromkheti / Khertvisi Significant Impacts and Mitigations

Road Link	Key Impacts	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation	Residual significance
Link A - I-2 (also designated as the E70)	Pedestrians/ cyclists in local settlements – temporary exposure to increased traffic flows on local road network during construction Roads crossed by project – temporary delays to traffic from pipeline works Roads – temporary delays due to abnormal load movements Local road network – reduction in 'physical quality' i.e. breaking up of road surfaces from deliveries of construction materials including abnormal loads	Medium	Not available	Moderate	Re-use of excavated materials on site TMP Construction of personnel accommodation on site Provision of bus/minibus services for personnel living in nearby settlements	Moderate
Link B - S-1		High	Minor	Moderate		Moderate
Link C - S-1		High	Major	Critical		Major
Link D - S-1		High	Moderate	Major		Moderate
Link E - S-1		High	Negligible	Insignificant		Insignificant
Link F – S-1		High	Negligible	Insignificant		Insignificant
Link G- S-1		High	Negligible	Insignificant		Insignificant
Link H - S-45		High	Moderate	Major		Moderate
Link I - Machakhela Road Access		High	Major	Critical		Major
Link J - S-74		High	Moderate	Major		Moderate
Link K - S-78		High	Moderate	Major		Moderate
Link L - S-77		High	Negligible	Insignificant		Insignificant
Link M - S-75			Negligible	Insignificant		Insignificant

13.7 Proposed Monitoring and Reporting

A monitoring system will need to be implemented throughout all of the project phases. Due to the potentially significant impacts of the project, a range of surveys will be required and should include the following:

- Traffic movement surveys – to determine the scale of impact on critical highway routes through sensitive areas
- Road accident surveys – to maintain a database of all road incidents involving vehicles associated with the project
- Road condition surveys – to record the impact of traffic movements, particularly trucks, on the road condition
- Road condition surveys – to record the impact of traffic movements, particularly trucks, on the road condition;

A summary of the survey requirements are presented in Table 13.32 below.

Table 13.32: Monitoring Requirements

Activity	Project Stages	Parameters	Locations	Frequency	Standards	Implementing Responsibility	Supervision / Reporting
Traffic movements	At regular intervals – to be agreed with local authorities	Traffic movement surveys	Route S-1 and all local access roads used by construction vehicles	At regular intervals – to be agreed with local authorities	To be confirmed by local authority	Lead Contractor	Roads Department of Georgia all contractors
Road accidents	At regular intervals – to be agreed with local authorities	Road accident surveys	Route S-1 and all local access roads used by construction vehicles	At regular intervals – to be agreed with local authorities	To be confirmed by local authority	Lead Contractor	Roads Department of Georgia and all contractors
Road conditions	Before any construction commences	Pre-construction road condition survey	Route S-1 and all local access roads used by construction vehicles	At regular intervals – to be agreed with local authorities	To be confirmed by local authority	Contractor	Lead Contractor Roads Department of Georgia
Road conditions	At regular intervals – to be agreed with local authorities	Road condition survey	Route S-1 and all local access roads used by construction vehicles	At regular intervals – to be agreed with local authorities	To be confirmed by local authority	Contractor	Lead Contractor Roads Department of Georgia
Bridge conditions	At regular intervals – to be agreed with local authorities	Bridge condition survey	Route S-1 and all local access roads used by construction vehicles	At regular intervals – to be agreed with local authorities	To be confirmed by local authority	Contractor	Lead Contractor Roads Department of Georgia

Following each survey a summary report will highlight any critical issues that need to be managed. This may include remedial works to road surfaces or local bridges. Additionally, should the accident reporting or traffic surveys identify any adverse impacts, the methods used to move materials and the timings of vehicle movements may need to be adjusted to mitigate developing problems.

13.8 Statement of Significance and Compliance

13.8.1 Statement of Significance

The Adjaristsquali Hydropower Cascade Project is a large and complicated development in a highly sensitive area. Prior to mitigations, the Project would have a large and very significant impact on the local highway network and communities that these routes serve. The mitigation measures will help to reduce the potential impacts, however, it is considered that major adverse impacts will remain.

13.8.2 IFC compliance

Table 13.33 and Table 13.34 presents a summary of the Project ecological impacts in the form of a Habitat Decision Framework against the requirement of IFC Performance Standard 1 (Assessment and Management of Environmental and Social Risks and Impacts) and 4 (Community Health, Safety and Security).

Table 13.33: IFC Assessment and Management of Environmental and Social Risks Decision Framework – Summary of Significant & Cumulative Effects

IFC PS1 compliance requirement	Significance of the Project and IFC compliance with the Performance Standard	Cumulative Effects
To identify and assess social and environment impacts, both adverse and beneficial, in the project's area of influence	The project will have a potentially significant impact on local communities. The introduction and implementation of mitigation measures will reduce the impact on local communities and any long-term significant adverse effect will be reduced.	Depends on the potential impacts of other developments within the study area, notably along the Machakhlistsqali.
To avoid, or where avoidance is not possible, minimize, mitigate, or compensate for adverse impacts on workers, affected communities, and the environment	The project will have a potentially significant impact on local communities. The introduction and implementation of mitigation measures will reduce the impact on local communities and any long-term significant adverse effect will be reduced.	Depends on the potential impacts of other developments within the study area, notably along the Machakhlistsqali.
To ensure that affected communities are appropriately engaged on issues that could potentially affect them	Due to the impact of the development on local communities, engagement is considered to be a critical element of the project. See Chapter 7 for the proposed community involvement measures.	Depends on the potential impacts of other developments within the study area, notably along the Machakhlistsqali.
To promote improved social and environment performance of companies through the effective use of management systems	Ongoing surveys, will record the impact of traffic movements on the local community. In conjunction with the community involvement programme, this information will be used to ensure that adverse impacts are being identified and mitigated against throughout the project lifetime.	Depends on the potential impacts of other developments within the study area, notably along the Machakhlistsqali.

Table 13.34: IFC Community Health, Safety and Security Decision Framework – Summary of Significant & Cumulative Effects

IFC PS4 compliance requirement	Significance of the Project and IFC compliance with the Performance Standard	Cumulative Effects
To avoid or minimize risks to and impacts on the health and safety of the local community during the project life cycle from both routine and non-routine circumstances	The TMP will ensure that the potential impacts on the local community are reduced wherever possible. Ongoing surveys will record the impact of traffic movements on the local community. In conjunction with the community involvement programme, this information will be used to ensure that adverse impacts are being identified and mitigated against throughout the project lifetime.	Depends on the potential impacts of other developments within the study area, notably along the Machakhlistsqali.
To ensure that the safeguarding of personnel and property is carried out in a legitimate manner that avoids or minimizes risks to the community's safety and security	Project security arrangements are considered in the ESMP. The TMP will be developed to compliment the project security approach.	Depends on the potential impacts of other developments within the study area, notably along the Machakhlistsqali.

14. Noise and Vibration

14.1 Introduction

The construction and subsequent use of the proposed Adjaristsqali Hydropower Cascade Project (hereafter referred to as 'the Project') has the potential to generate noise and vibration impacts in its vicinity. This section of the ESIA considers these impacts, how they will be quantified and addressed and what mitigation measures might be applied.

Potential noise impacts could arise through a number of sources during each phase of the Project, potentially generating levels in excess of prevailing conditions or recommended limits for sensitive receptors defined within International guidelines and National Regulations.

14.1.1 General Approach

Existing noise levels and sources have been determined by a noise survey at a number of key locations along the Project route. A comparison of calculated construction noise levels with national and international legislation guidance has then enabled potential significance effects to be identified at the main construction sites and haul routes associated with the Project. Principle construction sites are dam locations, powerhouse sites and haul routes, which include the existing road network and new sections of road to be constructed. Preliminary mitigation measures have been identified subject to further assessment at a later stage, once more precise details are known of working methodology and plant.

14.2 Methodology and Assessment Criteria

14.2.1 Legislative Background

14.2.1.1 National Guidelines

In Georgia "the standards of quality of the state of the environment are:

a) maximum permissible levels of the amount of microorganizms and of consentration of microorganizms and of consentration of substances harmful for the health of humans and for the environment in atmospherie air, water and land;

b) maximum permissible levels of noise vibration, electromagnetic field and other physical effects;

c) maximum permisible levels of radiation impact.

The standarts of quality of the state of the environment are defined every five years by the regulations *"on the Standards of Quality of the State of the Environment"* which is elaborated and approved by the Ministry of Health Care, in compliance with the Ministry of environment and Natural Resources Protection.

Article 37 of the Constitution of Georgia:

"Everyone has a right to live in a healthy environment".

The Law of Georgia on the State Complex Expertise of Construction Projects, 1999, comprises a series of legal norms. Decree 297 of the Georgian Ministry of Health, Labour and Social Defense, 2001 in their “affirmation of the norms over the qualitative norms of the environment” issued the following:

Table 14.1: Admissable Noise Norms

Time	Average allowed noise dB	Maximum allowed norms of noise dB
7am – 11pm	55	70
11pm – 7am	45	60

Table 14.2: Georgian Noise Quality Standards Inside Residential and Public Buildings

	7 am – 11 pm	11 pm – 7 am	7 am – 11 pm	11 pm – 7 am
	Indicative level dBA	Indicative level dBA	Maximum level dBA	Maximum level dBA
Residential areas	40	30	55	45
Schools	35	-	55	-
Hospitals	35	25	50	40

14.2.1.2 International Guidelines

International Finance Corporation

The International Finance Corporation (IFC) has developed a thorough programme of pollution prevention and management techniques in order to ensure that projects funded by the organisation are environmentally and socially responsible. The respective limit values in the IFC Environmental, Health and Safety (EHS) Guidelines that are relevant to the Projectre detailed below in Table 14.3.

Table 14.3: World Bank Group / International Finance Corporation Noise Limit Values

Specific Environment	Noise Level L_{Aeq} dB	
	Daytime (07:00-22:00)	Night-time (22:00-07:00)
Residential, educational or institutional	55	45
Industrial or commercial	70	70

Source: IFC EHS Guidelines

The EHS Guidelines require noise abatement measures be capable of achieving either the allowable $L_{Aeq,\ 1\ hour}$ ambient noise levels indicated above or a maximum increase in background levels of 3 dB at the nearest sensitive receptor.

The World Health Organisation

The World Health Organization (WHO) provides broad guidance on suitable environmental noise levels for a range of receptors. Guideline values for community noise in specific environments are detailed in ‘Guidelines for Community Noise 1999’. The specific limit values that are considered applicable to the Project are outlined in Table 14.4

Table 14.4: WHO Noise Guideline Values

Specific Environment	Guideline values
Outdoor living areas	55 dB LAeq,16 hours
School, playground outdoor	55 dB LAeq,during play
Dwellings – Outside bedrooms	45 dB LAeq,8 hours 60 dB LA(max)
Industrial, commercial, shopping and traffic areas, indoors and outdoors	70 dB LAeq,24 hours

Source: WHO Guidelines for Community Noise

The WHO guideline values take into account the potential impact of noise on quality of life and other aspects considered to be necessary for physical and mental wellbeing. The WHO noise guideline values for outside the bedrooms of dwellings recommend outdoor noise levels which correspond to internal noise levels, which would allow for the protection of occupiers from the critical health effects of sleep disturbance.

British Standard 5228: Code of Practice for Noise and Vibration Control

British Standard 5228 (BS 5228) provides comprehensive guidance on a range of aspects relating to construction noise and vibration including details of typical noise levels associated with various activities, construction noise prediction methods, significance criteria and an indication of the types of measures and procedures that can be used to reduce construction noise impacts. The document forms the basis for the majority of construction noise assessments throughout the United Kingdom (UK) and is widely recognised internationally. It has been used in this assessment.

BS 5228 states that sensitive receptors typically tolerate a greater change in noise level as a result of construction activity as compared to an industrial noise source. This is said to be partly due to awareness that construction noise is not a permanent source of disturbance.

Calculation of Road Traffic Noise

In the absence of specific Georgian methodology for calculating traffic noise it has been considered appropriate to apply the UK's Calculation of Road Traffic Noise (1988) as recommended in the UK's Design Manual for Roads and Bridges (DMRB). The methodology outlined in the The CRTN method may be applied to the construction, operational and decommissioning phases of the Project in order to calculate future noise levels as a result of changes to road traffic flows or design.

14.2.2 Methodology

Ideally the potential impact of an increase in traffic on the public road network associated with the project would be assessed using CRTN. This would require input information on measured or predicted movements, road type, average speed data and traffic flow composition in order to determine noise levels resulting from baseline and development scenarios. This would then allow an estimate to be made of potential impacts based on actual noise levels.

In the absence of traffic flows, or where traffic flows fall outside the range of validity in CRTN (less than 200 vehicles per hour) a more appropriate method is a sound power level-based approach such as that in BS5228

BS5228 methodology has been used to calculate impacts from various project activities.

14.2.3 Assessment of Impact Significance

14.2.3.1 Determining Sensitivity and Magnitude

Noise affects people in a number of different ways. This may include factors such as annoyance and sleep disturbance, enjoyment of quiet spaces, ability to communicate with others, ability to concentrate at home or at work, participation in social and community activities. As a consequence it is not appropriate to consider a single criterion when assessing the value of an existing noise environment.

Table 14.5 gives criteria used to determine the value of the noise environment at a receptor. For this assessment, it is necessary to consider how the intrinsic characteristics of a receptor define its intrinsic environmental value. For example:

- a national park (which in general would be characterised by isolation, tranquillity and corresponding low background noise and vibration) would be considered to have 'very high' environmental value. Any loss of tranquillity by way of increasing noise levels could potentially alter its intrinsic character
- an area of heavy industry (characterised by being built-up and source of noise and vibration) would be considered to have 'negligible' environmental value. Any increase in noise would be considered very unlikely to alter its intrinsic value.

EIA methodology requires the environmental value/sensitivity of potential receptors, likely to be impacted by the proposed development, is assigned in order to determine the significance of effects. The vast majority of receptors that could be affected by the proposed development are dwellings that would be considered to have 'high' environmental value on the basis that:

- people in dwellings have a low ability to absorb increases in noise and vibration without affecting the enjoyment of their dwelling
- people in dwellings are particularly susceptible to increases in noise and vibration because it may stop activities permanently.

Table 14.5: Criteria for determining sensitivity/environmental value

Sensitivity	Criterion 1 Ability to absorb change (increase) in noise level without fundamentally altering character	2 Geography	3 Susceptibility
Very high	No ability to absorb change (increase] in noise level without fundamentally altering character	International importance	People or operations are extremely susceptible to noise where any change (increase) would permanently stop people working
High	Low ability to absorb change (increase) in noise level without fundamentally altering character	National importance	People or operations are particularly susceptible to noise where any change (increase) would stop people working for long periods
Medium	Some ability to absorb change (increase) in noise level without fundamentally altering character	Regional/ county importance	People or operations are moderately sensitive to noise, where any change (increase) would stop people working for short periods
Low	High ability to absorb change (increase) in noise level without fundamentally altering character	District/ parish importance	People or operations are not very sensitive to noise, where any change (increase) would stop people working for very short periods

	Criterion		
Negligible	Tolerant of change (increase) in noise without altering its character	No listed importance	People or operations are not at all sensitive to noise, where any change (increase) would not stop people working

14.2.3.2 Noise Impacts from Construction noise

Fir the purposes of Table 14.6, the threshold is defined as 55 dB.

Table 14.6: Criteria for Determining Significance of Construction Noise Impacts on High Value Receptors

Level and Duration of Works	Magnitude of Impact
Ambient during construction is below threshold value at all times	None
Ambient during construction exceeds threshold value by less than 5dB for less than 1 month	Negligible Adverse
Ambient during construction exceeds threshold value by less than 5dB for more than 1 month	Minor Adverse
Ambient during construction exceeds threshold value by more than 5dB for less than 1 month	Moderate Adverse
Ambient during construction exceeds threshold value by more than 5dB for more than 1 month	Major Adverse

14.2.3.3 Noise impacts from construction traffic

Table 14.7: Noise Impacts from Construction Traffic

Noise change $L_{A10,18h}$ or $L_{Aeq,18h}$ dB	Magnitude of impact	Description of impact
≤ -5	Major beneficial	Major decrease in noise level which would be noticeable in the short, medium and long terms
> -5 and ≤ -3	Moderate beneficial	Moderate decrease in noise level which would be noticeable in the short and medium terms but possibly not in the long term
> -3 and ≤ -1	Minor beneficial	Minor decrease in noise level which might be noticeable in the short term but possibly not in the medium term and not in the long term after a period of habituation
> -1 and < -0	Negligible beneficial	Negligible decrease in noise level considered to be noticeable only when a subject is deliberately listening for a change. Such an impact would results from a 20% decrease in traffic volume (assuming no change in speed or composition). May be noticeable in the short-term but not in the medium and long terms.
0	None	No change in noise level and no alteration in the noise environment
> 0 and < +1	Negligible adverse	Negligible increase in noise level considered to be noticeable only when a subject is deliberately listening for a change. Such an impact would results from a 25% increase in traffic volume

Noise change $L_{A10,18h}$ or $L_{Aeq,18h}$ dB	Magnitude of impact	Description of impact
		(assuming no change in speed or composition). May be noticeable in the short-term but not in the medium and long terms.
≥ +1 and < +3	Minor adverse	Minor increase in noise level which might be noticeable in the short term but possibly not in the medium term and not in the long term after a period of habituation
≥ +3 and < +5	Moderate adverse	Moderate increase in noise level which would be noticeable in the short and medium terms but possibly not in the long term
≥ +5	Major adverse	Major increase in noise level which would be noticeable in the short, medium and long terms

14.2.3.4 Assigning Significance

The significance has been determined by the interaction between the magnitude of impacts and the sensitivity of receptors affected, as depicted in the significance matrix shown in Table 14.8. In this assessment all receptors that could be affected by the proposed development are assumed to have high environmental value. Therefore, tables describing the significance of effects are for receptors having high environmental value.

Table 14.8: Criteria for determining significance

Magnitude of impact	Significance of impact for receptors with high environmental value
Major beneficial	Large or very large beneficial
Moderate beneficial	Moderate or large beneficial
Minor beneficial	Slight or moderate beneficial
Negligible beneficial	Slight beneficial
No impact	Neutral
Negligible adverse	Slight adverse
Minor adverse	Slight or moderate adverse
Moderate adverse	Moderate or large adverse
Major adverse	Large or very large adverse

For this assessment, the categories of significance are applied to the qualitiative assessment of noise impacts.

14.3 Baseline Description

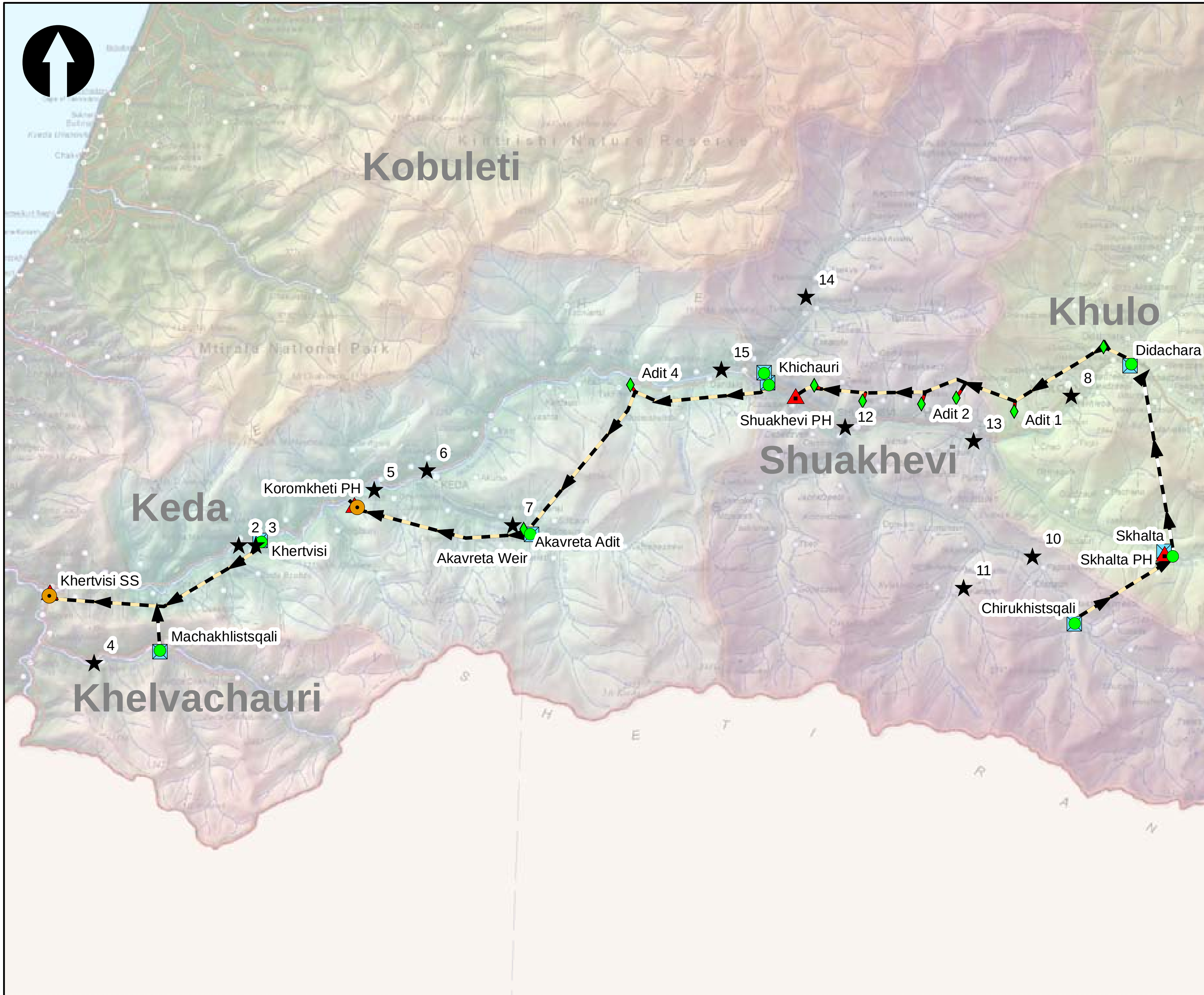
Although comprising three phases in three broad areas, the project as a whole will encompass the whole mountainous region of Adjara and extend across the Adjarastsqali River, from a height of 790 m above sea level at the confluence of the Adjaristsqali and Chorokhi Rivers.

There are no significant sources of man-made noise in the area other than traffic which is irregular and relatively light. Principal sources of sound are associated with weather – wind in trees etc.

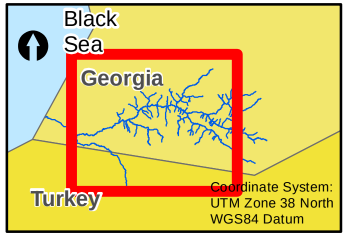
A baseline noise survey was undertaken across the area comprising spot measurements during the day and night-time periods. Monitoring points were selected in nearest settlements located close to the Adjaristsqali HPP facility. Monitoring points were chosen on those main road sections, where an increase in traffic intensity is possible during the construction phase (control points coordinates are presented in Table 14.9.

Measurements of noise levels have been carried out using the noise and vibration measuring unit ИВШ-1 (the instrument has passed metrological testing). The measurements were taken twice in the day-time (from 11 to 18 hr) and night-time (from 18 to 22 hr). At other monitoring points the baseline value has been determined with 20 minute intervals, using the average of three measurements. Coordinates of the control points and measured values are given in Table 14.9.

Figure 14.1 indicates the location of the measurements. It should be noted that the noise measurements reported in the baseline survey are presented for comparative purposes of noise levels at locations across the study area and the general difference between noise levels during day-time and night-time.



Location Map



Legend

Noise Baseline

Permanent Structures

Adit

Dam

Powerhouse

Surge Shaft

Intake

Underground Tunnel

Adit Tunnel

Headrace Tunnel

Transfer Tunnel

0 500 1,000 2,000 3,000 4,000 Meters

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	27/01/2012	For Information	WJG	JG	VH

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Mott MacDonald

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Gamma Consulting Limited
9, Merab Aleksidze Street,
Tbilisi 0193, Georgia

Drawing Title

Adjaristsqali Hydropower
Cascade Project
Baseline Noise Location

Scale @ A4	MM Project No.	Status
1:250,000	290039	PRE

GIS File
20120127_Noise_Baseline.mxd

Drawing No.	Rev
MMD-290039-MNC-GEN-002	P1

Table 14.9: Noise Baseline Measurement Data within the Project Area

N	Site Name	Site Coordinates (UTM System)	Noise Level, dBA	
			Day-time	Night-time
1	Village Adjaristskali, settlement area, adjacent to the crossroads	X = 727640 Y = 727640	56.3	44.2
2	Qveda Makhuntseti Adjariststali village, settlement area, adjacent to the crossroads	X = 736121 Y = 4605371	51.8	43.7
3	Village Qveda Bzubzu, dwelling house nearest to the the design weir	X = 736939 Y = 4605429	48.0	42.3
4	Village Sindieti, adjacent to motor road	X = 729492 Y = 4599173	38.6	39.2
5	Village Koromkheti, dwelling house nearest to the the design powerhouse	X = 742495 Y = 4608506	43.7	38.0
6	Village Keda, adjacent to the crossroads	X = 744988 Y = 4609623	54.1	47.9
7	Village Sikhalidzeebi, dwelling house nearest to the the design weir	X = 749336 Y = 4607264	34.2	32.8
8	Village Khulo, adjacent to the crossroads	X = 276275 Y = 4613610	58.6	46.5
9	Close proximity of the river Ghorjomi bridge	Not available	42.0	41.8
10	Adjacent to the Paposhvilebi village road	X = 274406 Y = 4605798	35.0	34.1
11	Adjacent to the Matskvalta village	X = 271046 Y= 4604269	32.0	32.8
12	Suakhevi, close to the crossroads	X = 265286 Y = 4612076	50.9	44.8
13	Village Zamleti, residential area	X = 271533 Y = 4611394	43.8	42.1
14	Adjacent to village Varjanauli	X = 263394 Y = 4618399	37.5	34.0
15	Adjacent to village Dandalo	X = 259271 Y = 4614871	53.6	43.1

Source: GAMMA

From measurement results given in Table 14.9, it can be seen that the noise levels in general do not exceed the prescribed limits (Georgian standards[34]). Small exceedances of norms were noted in two places, near the crossroads of settlement area of Adjaristsqali village (site N1) and Khulo town (site N8). Noise levels at these two locations were due to traffic.

The lowest noise levels were identified in the village adjacent to the Adjaristsqali HPP facilities, where the traffic flow was low (1-2 car(s)/hour in daytime). Consequently only natural noise was measured during the survey period (for example, noise generated by the river, wind and wildlife).

[34] Sanitary standards on Noise at Work Places, Residential and Public Buildings and Residential Territories (Sanitary Norms 2.2.4/2.1.8. 003/004-01)

14.4 Assessment of Impacts

This sub-section assesses the noise impacts of the construction, operational and decommissioning phases. It also considers the cumulative noise impacts of the Project combined with noise sources from other planned developments.

14.4.1 Construction Phase

14.4.1.1 General Construction Noise

Noise issues are most likely to arise during the construction period from activities such as construction of headworks, tunnels, powerhouse, tower foundations, truck movements and access roads. Noise effects for the most part will be localised and are likely to include the following types:

- Traffic
- Explosions / blasting
- Excavation using heavy plant
- Drilling
- Crushing plant
- Batching plant.

The likely effects of noise will depend mainly on:

- Distance from source to receiver
- Sound power level of the activity
- Duration of the works
- Operating times of the powerhouse
- Nature and extent of mitigation measures.

In addition to the above, it is generally accepted that noise effects are limited to within 200 m of the source. As such, the assessment of construction noise has been limited to receptors up to this distance.

Noise effects during the construction phases have been assessed from a qualitative perspective using a risk based approach to determine the likelihood of emissions resulting in nuisance. This has included consideration of the construction activities proposed and the sensitivity of local receptors (as discussed above, all residential receptors are classified as ‘high’ sensitivity). Sites have been ranked in terms of the likelihood of low, medium or high risk of noise nuisance effects. Mitigation measures will be proposed in following sections, where appropriate, based on the level of risk identified and in accordance with best practice guidance.

The following tables calculate construction noise due to a number of activities, results displayed for items of plant within each activity and for each activity subtotal. The methodology used is that of BS5228:2009. The tables calculate noise levels at 50 m, 100 m and 200 m respectively. In general, screening has not been assumed – for partial screening a correction of -5 dB may be made to each item of plant, and for full screening, a correction of -10 dB should apply. Subtotals reflect the total noise levels for each given activity.

Table 14.10: Predicted Construction Noise Impacts at 50 m

	A-weighted SPL LAeq,10m dB for continuous operation	Utilisation during working day %	Distance	Screening	Overall construction noise level dB	
Road Construction						
Dozer	78	50	50	0	60	
excavator	78	50	50	0	60	
Loader	68	50	50	0	50	
haul truck	80	25	50	0	59	
roller	75	25	50	0	54	Subtotal
Asphalt paver	77	25	50	0	56	65
Site Preparation						
Ground excavation/earthworks dozer	80	75	50	0	63	
Tracked excavator	76	75	50	0	59	
Chain saw	86	50	50	0	68	
Tractor	87	75	50	0	70	
Lorry	80	25	50	0	59	Subtotal
Face shovel	79	50	50	0	61	73
General						
Concrete batching plant						
Concrete batching	87	100	50	0	72	
Concrete mixer truck	77	50	50	0	59	
Pumping concrete	82	50	50	0	64	Subtotal
Face shovel	79	75	50	0	62	73
Diaphragm Walling						
Clam shovel	96	25	50	-5	70	
concrete pumps	82	50	50	0	64	Subtotal
crane	76	25	50	0	55	71
Dam						
Tower Crane	76	50	50	0	58	
Wheeled excavator	83	50	50	0	65	
Generator (lighting)	65	100	50	0	50	
Rock Drill	89	20	50	0	66	Subtotal
Drilling blast holes	90	15	50	0	66	71
Crusher plant						
Primary	80	100	50	0	65	
Secondary	80	100	50	0	65	
Tertiary	80	100	50	0	65	
Screens	80	100	50	0	65	Subtotal
Lorry	80	25	50	0	59	71

Table 14.11: Predicted Construction Noise Impacts at 100 m

Plant	A-weighted SPL LAeq,10m dB for continuous operation	Utilisation during working day %	Distance	Screening	Overall construction noise level dB	
Road Construction						
Dozer	78	50	100	0	52	
excavator	78	50	100	0	52	
Loader	68	50	100	0	42	
haul truck	80	25	100	0	51	
roller	75	25	100	0	46	Subtotal
Asphalt paver	77	25	100	0	48	57
Site Preparation						
Ground excavation/earthworks dozer	80	75	100	0	56	
Tracked excavator	76	75	100	0	52	
Chain saw	86	50	100	0	60	
Tractor	87	75	100	0	63	
Lorry	80	25	100	0	51	Subtotal
Face shovel	79	50	100	0	53	66
General						
Concrete batching plant						
Concrete batching	87	100	100	0	64	
Concrete mixer truck	77	50	100	0	51	
Pumping concrete	82	50	100	0	56	Subtotal
Face shovel	79	75	100	0	55	65
Diaphragm Walling						
Clam shovel	96	25	100	-5	62	
concrete pumps	82	50	100	0	56	Subtotal
crane	76	25	100	0	47	63
Dam						
Tower Crane	76	50	100	0	50	
Wheeled excavator	83	50	100	0	57	
Generator (lighting)	65	100	100	0	42	
Rock Drill	88.7	20	100	0	59	Subtotal
Drilling blast holes	90	15	100	0	59	63
Crusher plant						
Primary	80	100	100	0	57	
Secondary	80	100	100	0	57	
Tertiary	80	100	100	0	57	
Screens	80	100	100	0	57	Subtotal
Lorry	80	25	100	0	51	63

Table 14.12: Predicted Construction Noise Impacts at 200 m

Plant	A-weighted SPL LAeq,10m dB for continuous operation	Utilisation during working day %	Distance	Screening	Overall construction noise level dB	
Road Construction						
Dozer	78	50	200	0	44	
excavator	78	50	200	0	44	
Loader	68	50	200	0	34	
haul truck	80	25	200	0	43	
roller	75	25	200	0	38	Subtotal
Asphalt paver	77	25	200	0	40	50
Site Preparation						
Ground excavation/earthworks dozer	80	75	200	0	48	
Tracked excavator	76	75	200	0	44	
Chain saw	86	50	200	0	52	
Tractor	87	75	200	0	55	
Lorry	80	25	200	0	43	Subtotal
Face shovel	79	50	200	0	45	58
General						
Concrete batching plant						
Concrete batching	87	100	200	0	56	
Concrete mixer truck	77	50	200	0	43	
Pumping concrete	82	50	200	0	48	Subtotal
Face shovel	79	75	200	0	47	58
Diaphragm Walling						
Clam shovel	96	25	200	-5	54	
concrete pumps	82	50	200	0	48	Subtotal
crane	76	25	200	0	39	56
Dam						
Tower Crane	76	50	200	0	42	
Wheeled excavator	83	50	200	0	49	
Generator (lighting)	65	100	200	0	34	
Rock Drill	88.7	20	200	0	51	Subtotal
Drilling blast holes	90	15	200	0	51	56
Crusher plant						
Primary	80	100	200	0	49	
Secondary	80	100	200	0	49	
Tertiary	80	100	200	0	49	
Screens	80	100	200	0	49	Subtotal
Lorry	80	25	200	0	43	56

From an examination of available information – satellite photographs and mapping, information on nearest receptors to principal construction sites has been derived and is presented in the following Table 14.13.

Table 14.13: Level of Risk to Sensitive Receptors adjacent to Principle Construction Sites

Adjaristsqali Hydropower Cascade Project	Nearest receptors	Noise standards	Comments	Risk
Shuakhevi HPP				
Didachara Dam (Crusher plant to be used during construction)	150	55	Possible screening by intervening ground	Medium
Chirukhi Dam (Crusher plant to be used during construction)	100	55		High
Skhalta Dam (Crusher plant to be used during construction)	600	55	Screened by intervening ground	Low
Skhalta powerhouse	600	55	Screened by intervening ground	Low
Shuakhevi powerhouse	160	55		High
Koromkheti HPP				
Chvanistsqali Dam (Batching plant to be used during construction)	100	55	Overlooking site	High
Vaoi Dam (Batching plant to be used during construction)	100	55	Overlooking site	High
Akavreta Dam (Batching plant to be used during construction)	150	55	Screened by intervening ground	Medium
Khertvisi HPP				
Khertvisi Dam (Crusher plant to be used during construction)	100	55		High
Machakhela Dam (Crusher plant to be used during construction)	200	55		Low

It can be seen that there are sensitive receptors (i.e. high sensitivity) within 200 m of the majority of sites. There will also be further construction works in the vicinity of each site – access road construction, bridge construction, construction camps and welfare facilities.

Potential risks identified above should be regarded as indicative, based on worst case estimates. The risk ratings therefore represent points on a scale between minor adverse and major adverse effects. The position depends on the receptor location, topography, construction methodology etc. and it has not been possible to assess each of these factors for each of these project components at the residential areas (sensitive receptors). Therefore, for the purposes of this assessment, these effects are considered significant environmental effects and indicative of the need to consider mitigation measures.

14.4.1.2 Construction Traffic Noise

Significant effects associated with traffic noise impacts are conventionally described in terms of increases over existing. Traffic flows in Table 14.13 have been supplied for each link as shown in Figure 13.1

Table 14.14: Traffic Flow and Noise Changes

	Existing		Shuakhevi Cons. Phase			Koromkheti Cons. Phase			Khertvisi Cons. Phase		
Link Ref	AADT	% hgv	AADT	% hgv	dB Change	AADT	%hgv	dB Chan ge	AADT	% hgv	dB Chan ge
A	No base data available										
B	1,424	18	1,750	16	0.9	1,769	16	0.9	1,761	16.1	0.9
C	1,000	18	1,359	18	1.3	1,553	22	1.9	1,634	24.0	2.1
D	880	13	1,167	15	1.2	1,191	17	1.3	992	11.3	0.5
E	1,040	20	1,590	22	1.8	1,328	18	1.1	1,248	16.7	0.8
F	1,040	20	1,518	22	1.6	1,248	17	0.8	1,248	16.7	0.8
G	1,040	20	1,742	26	2.2	1,248	17	0.8	1,248	16.7	0.8
H	472	24	584	19	0.9	584	19	0.9	718	23.8	1.8
I	168	29	216	22	1.1	216	22	1.1	350	30.4	3.2
J	296	27	376	21	1.0	524	28	2.5	376	21.3	1.0
K	168	29	216	22	1.1	268	25	2.0	216	22.2	1.1
L	224	25	397	27	2.5	280	20	1.0	280	20.0	1.0
M	176	32	387	33	3.4	232	24	1.2	232	24.1	1.2

It can be seen from the above table that noise impacts are for the most part minor an increase between 1 dB and 3 dB. There are two instances where a change in noise is expected to result in an increase of noise over 3 dB. These are:

- Link Ref. I. Khertvisi Construction Phase from Route S-45 to the Project site (3.2dB)
- Link Ref. M. Shuakhevi Construction Phase from Route S-1 at Zomoleti to the Project site (3.4dB)

At these two locations, the predicted impact is rated as being of adverse moderate significance.

14.4.1.3 Construction Vibration

In general, vibration arising from construction activities is ground-borne and may be generated by operations such as ground compaction, piling and the movement of vehicles over irregular surfaces. Detailed prediction of construction vibration requires many factors such as ground type, dynamic forces, transfer function, building foundatios etc. For this reason an empirical approach has been used.

The Transport and Road Research Laboratory (TRRL) in their Report 53 “Ground vibration caused by civil engineering works” have published the results of a series of measurements of vibration levels at distances from a range of construction works. The ground conditions in the area of the source and receiver position and of the intervening ground are not specified so the data can only be used for general guidance. The data are reproduced in Table 14.15 with vibration levels expressed as peak particle velocity (PPV). PPV is defined as the instantaneous maximum velocity reached by a vibrating element as it oscillates about its rest position and can be used in the assessment of vibration impacts with respect to disturbance and building damage.

Table 14.15: Estimated peak particle velocities at distances between construction plant and vibration measurement positions

Construction plant	Distance between construction site and vibration measurement position in metres	Estimated peak particle velocity at measurement position in mm/s
General construction traffic including haul routes	1	0.60
	2	0.24
	4	0.14
	6	0.10
	≥8	<0.10
Heavy lorry on poor road surface	1	2.20
	2	0.80
	4	0.24
	6	0.16
	8	0.10
	≥10	<0.10

BS 5228 'Code of construction practice for noise and vibration control on construction and open sites – Part 2: Vibration' (2009) [15] provides guidance on the effect of vibration and the likelihood they will cause complaint and cosmetic damage to buildings. BS 5228 does not indicate whether particular vibrations are significant. However, it does state "It is likely that vibration of...[1.0 mm/s]...in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents".

Generally, vibration from construction activities will be temporary and intermittent in nature. To put the values in Table 14.15 into some context, the BS 7385 'Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground-borne vibration' provides guidance on the levels of vibration that would be necessary to cause structural damage to different types of buildings. BS 7385 indicates that:

- in industrial and heavy commercial buildings, continuous PPVs of more than about 25 mm/s would be required to cause structural damage; and
- in residential buildings and light commercial buildings, continuous PPVs of more than about 7 mm/s would be required to cause structural damage.

Potential sources of vibration would be both construction traffic on local roads and plant on construction sites. It is considered that vibration will not cause an impact on construction sites owing to the fact that there are no receptors close enough to be exposed. Where local road surfaces are poor, movement of construction traffic is likely to result in perceptible vibration at houses immediately adjacent, although this will not cause structural damage. Construction vibration is therefore not considered to cause significant effects.

It should be noted that blasting has not been considered as adverse effects resulting from pressure waves, not all of which are perceptible as sound can be controlled by appropriate blast design.

14.4.2 Operational Phase

14.4.2.1 General Operational Noise

Operational noise impacts will be limited to turbines within powerhouses, most of which will be located below ground or within enclosed buildings. Therefore operational impacts from fixed plant are not predicted to generate a significant impact and are not considered further in this assessment.

14.4.2.2 Operational Traffic Noise

There will be maintenance work necessary associated with the powerhouses and associated infrastructure in addition to staff movements. However these will be limited, occasional and are not considered further.

14.4.2.3 Operational Vibration

There will be no vibration impacts associated with operation of the scheme.

14.4.3 Decommissioning Phase

During decommissioning there will be no impacts associated with infrastructure constructed as part of the scheme as this will remain. Decommissioning of powerhouses and other ancillary structures will not require large-scale movement of materials therefore impacts will be negligible.

14.4.4 Cumulative Impacts

Although a number of developments are underway in the area there are no developments in the area likely to add to impacts associated with the scheme under consideration. Although there are other HPP schemes planned, it is assumed that they will not occur simultaneously and will use different parts of the road network for construction associated traffic. Of the three hydropower schemes, any overlap would potentially result in possible impacts arising from construction traffic associated with more than one scheme.

14.5 Mitigation and Enhancement Measures

14.5.1 Overview

The assessment of potential impacts arising from the Project has of necessity been qualitative. Insufficient information is available to provide a full, quantitative assessment, however potential risks have been identified and further assessment as part of the mitigation strategy will occur.

Where potential cumulative noise effects may occur in respect of existing or proposed developments, the assessment will consider the combined effects and identify applicable mitigation measures as necessary.

14.5.2 Generic Mitigation and Monitoring Measures

Generic measures are likely to include the following:

- Restricted general hours of working to avoid sensitive periods
- Positioning of temporary site compounds as far as reasonably practicable from sensitive receptors
- Undertaking construction activities in accordance with good practice
- Maintaining equipment in good working order and fitting with appropriate noise control at all times

- Use of site terrain, material stockpiles and suitable work locations so as to screen work locations and maximise the distance between work activities and receptors
- Keep haul routes well maintained
- Consider enclosures for compresors/generators if located near sensitive receptors
- Ensure deliveries arrive and depart so as not to disturb residents at inconvenient times
- Setting noise limits
- A regime of noise monitoring where appropriate
- Providing the public with advance notice of planned noise-generating activities.

14.5.3 Specific Mitigation Measures

Site-specific mitigation measures will be identified within the ESMP and will require an identification of noise-sensitive receptors and potential impacts at each site. Once this has been undertaken specific mitigation measures most appropriate to site operations and receptor proximity should be implemented.

There are predicted to be some adverse impacts associated with increased construction traffic at two locations (road links), as identified in section 14.4.1.2. Any noise complaints relating to these areas will be investigated before developing any specific mitigation measures.

In order to reduce the likelihood of vibration occurring it is recommened that driving behaviour should be modified accordingly i.e. reduced speed, avoiding asperities in the road surface.

14.6 International Requirements

14.6.1 Overview

This section demonstrates how the Project meets the compliance requirements for international financing institutions with respect to noise.

14.6.2 National Guidelines

A demonstration of compliance with the noise requirements contained within the Law of Georgia on the State Complex Expertise of Construction Projects, 1999 is presented in Table 14.16.

Table 14.16: International Requirements and Associated Project Compliance

Requirement	How Project Compliance will be Achieved
Admissable Noise Norms 7am – 11pm; Average 55 db, Maximum 70 dB 11pm – 7am; Average 45 db, Maximum 60 dB Georgian Noise Quality Standards Inside Residential and Public Buildings 7am – 11pm, indicative level; Residential areas 40 dB, Schools 35 db, Hospitals 35 dB 7am – 11pm, maximum level; Residential areas 55 dB, Schools 55 db, Hospitals 50 dB 11pm – 7am, indicative level; Residential areas 30 dB, Schools No limit, Hospitals 25 dB 11pm – 7am, maximum level; Residential areas 45 dB, Schools No limit, Hospitals 40 dB	The relevant project phase for determining compliance is restricted to construction. The principle sources of significant noise are limited to general construction activities, such as traffic, blasting, excavation, drilling, crushing plant and batching plant. A number of high risk sensitive receptors have been identified as being within 200 m of major construction activities. However, a suite of construction phase noise mitigation measures have been proposed which will result in a reduction of noise from these activities.

14.6.3 International Requirements

The following documents and guidelines form the noise compliance requirements for the Project;

- IFC EHS General Guidelines
- The World Health Organisation
- British Standard 5228: Code of Practice for Noise and Vibration Control
- UK's Calculation of Road Traffic Noise (1988).

A demonstration of compliance against each of these is presented in Table 14.17.

Table 14.17: International Requirements and Associated Project Compliance

Requirement	How Project Compliance will be Achieved
IFC EHS General Guidelines	
Noise levels at residential, educational or institutional facitlities of 55 LAeq dB (between 07:00 and 22:00) and 45 LAeq dB (between 22:00 and 07:00). Noise levels at industrial or commercial facitlities of 55 LAeq dB (between 07:00 and 22:00) and 45 LAeq dB (between 22:00 and 07:00). Noise abatement measures to be capable of of achieving either the allowable LAeq 1 hour ambient noise levels indicated above or maximum increase in background levels of 3 dB at the nearest sensitive receptor.	**Compliant**. The relevant project phase for determining compliance is restricted to construction. The principle sources of significant noise are limited to general construction activities, such as traffic, blasting, excavation, drilling, crushing plant and batching plant. There are estimated to be two locations where a change in noise is likely to result in an increase in noise over 3 dB. These are; • Link Ref. I. Khertvisi Construction Phase from Route S-45 to the Project site (3.2dB) • Link Ref. M. Shuakhevi Construction Phase from Route S-1 at Zomoleti to the Project site (3.4dB) However, relevant construction phase mitigation measures have been proposed which should mean that the background noise level increases do not exceed an increase in 3 dB at nearest sensitive receptors.
The World Health Organisation	
Guideline noise levels at outdoor living areas of 55 LAeq dB, 16 hours. Guideline noise levels at schools and outdoor playgrounds of 55 LAeq dB, during play. Guideline noise levels at dwellings outside bedrooms of 45 LAeq dB, 8 hours and 60 LA max dB. Guideline noise levels at industrial, shopping and traffic areas, indoors and outdoors of 70 LAeq dB, 24 hours. Outside the bedroom of dwellings, recommend outdoor noise levels which correspond to internal noise levels which would allow for the protection of occupiers from the critical health effects of sleep disturbance.	**Compliant**. The relevant project phase for determining compliance is restricted to construction. The principle sources of significant noise are limited to general construction activities, such as traffic, blasting, excavation, drilling, crushing plant and batching plant. A number of high risk sensitive receptors have been identified as being within 200 m of major construction activities. However, a suite of construction phase noise mitigation measures have been proposed which will result in a reduction of noise from these activities.
British Standard 5228: Code of Practice for Noise and Vibration Control	
Comprehensive guidance on a range of aspects relating to construction noise and vibration including details of typical noise levels associated with various activities, construction noise prediction methods, significance criteria and an indication of the types of measures and procedures that can be used to reduce construction noise impacts. The document forms the basis for the majority of construction noise assessments throughout the United Kingdom (UK) and is widely recognised internationally.	**Complaint**. BS5228 has been used and referred to throughout this noise assessment and for the purposes of calculating the expected noise levels from various construction activities and plant items which will be used during the construction phase.
Calculation of Road Traffic Noise (CRTN) (1988)	

Requirement	How Project Compliance will be Achieved
The methodology outlined in the The CRTN method may be applied to the construction, operational and decommissioning phases of the Project in order to calculate future noise levels as a result of changes to road traffic flows or design.	**Complaint**. Methodology used in this noise assessment where relevant.

Through appropriate construction phase mitigation, it is believed that the Project is able to achieve compliance with all relevant provisions and requirements for noise.

14.7 Summary of Impacts, Mitigation and Residual Significance

Construction impacts have the potential to result noise impacts arising from both construction site activity and construction traffic on the local road network. In addition there is the potential for vibration impacts resulting from construction related traffic on poorly maintained local roads.

Much of the assessment has has been qualitative, and results derived from indicative calculations. However this has enabled the identification of areas where mitigation will be required.

14.7.1 Residual Impacts

A summary of the expected residual impacts associated with noise is provided in Table 14.18. Following mitigation it is expected that residual impacts will be confined to impacts associated wih the construction of major project components (minor significance) and the impacts on the local road network arising from construction traffic (minor adverse impacts, with moderate adverse impacts on two stretches of road). However these will be of limited duration and vary according to the construction programme.

Table 14.18: Summary of Key Significant Impacts and Mitigations

Activity	Project Phase	Potential Impact	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation	Residual Significance
General construction activities, such as traffic, blasting, excavation, drilling, crushing plant, batching plant.	• Construction	Potential impacts include; • Nuisance to local residents • Ecological disturbance There are sensitive receptors located less than 200 m from the proposed location of the following project components; • Didachara Dam • Khichauri Dam • Shuakhevi powerhouse • Chvanistqali dam • Skalta dam • Akavreta dam • Khertvisi dam	Medium	Moderate	Moderate	Noise mitigation measures are likely to include the following: • Restricted general hours of working to avoid sensitive periods • Positioning of temporary site compounds as far as reasonably practicable from sensitive receptors • Undertaking construction activities in accordance with good practice • Maintaining equipment in good working order and fitting with appropriate noise control at all times • Use of site terrain, material stockpiles and suitable work locations so as to screen work locations and maximise the distance between work activities and receptors • Consider enclosures for compresors/generators if located near sensitive receptors • Ensure deliveries arrive and depart so as not to disturb residents at inconvenient times • Setting noise limits • A regime of noise monitoring where appropriate • Providing the public with advance notice of planned noise-generating activities.	Minor
Construction traffic noise	• Construction	Potential impacts include; • Nuisance to local residents • Ecological disturbance There are two locations where a change in noise is likely to result in an increase in noise over 3 dB. These are; • Link Ref. I. Khertvisi Construction	Medium	Moderate	Moderate	Noise mitigation measures are likely to include the following: • Maintaining equipment in good working order and fitting with appropriate noise control at all times • Keep haul routes well maintained • Ensure deliveries arrive and depart so as not to disturb residents at	Moderate / Minor

Activity	Project Phase	Potential Impact	Sensitivity Score	Magnitude Score	Impact Significance	Mitigation	Residual Significance
		Phase from Route S-45 to the Project site (3.2 dB) • Link Ref. M. Shuakhevi Construction Phase from Route S-1 at Zomoleti to the Project site (3.4 dB)				inconvenient times • Setting noise limits • A regime of noise monitoring where appropriate	

14.8 Proposed Monitoring and Reporting

Propose monitoring and associated reporting will be identified in the Environment and Social Management Plan (ESMP).

14.9 Statement of Significance and Compliance

Based on the level of assessment which is in turn based upon the level of information available, there are predicted to be residual moderate adverse noise impacts from construction traffic on two stretches of road.

Overall, the Project is considered to be in compliance with national legislation and international standards. Where adverse impacts are predicted, appropriate mitigation measures have been incorporated

15. Air Quality

15.1 Introduction

This Section considers the potential air quality impacts associated with the construction of the Adjaristsqali Hydropower Casecade Project (the 'Project'). Key potential emission sources of air pollutants which could affect the health of local receptors and / or amenity have been considered.

15.1.1 General Approach

15.1.1.1 Construction Phase

Air quality impacts which may arise during the construction of the Project include:

- Emissions associated with on-site plant and vehicles – typically particulate matter, sulphur dioxide (SO_2) and oxides of nitrogen (NO_x)
- Dust arising from on-site construction activities of power plants, dams/weirs, access roads, transport of spoil material and set up of temporary construction phase substations – dust generated by construction activities can be mechanically transported off site by wind or re-suspension by vehicles
- Emissions associated with construction related traffic.

Combustion related emissions (such as NO_x, SO_2 and fine particulates) from on-site plant and vehicles will occur during the construction phase, particularly during the tunnel extraction phase and could affect local air quality. However, given the local and temporary nature of site plant and potential impacts of emissions on local air quality, assessment of construction plant emissions have not been assessed further. Mitigation measures to reduce the impact of site plant on local air quality are nevertheless discussed in Section 15.5. At this stage, there is limited information available relating the energy requirements for operation of large on-site equipment, such as the tunnel boring machines (TBM). There is a possibility that the TBM will be powered via on-site diesel generators. IFC emission limits for small combustion facilities, which would be applied to these generators, are presented within Section 15.5.3 and are included within the ESMP. This will only be relevant for the Shuarkhevi and Khertvisi Schemes.

The construction phase could result in on-site dust emissions arising from construction activities and on-site vehicle movements. Dust can be mechanically transported either by wind or re-suspension by vehicles. It can also arise from wind erosion on material stock piles and earth moving activities. Details of the assessment procedure are explained further within Section 15.2.2. Appropriate construction phase mitigation measures for the minimisation of air quality and dust impacts have been identified for inclusion within the ESMP and are presented within Section 15.5. Occupational Health and Safety mitigation measures, as recommended by the IFC, are also presented within Section 15.5.

Daily construction traffic movements for the AGL Schemes have been produced and are discussed in depth within Section 13. The most affected road link for all the AGL Scheme will be the S-1 between Adjaristsqali (junction with S-45) and Keda (junction with S-74) where there will be between 42 and 72 additional Heavy Goods Vehicles (HGV) movements for the project durations. Expected traffic movements associated with the removal of spoil from the headrace and transfer tunnel portals and adits have also been calculated. The traffic movements associated with spoil transportation relating to the Didachara Dam and Adit 1 Sites are predicted to be approximately 226 per day. These movements will however be localised, where material will be transported no more than one kilometre from the extraction sites and not through densely populated areas. As baseline pollutant concentrations are low, as described within Section 15.3

and that traffic flows will be small in air quality terms, construction traffic movements have not been considered further within this assessment.

15.1.1.2 Operational Phase

The Project is not considered to have the potential to cause significant long term impacts. Vehicular access to these sites for maintenance and operational purposes will be minimal, hence emissions from such vehicles will be negligible. Additionally, back-up power for the operation of the Project will be sources from back-up diesel generators and a mains grid connection. As these will only be in use under emergency conditions and for limited periods of time, no further consideration within this assessment is required. There are no potentially significant emission sources associated with other operational elements of the Project.

15.1.1.3 Decommissioning Phase

It is anticipated that the Project will have an operational life of 30 years. In the event of decommissioning of the Project, it is likely that any potential air quality impacts would be similar to those in the construction phase, as broadly similar activities would be required and therefore impacts on air quality associated with this phase are considered to be of a similar nature.

15.2 Methodology and Assessment Criteria

15.2.1 Legislative Background

15.2.1.1 Overview

This section outlines the relevant national and international standards and guidelines relevant to both ambient air quality and emissions to air.

15.2.1.2 National Standards

The Law of Georgia on Protection of Atmospheric Air (1999, amend. 2000, 2007) regulates the protection of ambient air from adverse anthropogenic impact within the whole Georgian territory (Part I, Chapter I, Article 1.1). Adverse anthropogenic impact is any human-induced impact on ambient air causing or capable of causing negative impacts on human health and the environment (Part II, Chapter IV, Article II.I).

Maximum permissible concentrations (MPC) for airborne pollutants are set by the hygienic standards on Maximum Permissible Concentrations of Harmful Substances in Ambient Air. are presented inTable 15.1.

Table 15.1: Maximum Permissible Concentrations of Harmful Substances in Ambient Air

Pollutant	MPC, µg/m^3	Averaging Period
Nitrogen Dioxide	200	30 Minutes
	40	24 Hours
Carbon Monoxide	5000	30 Minutes
	3000	24 Hours
Sulphur Dioxide	500	30 Minutes
	50	24 Hours
Particulates	500	30 Minutes

Pollutant	MPC, µg/m^3	Averaging Period
	150	24 Hours

NB: maximum one-off limit means an instant concentration which shall not be surpassed.

15.2.1.3 International Standards

Ambient Air Quality Standards

The IFC General EHS Guidelines advise that 'relevant standards' with respect to ambient air quality are national legislated standards or, in their absence, the current World Health Organisation (WHO) Air Quality Guidelines or other internationally recognised sources, including relevant EU Directives.

EBRD is committed to promoting EU environmental standards. Although numerically equal to the WHO standards, the EU Directives introduce a threshold of tolerance to account for exceptional, worst case episodes. This translates as a limit not to be exceeded more than a certain number of times, and can be expressed as a 'percentile'. In an assessment of human health impacts, which takes account of a relevant exposure period, this approach is considered more appropriate.

EU Framework Directive 96/62/EEC on ambient air quality assessment and management came into force in November 1996 and had to be implemented by Member States by May 1998. This Directive aims to protect human health and the environment by avoiding, reducing or preventing concentrations of air pollutants. As a Framework Directive, it requires the European Commission to propose 'Daughter' Directives which set air quality limit and target values, alert thresholds and guidance on monitoring and measurement for individual pollutants. The four Daughter Directives are as follows:

- Council Directive 1999/30/EC (the first Daughter Directive) relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air
- Directive 2000/69/EC (the second Daughter Directive) relating to limit values for benzene and carbon monoxide in ambient air
- Directive 2002/3/EC (the third Daughter Directive) relating to ozone in ambient air
- Directive 2004/107/EC (the fourth Daughter Directive) relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.

Directive 2008/50/EC on ambient air quality and cleaner air for Europe was adopted in May 2008. This latest Directive merges the first three existing Daughter Directives and one Council Decision into a single Directive on air quality (it is anticipated that the fourth Daughter Directive will be brought within the new Directive at a later date). It also sets new standards and target dates for reducing concentrations of fine particles.

As described in Section 4.3.5 Georgia's relations with the European Union are shaped via the European ENP. The key EU environmental directives making up the acquis include the 96/62/EC Framework Directive which has been implemented through national legislation.

Construction Dust

The IFC General EHS Guidelines, 2007, highlights Best Practice techniques to consider during construction and decommissioning of a project to reduce potential emissions. These techniques are discussed further within Section 15.5.

Guidance in the UK advises that most non-toxic dusts will begin to be perceived as a nuisance when deposition reaches 200 mg/m^2/day. This figure is based on an annual deposition rate and represents the threshold for significant nuisance. However, a range of criteria from 133 to 350 mg/m^2/day is found in national guidance around the world.

The usefulness of numerical criteria to determine effects from construction dust is limited as the perception of loss of amenity or nuisance is affected by a wide range of factors such as character of the locality and sensitivity of receptors. Because of this, assessment methodologies that are based on a qualitative approach are advocated in a range of guidance and this principle has been adopted for the assessment.

Performance Standards and Requirements

The IFC's Performance Standards and EBRD's Performance Requirements define roles and responsibilities for IFC and EBRD financed schemes. IFC Performance Standard 3 (PS3) on Pollution Prevention and Abatement requires reference to be made to the relevant EHS Guidelines and other internationally recognized sources. The IFC EHS guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The IFC General EHS Guidelines and IFC EHS Guidelines for Construction Materials Extraction have been used within this assessment. EBRDs Performance Requirement 3 (PR3) on Pollution Prevention and Abatement requires compliance with relevant EU environmental standards. A key objective of PR3 is to 'avoid or, where avoidance is not possible minimise adverse impacts on human health and the environment by avoiding or minimising pollution directly arising from projects.' Further discussion of the Projects compliance with PS3 and PR3 is presented within Section15.5.

Summary

On the basis of the standards and guidelines presented above, the EU limit values for ambient air quality have been adopted for the assessment and are presented in Table 15.2.

Table 15.2: Summary of Relevant Ambient Air Quality Standards for Protection of Human Health (µg/m^3)

Pollutant	Averaging Period	European Union Limit Values [(a)]
Nitrogen Dioxide (NO_2)	1 Hour	200[(b)]
	Annual	40
Nitrogen Oxides (NO_x)	Annual	30[(c)]
Sulphur Dioxide (SO_2)	1 Hour	350 [(d)]
	24-hour	125 [(e)]
Particulates (PM_{10})	24-hour	50 [(f)]
	Annual	40
Carbon Monoxide (CO)	8 Hour Average	10,000

Notes (a) Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe

(b) Not to be exceeded more than 18 times per calendar year

(c) For the protection of vegetation and ecosystems

(d) Not to be exceeded more than 24 times per calendar year

(e) Not to be exceeded more than 3 times per calendar year

(f) Not to be exceeded more than 35 times per calendar year

15.2.2 Methodology

15.2.2.1 Construction Phase Methodology

Construction activities can result in temporary impacts from dust. 'Dust' is a generic term which usually refers to particulate matter in the size range 1-75 microns. Dust from these activities is mainly associated with the movement and handling of material and is therefore predominantly composed of the larger fractions of this range which do not penetrate far into the respiratory system. The primary air quality issue associated with dust emissions from the construction phases is therefore loss of amenity and/or nuisance caused by, for example, soiling of buildings, vegetation and laundry and reduced visibility. Nevertheless, methods proposed to reduce dust emissions will, by definition, reduce emissions of finer particulates too.

It is considered that a quantitative approach is inappropriate and unnecessary for assessing particulate emissions associated with the construction of the Project as the quantities of dust emitted are not uniform in nature and do not arise from a single quantifiable point source. The potential for construction activities to raise dust, and the likely consequences of dust emissions have therefore been assessed qualitatively.

The first stage of the assessment identifies the construction activities which have the potential to cause dust emissions and the degree of that potential. Typical construction activities that will be associated with the AGL Schemes are presented in Table 15.3.

Table 15.3: Generic Construction Phase Dust Emitting Activities

Stage	Description	Potential Dust raising Activities
Setup and enabling works	Rerouting of utilities	Excavation works
Roads and infrastructure	Decommissioning, Re-energising of existing mains. Diversion of public sewers. Installation of new roads as required. Installation of infrastructure below road level. Roads to be constructed as phasing dictates.	Excavation works; Transport of materials; and Resuspension of dust on unsurfaced roads.
Site clearance and ground works	Preparation of the Site e.g., levelling, removal of vegetation etc. excavation Soil storage	Earthmoving Excavation Transport of materials Resuspension of dust on unsurfaced roads Concrete batching
Site Enabling Works	Transport of materials Backfilling of all trenches and levelling of relief Land restoration	Transport and handling of soil / materials Storage of soil / materials Preparation of materials (cutting, etc.) Resuspension of dust on unsurfaced roads.
Landscaping	Final Landscaping of the AGL Schemes.	Earthworks; and, Storage of materials.

15.2.3 Assessment of Impact Significance

15.2.3.1 Determining Sensitivity and Magnitude

The significance of potential impacts is a function of the presence and sensitivity of receptors, and magnitude of the impact. The magnitude of air quality impacts is determined based on professional judgement taking into account the sensitivity of the receiving environment.

Sensitive receptors with the potential to be significantly affected by construction phase dust emissions have been identified based on a review of satellite imagery. The actual distances from a source that dust impacts can occur is highly site specific and will depend on the extent and nature of incorporated mitigation measures, prevailing wind conditions, rainfall and the presence of natural screening by, for example, vegetation or existing physical screening such as boundary walls on a site. However, research indicates that impacts from unmitigated construction activities that generate dust are generally limited to within 150-200 metres of the site boundary. Nevertheless, given the site conditions described above and to ensure a conservative assessment for the Project, all sensitive receptors within 500 metres of the proposed construction works have been identified (receptors beyond 500 metres from construction activities have not been considered further). Receptor sensitivity to dust impacts, assuming that there is no mitigation (thereby identifying risk) is determined in accordance with the classification criteria presented in Table 15.4.

Table 15.4: Receptor Sensitivity Classification

High	Medium	Low	Negligible
Hospitals and clinics	Residential and commercial areas, schools	Farmland, ecologically sensitive sites and temporary contractor's colony	-

Table 15.5 provides distance criteria upon which the receptor sensitivity to dust impacts from the construction phases have been determined.

Table 15.5: Determination of Receptor Sensitivity - Construction Phase

		Distance to Construction Site			
		0-50m	50-100m	100-200m	200-500m
Receptor Sensitivity Classification[a]	High	High	High	Medium	Low
	Medium	Medium	Medium	Low	Low
	Low	Medium	Low	Low	Low
	Negligible	Negligible	Negligible	Negligible	Negligible

Notes: (a) Receptors classified in accordance with approach described in Table 15.4

Table 15.6 presents the approach used to define the magnitude of dust impacts from the construction phases associated with the AGL Schemes.

Table 15.6: Determination of Impact Magnitude – Construction Phase

Dust Raising Potential[a]	Duration	Impact Magnitude
High	Any	Major
Medium	> 3 Months	Moderate
Medium	< 3 Months	Minor
Low	Any	Negligible

Notes: [a] Dust raising potential defined in accordance with approach described in Table 15.3

15.2.3.2 Assigning Significance

The predicted significance of the impact has been determined through a standard method of assessment based on professional judgement, considering both the sensitivity of the receiving receptors and the potential magnitude of change as defined in Table 15.7.

Table 15.7: Impact Significant Matrix

Magnitude of Impact	Sensitivity of Receptors			
	Negligible	Low	Medium	High
Negligible	Insignificant	Insignificant	Insignificant	Insignificant
Minor	Insignificant	Minor	Minor	Moderate
Moderate	Insignificant	Minor	Moderate	Major
Major	Insignificant	Moderate	Major	Critical

15.2.4 Sensitive Receptors

The Project will be located within the Adjara region of south west Georgia, bounded by Turkey to the south, the Meskheti mountain range to the north; the Arsiani mountain range to the east and the Black Sea to the west. The Project will directly influence the municipalities of Khelvachauri, Keda, Shuakhevi and Khulo within Adjara. The municipalities are mostly rural with a total population of approximately 176,000. Depending on the altitude the main income source for the local population consists of growing vegetables (potato, tomato, etc.), fruits, tobacco, grapes, and cattle farming.

Sensitive receptors within 500 metres of key construction areas have been identified using online mapping software. As very limited information is available, all structures identified within this distance have been assumed to be residential. It has been noted that there is a proposed Nature Reseve in the Machakhela River Valley which is adjacent to the Machakhela Dam Site of the Khertvisi Scheme. At this time, however, there are no details of Nature Reserve boundaries or specific designations. This receptor has been included and is discussed further within Section 15.4.1.3.

15.3 Baseline Description

15.3.1 Determining Baseline

Throughout the project area, particularly within the territories of Khelvachauri, Keda, Shuakhevi and Khulo municipalities, regular monitoring of ambient air quality is not conducted. Therefore, information about baseline conditions of ambient air quality for the Project is not available.

As identified by the results of a visual audit, the major stationary sources of ambient air pollution are not located on the territories within the Project. Therefore, vehicle emissions must be considered as the main source of ambient air pollution. On the basis that the central highway of the project region is not characterised by a high number of movements, and flows on the local roads are very low, it can be concluded that ambient air quality due to existing vehicle emissions are unlikely to be significant.

In accordance with Georgian Environmental Legislation (The regulation approved on basis of the order 20.10.2008 N 705 of the Minister of Environment Protection and Natural Resources of Georgia “about the maximum permissible levels of harmful substances and/or temporarily agreed emissions regulations method of calculation, Appendix N 3"), when monitored data are unavailable, an assessment of baseline ambient air has been carried out based on the population of the nearest residential area (see Table 15.8).

Table 15.8:: Baseline Ambient Air Quality Concentrations per Population Size

Population, (1,000's)	Background Level of Pollution, µg/m^3			
	NO_2	SO_2	CO	Dust
250-125	30	50	1500	200
125-50	15	50	800	150
50-10	8	20	400	100
<10	0	0	0	0

On the basis that Khelvachauri municipality population is 94,400 people, Keda municipality population is 20,200 people, Shuakhevi municipality population is 22,600 people and Khulo municipality population is 35,500 people, baseline ambient air quality concentrations may be determined as follows:

For Shuakhevi, Keda and Khulo Municipalities

- Nitrogen Dioxide - 8. µg/m^3
- Sulphur Dioxide - 20 µg/m^3
- Carbon Monoxide - 400 µg/m^3
- Dust - 100 µg/m^3.

For Khelvachauri Municipality:

- Nitrogen oxide - 15 µg/m^3
- Sulphur dioxide - 50 µg/m^3
- Carbon Monoxide - 800 µg/m^3
- Dust - 150 µg/m^3.

A comparison between the data available for NO_2, SO_2 and CO concentrations for the Project highlights that background concentrations are well below the National and International daily averages discussed within Section 15.2. This is mainly due to the rural nature of the study area. No exceedence of the air quality standards are therefore expected. As described above, there are no legislated standards for dust concentrations in ambient air. However, the concentrations above are typical for rual areas.

15.3.2 Data limitations

A detailed project construction programme has not yet been completed and therefore the timing and sequencing of works is as yet unknown and would be determined by the construction contractor(s). The timing of likely air quality impacts has been based upon the limited data available using professional experience of similar schemes worldwide. Receptor identification has been carried out using online mapping software and therefore has not considered the exact number of receptors within 500 metres from each construction site. Due to the scale of the Project, the closest receptor to the relevant construction activity has been used to define significance and therefore assumes a 'worst case scenario'.

15.4 Assessment of Impacts

15.4.1 Construction Phase – Dust

A basic description of the proposed construction phasing for the proposed Project is presented within Table 15.9, for all the Schemes and is based on information from Section 2. Table 15.9 also presents the dust raising potential of the activities associated with the Schemes and is consistent with the methodology described in Section 15.2.2.

Table 15.9: Project Schemes Dust Emitting Activities

Stage Number	Stage Description	Generic Activity Description	Potential Dust Raising Activities	Dust Raising Potential
1	Site Preparation	Vegetation Clearance Construction of Access Roads and Consolidation. Upgrade to existing roads and bridges where practicable. Site Componds and Contractor Colony Set-Up Set-up of site utilities Substation set-up	Earthmoving Excavation works. Transport of materials Resuspension of dust on unsurfaced roads.	Medium
2	Transfer and Tunnel Head Race Portal Construction	Construction of transfer and headrace tunnels (Combination of Drill & Blast and Tunnel Boring Machine). Additional Adit areas where required. Construction of surge shafts Movement of spoil to deposit locations.	Excavation works Transport and handling of soil / materials Storage of soil / materials Preparation of materials (cutting, etc.) Re-suspension of dust on unsurfaced roads. Concrete batching	High
3	Weir and Dam Construction	Construction of weirs and dams Construction of Intake to transfer and head race tunnels	Excavation works Transport and handling of soil / materials Concrete batching	Medium
4	Power House Construction	Ground preparation Power house construction set up of utilities	Transport and handling of soil / materials Concrete batching	Medium
5	Power Cavern Construction	Excavation of subsurface cavern Power cavern construction Set up of utilities	Excavation works Preparation of materials (cutting, etc.) Transport and handling of soil / materials Concrete batching	High

15.4.1.1 Shuakhevi Scheme

The construction period of the full Shuakhevi Scheme will be approximately three years. Based on the assessment presented in Table 15.9, construction activities for the Schuakhevi Scheme have the potential to result in a 'high' dust emitting potential, during stage 2, primarily due to the large amount of earthmoving required for the removal of the spoil. Stages 1, 3 & 4 have the potential to result in a 'medium' dust emitting potential. Based on Table 15.6, this equates to a 'major' impact magnitude for stage 2 and 'moderate' impact magnitudes for stages 1, 3 & 4. The access road and infrastructure upgrade required for the Schemes are expected to require less than three months to complete, therefore in accordance with Table 15.6 is predicted to result in a 'minor' impact magnitude.

Table 15.10 presents the specific activities and the overall significance.

Table 15.10: Shuakhevi Scheme Impact Magnitude, Receptor Sensitivity and Overall Significance

Site	Specific Activity Description	Impact Magnitude[a]	Distance from Nearest Receptor to Activity[b]	Receptor Sensitivity[c]	Overall Significance[d]
Full Shuakhevi Scheme	Upgrade to existing roads and bridges where practicable on main road network.	Minor	0-50	Medium	Minor
Chirukhi Weir Site	Construction of headrace tunnel (Drill & Blast).	Major	200-500	Low	Moderate
	Construction of weir	Moderate	200-500	Low	Minor
	Movement of spoil to deposit locations	Major	100-200	Low	Moderate
Skhalta Dam Site	Construction of transfer and headrace tunnels (Combination of Drill & Blast and Tunnel Boring Machine).	Major	200-500	Low	Moderate
	Construction of dam and power house.	Moderate	200-500	Low	Minor
	Movement of spoil to deposit locations	Major	200-500	Low	Moderate
Didachara Dam Site	Construction of transfer and headrace tunnels (Combination of Drill & Blast and Tunnel Boring Machine).	Major	200-500	Low	Moderate
	Construction of dam.	Moderate	200-500	Low	Minor
	Movement of spoil to deposit locations	Major	200-500	Low	Moderate
Adit 1	Construction of headrace tunnel (Drill & Blast).	Major	200-500	Low	Moderate
	Movement of spoil	Major	200-500	Low	Moderate

Site	Specific Activity Description	Impact Magnitude[(a)]	Distance from Nearest Receptor to Activity[(b)]	Receptor Sensitivity[(c)]	Overall Significance[(d)]
	to deposit locations				
Adit 2	Construction of headrace tunnel (Drill & Blast).	Major	100-200	Low	Moderate
Shuakhevi Powerhouse	Power house construction.	Moderate	200-500	Low	Minor
Khichauri Dam Site	Construction of dam	Moderate	200-500	Low	Minor
Chvanistsqali Dam Site	Construction of dam	Moderate	100-200	Low	Minor

Source: [(a)] Based on dust raising potential of generic activities presented in Table 15.9. All activities assumed to be carried out for >3 months, except ‘Upgrade to existing roads and bridges where practicable on main road network.’
[(b)] Distances obtained from Google Maps
[(c)] Based on determination of receptor sensitivity presented in Table 15.5. All receptors assumed to be of ‘Medium’ sensitivity classification.
[(d)] Overal Significance as described in Table 15.7

In accordance with Table 15.7 Shuakhevi Scheme will cause temporary ‘moderate adverse’ to ‘minor adverse’ impact, without appropriate mitigation measures in place. Proposed mitigation measures to avoid or reduce the dust impacts are described in Section 15.5. Specific reference has also been made of measures to control cement dust emissions.

Temporary contractor’s colonies will also be present during the construction phases. They are all located beyond 100 metres from the proposed headrace and transfer tunnel portals therefore in accordance with Table 15.5 is predicted to result in a temporary ‘moderate adverse’ impact.

15.4.1.2 Koromkheti Scheme

The construction period of the full Koromkheti Scheme will be approximately four years. Based on the assessment presented in Table 15.9, construction activities for the Koromkheti Scheme have the potential to result in a ‘high’ dust emitting potential, during stages 2 & 5, mostly due to the large amount of earthmoving required for the removal of the spoil. Stages 1, 3 & 4 have the potential to result in a ‘medium’ dust emitting potential. Based on Table 15.6, this equates to a ‘major’ impact magnitude for stages 2 & 5 and ‘moderate’ impact magnitudes for stages 1, 3 & 4. The access road and infrastructure upgrade required for the Schemes are expected to require less than three months to complete, therefore in accordance with Table 15.6 is predicted to result in a ‘minor’ impact magnitude.

Table 15.11 presents the specific activities and the overall significance.

Table 15.11: Koromkheti Scheme Impact Magnitude, Receptor Sensitivity and Overall Significance

Site	Specific Activity Description	Impact Magnitude[(a)]	Distance from Nearest Receptor to Activity[(b)]	Receptor Sensitivity[(c)]	Overall Significance[(d)]
Full Koromkheti Scheme	Upgrade to existing roads and bridges where practicable on main road network.	Minor	0-50	Medium	Minor

Site	Specific Activity Description	Impact Magnitude[(a)]	Distance from Nearest Receptor to Activity[(b)]	Receptor Sensitivity[(c)]	Overall Significance[(d)]
Adit 3 (Standby)	Construction of headrace tunnel (Drill & Blast).	Major	100-200	Low	Moderate
	Movement of spoil to deposit locations	Major	100-200	Low	Moderate
Adit 4	Construction of headrace tunnel (Drill & Blast).	Major	200-500	Low	Moderate
	Movement of spoil to deposit locations	Major	200-500	Low	Moderate
Akavreta Weir Site	Construction of weir	Moderate	100-200	Low	Minor
Adit 5	Construction of headrace tunnel (Drill & Blast).	Major	100-200	Low	Moderate
Adit 6	Construction of headrace tunnel (Drill & Blast).	Major	50-100	Medium	Major
	Movement of spoil to deposit locations	Major	100-200	Low	Moderate
Koromkheti Power Cavern	Power cavern construction	Major	50-100	Medium	Major
	Movement of spoil to deposit locations	Major	200-500	Low	Moderate

Source: [(a)] Based on dust raising potential of generic activities presented in Table 15.9. All activities assumed to be carried out for >3 months, except 'Upgrade to existing roads and bridges where practicable on main road network.'

[(b)] Distances obtained from Google Maps

[(c)] Based on determination of receptor sensitivity presented in Table 15.5. All receptors assumed to be of 'Medium' sensitivity classification.

[(d)] Overal Significance as described in Table 15.7

Therefore in accordance with Table 15.7, the majority of the Koromkheti Scheme will cause temporary 'moderate adverse' to 'minor adverse' impact, without appropriate mitigation measures in place. However the close proximity of receptors to the Adit 6 portal and Koromkheti power cavern construction results in a 'major adverse' impact at this location. Proposed mitigation measures to avoid or reduce the dust impacts are described in Section 15.5. Specific reference has also been made of measures to control cement dust emissions.

Temporary contractor's colonies will also be present during the construction phases. They are all located beyond 100 metres from the proposed headrace and transfer tunnel portals therefore in accordance with Table 15.6 is predicted to result in a temporary 'moderate adverse' significance of impact.

15.4.1.3 Khertvisi Scheme

The construction period of the Full Khertvisi Scheme will be approximately three years. Based on the assessment presented in Table 15.9, construction activities for the Khertvisi Scheme have the potential to result in a 'high' dust emitting potential, during stage 2, due to the large amount of earthmoving required for the removal of the spoil. Initial site preparation, weir and dam construction and power house construction have the potential to result in a 'medium' dust emitting potential. Stages 1, 3 & 4 have the potential to result in a 'medium' dust emitting potential. Based on Table 15.6, this equates to a 'major' impact magnitude for stage 2 and 'moderate' impact magnitudes for stages 1, 3 & 4. The access road and infrastructure upgrade required for the Schemes are expected to require less than three months to complete, therefore in accordance with Table 15.6 is predicted to result in a 'minor' impact magnitude.

Table 15.12 presents the specific activities and the overall significance.

Table 15.12: Khertvisi Scheme Impact Magnitude, Receptor Sensitivity and Overall Significance

Site	Specific Activity Description	Impact Magnitude[(a)]	Distance from Nearest Receptor to Activity[(b)]	Receptor Sensitivity[(c)]	Overall Significance[(d)]
Full Khertvisi Scheme	Upgrade to existing roads and bridges where practicable on main road network.	Minor	0-50	Medium	Minor
Khertvisi Dam Site	Construction of Dam	Moderate	100-200	Low	Minor
Adit 7	Construction of headrace tunnel (Drill & Blast and Tunnel Boring Machine).	Major	200-500	Low	Moderate
	Movement of spoil to deposit locations	Major	200-500	Low	Moderate
Machakhela Dam Site	Construction of Transfer tunnel (Drill & Blast).	Major	200-500	Low	Moderate
	Movement of spoil to deposit locations	Major	200-500	Low	Moderate
Khertvisi PowerHouse	Power house construction	Moderate	200-500	Low	Minor
	Movement of spoil to deposit locations	Major	200-500	Low	Moderate

Source: [(a)] Based on dust raising potential of generic activities presented in Table 15.9. All activities assumed to be carried out for >3 months, except 'Upgrade to existing roads and bridges where practicable on main road network.'

[(b)] Distances obtained from Google Maps

[(c)] Based on determination of receptor sensitivity presented inTable 15.5. All receptors assumed to be of 'Medium' sensitivity classification.

[(d)] Overal Significance as described in Table 15.7

Therefore in accordance with Table 15.7, Khertvisi Scheme will cause temporary 'moderate adverse' to 'minor adverse' impact, without appropriate mitigation measures in place. Proposed mitigation measures to avoid or reduce the dust impacts are described in Section 15.5. Specific reference has also been made of measures to control cement dust emissions.

Temporary contractor's colonies will also be present during the construction phases. They are all located beyond 100 metres from the proposed headrace and transfer tunnel portals therefore in accordance with Table 15.6 is predicted to result in a temporary 'moderate adverse' significance of impact..

15.4.1.4 Construction Phase – Occupational Health

No assessment of occupational health impacts have been carried out for this assessment, however a list of IFC Occupational Health and Safety mitigation measures for dust is presented within Section 15.5.

15.4.2 Operational

As discussed above within Section 15.1.2.2, vehicular access to these sites for maintenance and operational purposes will be minimal and hence emissions from such vehicles will be negligible and do not require assessment.

15.4.3 Decommissioning

It is anticipated that the Schemes will have an operational life of 30 years. In the event of decommissioning of the Schemes, it is likely that any potential air quality impacts would be similar to those in the construction phase, as broadly similar activities would be required. Similarly to the construction phase these are considered to be temporary 'moderate' to 'minor' adverse significance following implementation of appropriate mitigation measures.

There is some uncertainty in the potential presence of receptors, which depending on the time of any such decommissioning may have been introduced or removed from the site. Therefore at the time of decommissioning, the site decommissioning plan should take due care to ensure that all receptors at that time are accounted for and that the management plan adequately minimises potential issues for receptors that could be affected.

15.4.4 Cumulative Impacts

There are a number of Schemes in development which could have a cumulative impact on the Schemes. These include:

- Ski resorts at the following locations:
  - Goderdzi Pass Ski Resort (Khulo Municipality)
  - Gomarduli Ski Resort (Shuakhevi Municipality, Gomarduli Village
  - Goma Mountain Ski Resort (Shuakhevi and Qeda Municipalities)
- River Chorokhi HPP Cascade - Three steps runoff river cascades (Kirnati, Khelvachauri 1 and Khkelvachauri 2) will have 105.4 MW capacities.

It is expected that each of the projects will commence in 2012 and construction is likely to continue for a further five years. Once the ski resorts are operational it is expected that the sites will generate traffic at all times of the year, however, the greatest traffic levels will occur in the winter months for the ski season.

Details of the cumulative developments are currently limited and further information is required with regard to the land use details and construction phasing of the above development proposals before a robust assessment of the likely cumulative impacts can be undertaken. The cumulative impact could be especially pronounced if the construction programmes of these developments overlap with the Schemes peak construction traffic generation. Due to the limited information available, it is not possible to conclude with certainty that cumulative impacts from traffic emissions would be not signficiant at all locations. However, given the relatively low levels of construction traffic associated with the Schemes and low background pollutant concentrations, significant impacts are considered unlikely.

There will be no cumulative impacts associated with construction dust as the above schemes are greater than 500 metres and therefore no impacts are predicted.

15.5 Mitigation and Enhancement Measures

Management of construction activities relating to potential air quality impacts will be included in the Schemes project framework ESMP. The measures presented below are based on the potential impacts identified within Section 15.4, the majority of which are temporary ‘moderate adverse’. For the Koromkheti Scheme, temporary ‘major adverse’ significance is predicted during the power house construction and Adit 6, headrace tunnel portal. Receptors are located between 50 -100 metres away however extra care will be given to these sites.

The IFC General EHS Guidelines and EHS Guidelines for Construction Materials Extraction provide general air emission abatement techniques to consider during construction and decommissioning of a project. Relevant measures from the Guidelines to be included within the ESMP are:

- Minimising dust from material handling sources, such as conveyors and bins, by using covers and/or control equipment (water suppression, bag house, or cyclone)
- Minimising dust from open area sources, including storage piles, by using control measures such as installing enclosures and covers, and increasing the moisture content
- Dust suppression techniques should be implemented, such as applying water or non-toxic chemicals to minimize dust from vehicle movements
- Managing emissions from mobile sources
- Avoiding open burning of solid
- Land clearing, removal of topsoil and excess materials, location of haul roads, tips and stockpiles, and blasting shall be planned with due consideration to meteorological factors (e.g. precipitation, temperature, wind direction, and speed) and location of sensitive receptors
- A simple, linear layout for materials-handling operations will be applied to reduce the need for multiple transfer points should be designed and installed (e.g. processing plants should be preferably located within the extraction area)
- Dust emissions from drilling activities should be controlled at the source by dust extractors, collectors, and filters, and wet drilling and processing should be adopted, whenever possible
- Dust emissions from processing equipment (e.g. crushers, grinders, screens) should be adequately controlled through dust collectors, wet processing, or water spraying. Dust control applications should consider the final use of extracted material (e.g. wet-processing stages are preferred when wet materials or high water contents would not negatively affect their final use)
- Use of mobile and fixed-belt transport and conveyors should be preferred to hauling the material by trucks through internal roads (enclosed rubber-belt conveyors for dusty materials are recommended in conjunction with cleaning devices)
- Internal roads should be adequately compacted and periodically graded and maintained
- A speed limit for trucks should be considered
- Water spraying and surface treatment (e.g. hygroscopic media, such as calcium chloride, and soil natural–chemical binding agents) of roadways and exposed stockpiles using a sprinkler system or a ”water-mist cannon” should be implemented
- Exposed surfaces of stockpiled materials should be vegetated.

As noted above, at discrete locations blasting may be carried out. The EHS Guidelines for Construction Materials Extraction provide the following specific guidance with respect to blasting, which will be incorporated within the ESMP:

- Alternatives to blasting, such as hydraulic hammers or other mechanical methods
- If blasting is necessary, planning of the blasting (arrangement, diameter, and depth and direction of blast holes) should be implemented
- The correct burning of the explosive, typically composed of a mixture of ammonium nitrate and fuel oil, should be ensured by minimizing the presence of excess water and avoiding incorrect or incomplete mixing of explosive ingredients.

As noted above, generators will be required at discrete locations. Ensure generators meet IFC General EHS guidelines for ‘Small Combustion Facilities’ (Table 1.1.2 within the IFC General EHS guideline) if system is between three and 50 Megawatt thermal. Consideration should also be given to the location and height of exhaust flues to ensure proper dispersion of pollutants.

UK guidance for blending, packing, loading, unloading and use of bulk cement has been presented specifically with reference to the proposed concrete batching plant. Best available techniques presented below will be incorporated within the ESMP to control dust emissions:

- Containment of dusty processes. Containment and arrestment is the preferred option for control of emissions to air from processes handling cement;
- Suppression of dust using water or proprietary suppressants. Where water is used for dust suppression, processes require an adequate supply of water. To demonstrate an adequate water supply on tanks that are not fed from the mains, a low level alarm could be fitted;
- Protection of external sources, such as stockpiles and external conveyors, from wind whipping is necessary. There are various methods that may be used to this end. Crushed rock, sand or coarse aggregate, can be delivered, stored and handled so as to minimise dust emissions, for example by dampening or covering.

As described previously, no assessment of occupational health impacts have been carried out, however a list of IFC Occupational Health and Safety mitigation measures for dust is presented below for inclusion within the ESMP:

- Dust suppression techniques should be implemented, such as applying water or non-toxic chemicals to minimise dust from vehicle movements
- Personal Protective Equipment (PPE), such as dust masks, should be used where dust levels are excessive
- Excavators, dumpers, dozers, wagon-drills, and other automated equipment that requires an operator should be equipped with air conditioned, dustproof, and soundproof cabs.

15.6 Compliance with International Requirements

15.6.1 Overview

This section demonstrates how the Project meets the compliance requirements with respect to air quality for Georgian Legislation and international financing institutions.

15.6.2 IFC Performance Standards

A demonstration of compliance with IFC Performance Standard 3: Resource Efficiency and Pollution Prevention for air quality is presented in Table 15.13.

Table 15.13: IFC Performance Standard 3: Resource Efficiency and Pollution Prevention

Requirement	How Project Compliance will be Achieved
The client will refer to the EHS Guidelines or other internationally recognized sources, as appropriate, when evaluating and selecting resource efficiency and pollution prevention and control techniques for the project. The EHS Guidelines contain the performance levels and measures that are normally acceptable and applicable to projects. When host country regulations differ from the levels and measures presented in the EHS Guidelines, clients will be required to achieve whichever is more stringent. If less stringent levels or measures than those provided in the EHS Guidelines are appropriate in view of specific project circumstances, the client will provide full and detailed justification for any proposed alternatives through the environmental and social risks and impacts identification and assessment process. This justification must demonstrate that the choice for any alternate performance levels is consistent with the objectives of this Performance Standard.	**Compliant:** Identification of relevant National and Internationally to the AGL Schemes. Specific reference has been made to measure recommended by IFC to reduce environmental impacts of the AGL Schemes. Measures to reduce these temporary impacts are discussed in the IFC EHS General Guidelines (2007) and The IFC EHS Guidelines for Construction Materials Extraction (2007) within Section 16.5.

Table 15.13 shows that the Schemes are able to achieve compliance with all relevant provisions for air quality as provided in the IFC EHS Guidelines.

15.6.3 EBRD Environmental and Social Policy

A demonstration of compliance with the air quality provisions given within Performance Requirement 3: Pollution Prevention and Abatement is presented in Table 15.14.

Table 15.14: EBRD Performance Requirement 3: Pollution Prevention and Abatement and Associated Project Compliance

Requirement	How Project Compliance will be Achieved
<u>Ambient Considerations</u> To address adverse project impacts on existing ambient conditions, the client will: (i) consider a number of factors, including the finite assimilative capacity of the environment, existing and future land use, existing ambient conditions, the project's proximity to ecologically sensitive or protected areas, and the potential for cumulative impacts with uncertain and irreversible consequences; and (ii) promote strategies that avoid or, where avoidance is not feasible, minimise or reduce the release of pollutants, including strategies that contribute to the improvement of ambient conditions when the project has the potential to constitute a significant source of emissions in an already degraded area. These strategies include, but are not limited to, evaluation of project location alternatives and emissions' offsets.	**Compliant:** No long-term air quality impacts are predicted as a result of the Schemes. Construction dust assessment has taken into consideration all sensitive receptors close to the construction areas. Measures to reduce these temporary impacts have been identified Cumulative impacts from three ski resorts and the River Chorokhi HPP Cascade has been considered within this assessment.

Table 15.14 shows that the Schemes are able to achieve compliance with all relevant provisions for air quality as provided in the EBRD Environment and Social Policy, 2008.

15.7 Summary of Impacts, Mitigation and Residual Significance

Table 15.15 provides a summary of the project activities, their significance and mitigation.

15.7.1 Residual Impacts

Table 15.15: Summary of Key Significant Impacts and Mitigations

Activity	AGL Scheme	Potential Impact	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual Significance
Dam/Weir Construction	Shuakhevi	Construction Dust	Low	Moderate	Minor	IFC EHS Guidelines	**Insignificant**
Powerhouse Construction			Low	Moderate	Minor	IFC EHS Guidelines	**Insignificant**
Access Road Upgrades and Bridge Construction			Medium	Minor	Minor	IFC EHS Guidelines	**Insignificant**
Headrace and Transfer Tunnel Construction			Low	Major	Moderate	IFC EHS Guidelines	**Insignificant**
Adit Construction			Low	Major	Moderate	IFC EHS Guidelines	**Insignificant**
Spoil Deposit Deposition			Low	Major	Moderate	IFC EHS Guidelines	**Insignificant**
Weir Construction	Koromkheti	Construction Dust	Low	Moderate	Minor	IFC EHS Guidelines	**Insignificant**
Powercavern Construction			Medium	Major	Major	IFC EHS Guidelines	**Insignificant**
Access Road Upgrades and Bridge Construction			Medium	Moderate	Minor	IFC EHS Guidelines	**Insignificant**
Adit Construction			Low	Moderate	Minor	IFC EHS Guidelines	**Insignificant**
Adit 6			Medium	Major	Major	IFC EHS Guidelines	**Insignificant**
Spoil Deposit Deposition			Low	Major	Moderate	IFC EHS Guidelines	**Insignificant**
Dam Construction	Khertvisi	Construction Dust	Low	Moderate	Minor	IFC EHS Guidelines	**Insignificant**
Powerhouse Construction			Low	Moderate	Minor	IFC EHS Guidelines	**Insignificant**

Activity	AGL Scheme	Potential Impact	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual Significance
Access Road Upgrades and Bridge Construction			Medium	Moderate	Minor	IFC EHS Guidelines	**Insignificant**
Headrace and Transfer Tunnel Construction			Low	Major	Moderate	IFC EHS Guidelines	**Insignificant**
Adit Construction			Low	Major	Moderate	IFC EHS Guidelines	**Insignificant**
Spoil Deposit Deposition			Low	Major	Moderate	IFC EHS Guidelines	**Insignificant**

15.8 Proposed Monitoring and Reporting

No air quality monitoring is proposed as part of this assessment. Auditing of work-sites against the requirements of the ESMP for minimising dust raising activities will be undertaken.

15.9 Statement of Significance and Compliance

This assessment of air quality effects predicts that the AGL Schemes will not result in significant effects, assuming that the required mitigation measures are implemented, Therefore the AGL Schemes are predicted to comply with relevant national legislation and international guidance

16. Greenhouse Gases

16.1 Introduction

This section provides an overview of emissions of greenhouse gases (GHGs) from the Adjaristsqali Hydropower Cascade Project (hereafter referred to as the ‘Project’). The assessment takes account of the emissions associated with the construction and operation. The Project will include the construction of tunnels, dams and powerhouses as well as substations, and other associated access works such as temporary access roads. The contribution of GHG emissions as a direct result of the Project has been reviewed focusing on the construction phase.

The use of construction plant and the manufacture of materials required to build the Project will contribute to GHG emissions. During the operational phase of the Project, only minor emissions are expected to occur given the type of operation. GHG emissions that do occur are expected to be negligible. No quantitative assessment of the operational phase has been made as discussed in Section 16.1.

The assessment has been split into three phases as described in the Construction Planning, Scheduling and Contracting Report (05.01.11). The three phases are:-

1. Shaukhevi HPP
2. Koromkheti HPP
3. Khertvisi HPP.

16.1.1 General Approach

The general approach of the assessment of greenhouse gases involves quantifying the emissions likely to occur as a result of the Project and placing these emissions within the context of international guidance and comparison with emissions from other type’s power generating activities.

16.2 Methodology and Assessment Criteria

16.2.1 Methodological Overview

Plant and machinery used in extracting raw materials and processing to produce composite materials all require energy inputs. Fossil fuels provide a large proportion of this energy and therefore the GHG emissions that result are ‘embodied’ in the material. Some materials require more energy to become useful than others. For example, the relative work required to extract sand or aggregate is much lower to that required to make aluminium or cabling. Generally, products and designs that have used less materials and fewer metals or plastics are likely to have less embodied GHG emissions

Transport of materials can be an important factor and, in general, local sources of materials are preferred due to the reduction in transport effort required to get materials to site. However, the significance of transport differs between materials and equipment in terms of the percentage of the total embodied GHG emissions of the design it represents. As distance from site increases, the preferred mode of transport might vary. Typically, local materials will be delivered by road, nationally sourced materials by rail, and internationally sourced materials by ship. Transportation of the workforce to site can also lead to non-negligible emissions particularly where the working site is in remote location, or where the project lasts a considerable amount of time.

Different on-site construction methods lead to different releases of carbon emissions. These emissions are associated with the energy use of the construction plant which can arise from the combustion of fuel on site, or the use of electricity. Typically, construction methods that use less construction plant and involve the least amount of earthworks and waste will lead to the fewest emissions. Works that can be completed by manual labour are typically regarded as having no associated carbon (not withstanding the transportation of labourers to site).

16.2.2 International Guidance and National Legislation.

16.2.2.1 United Nations Framework Convention on Climate Change

The United Nations Framework Convention on Climate Change (UNFCCC) was established on 9th May 1992. Its objective is to achieve the *'stabilisation of greenhouse gas concentrations in the atmosphere, at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.'*

The understanding that GHGs could eventually lead to rising global temperatures and sea level rise led to the development of the Montreal Protocol and the Kyoto Protocol. The Montreal Protocol banned or limited the emissions of substances, such as chlorofluorocarbons (CFC) that deplete the ozone layer. The Kyoto Protocol sets objectives to limit the emissions of GHGs by countries agreeing to its terms.

Georgia joined the UNFCCC in 1994 as a non-Annex 1 party. The UNFCCC reporting guidelines on annual inventories requires all Parties to submit to the Conference of the Parties an annual national anthropogenic GHG emissions inventory of all GHGs not covered by the Montreal Protocol. The information must be made available using the national communications guidelines from non-Annex I Parties (Decision 17/CP 8). As a non-Annex I Party, Georgia has no commitments to reduce GHG emissions under this protocol.

16.2.2.2 IFC Guidance

The IFC Performance Standard 3 for Resource Efficiency and Pollution Prevention (2012) outlines requirements that must be followed when calculating GHG emissions. The overall objective of Performance Standard 3 is 'to reduce the project-related GHG emissions.' The performance standard states:

> *'for projects that are expected to or currently produce more than 25000 tonnes of CO_2-equivalent annually, the client will quantify direct emissions from the facilities owned or controlled within the physical project boundary, as well as direct emissions associated with the off-site production of energy used by the project.'*

16.2.2.3 EBRD Guidance

Version 7[35] of the EBRD Methodology for GHG Assessments sets out guidance for consultants working on EBRD projects. Section GN0 provides guidance on "Initial GHG Screening" and states the relative impact of a variety of projects. The categories defined by EBRD are:

- Negligible (no GHG assessment necessary)

[35] Released 06/07/2010

- Low (< 20 kt/y CO_2e per year)
- Medium-Low (20 – 100 kt CO_2e /y)
- Medium-High (100 kt – 1 Mt CO_2e /y)
- High (>1 Mt CO_2e /y).

The EBRD Methodology for GHG Assessments provides emission factors and tools for many sectors, however, it notes that:

> *"Users of the EBRD Methodology may choose to…construct a project-specific spreadsheet for this purpose. However, in order to have a formal record of the basis of the GHG assessment calculations, the assessment should show clearly the data employed and their sources and the calculations performed."*

16.2.2.4 National Legislation

Although no legislation exists for the control of GHG release in Georgia, Table 1.12 of the Second National Communication to the UNFCCC highlights the institutional structure and functions of Georgia. Relevant legislation has been presented in Table 16.1.

Table 16.1: Legislative structures of Georgia related to the Implementation of the UNFCCC and their Functions

Institutional Structures		Functions
Legislative structures of Georgia	Committees of the Parliament of Georgia: - Environment Protection and Natural Resources; - Economic branches and economic policy; - Agriculture; - Education, science and culture; - Health care and Social Services; - Regional policy, local municipal and highlands administrations	- Support in setting up legal basis for implementation of the UNFCCC and Clean Development Mechanism of the Kyoto Protocol; - Incorporation of climate change concerns in the sectoral and regional development plans

Source: Georgia's Second National Communication to the UNFCCC

16.2.3 Assessment Boundary

The assessment considers a number of sources that contribute to the overall GHG emissions in the design of the Project. Emissions incurred during the construction phase are associated with the materials required for the structure from both their manufacture and transport to site. Emissions in the construction phase associated with construction of the tunnels, dams, weirs, powerhouses and substations have been considered based upon the quantity or monetary value of concrete, cement, PVC, steel, clay, stone, construction and transport estimated for each site. Assessment of transmission lines is not part of the scope of this assessment and has therefore not been considered further.

Maintenance activities may also lead to emissions during the life of the structure, although these are not as significant as the initial construction. Maintenance will include replacement materials, plant use and transport to the site, and some of the materials already in the structure may go to waste. Given the uncertainty in future maintenance requirements emissions from such sources have nit been included within this assessment.

16.2.4 Calculation Methodology

The following sub-sections outline the components of the methodology used to assess the carbon emissions in the design of the Project and provides detail on how the calculations are undertaken and the data sources used. CO_2 emissions can be calculated based on the relevant activity data (e.g. concrete used), and the emission factor which represents an amount of emissions per unit of activity. For example the construction of buildings using concrete, emissions are calculated by multiplying the emission factor of the concrete by the volume of concrete used. The emissions from concrete may also be calculated using the mass or monetary value of the concrete depending on the emission factor unit.

Note that a standardised way of accounting for all the GHG emissions associated with an item or activity is to express those emissions in equivalents of CO_2 – the unit for this is CO_2e. This measure normalises all of the different GHGs in to units of CO_2 based on their global warming potential. For example, 1 kg of methane has the same global warming potential as 25 kg of CO_2, therefore 1 kg or methane can also be expressed as 25 $kgCO_2e$.

Potential GHG emissions generated from the decommissioning phase have not been considered within the greenhouse gas assessment given the expected operational lifetime of the scheme and uncertainty over emission factors so far into the future.

16.2.5 Construction Phase Methodology

16.2.5.1 Construction Component

Emissions of GHGs will arise during the construction of the tunnels, dams, powerhouses and substations. This includes embodied GHGs in the materials (from their manufacture) and plant and vehicular emissions used for construction. Where possible, the GHG emissions have been quantified based on available data and/or assumptions and using standard published emissions factors for the construction period.

This assessment has used the most up-to-date secondary data sources, such as the IFC Carbon Emissions Estimation Tool, the UK Inventory of Carbon & Energy version 2 (ICE v2) and the top down Input/Output approach as presented in the Department for the Environment, Food and Rural Affairs (Defra), UK (Annex 13 of 2011 Guidelines to Defra/DECC's GHG Conversion Factors for Company Reporting). Emissions factors that have been utilised in this assessment and their sources have been stated in Appendix G.

Emission factors from Defra are based on a top-down analysis of the supply chain and processes required to form a useful product, where the emissions are summed from the energy use required to reach the products' final state. This is based on macro level economic and environmental input-output analysis and generally represents emissions from given sectors of the economy. It is considered that the conversion factors used in this process are considered to be generally representative of Europe. The Defra emissions factors have only been used when only the cost of materials was available or no suitable emissions factor for a specific activity could be sourced.

The cost of equipment has been provided in Turkish Lira (TL). As the emissions factors are based on Defra methodology they are UK based and as such require the emission factor to be converted from Great British Pounds (GBP) to TL (as stated in the Bill of Quantities). This conversion has been presented in the following paragraph. The calculation of total kg per CO_2e per GBP uses an emission factor based on the sum of the supply chain emission factors for CO_2, methane, nitrous oxides, HFCs, PFCs and SF_6. The emissions factors based on the Defra methodology have been converted from $kgCO_2e/£$ to $kgCO_2e/TL$ using a conversion factor of £1 = 2.38 TL[36].

16.2.5.2 Construction Transport and Haulage Component

The transport and haulage of materials and workers to site has been calculated using total vehicle movements along a set of links, as presented in Table 16.2, for each phase. Emission factors for vehicles are based on the Defra methodology as discussed below.

Table 16.2: Link names and Distances as used in Transport Calculations

Link[(a)]	Link Distance off site (km)	Link Distance on site (km)
A	5.5	1
B	15.2	1
C	22.5	1
D	21	1
E	5.5	1
F	9.3	1
G	43	1
H	3.7	1
I	4.1	1
J	12	1
K	4	1
L	24	1
M	19	1

[(a)] Links can be seen in Chapter 13.

Vehicles movements were divided into three individual calculations to account for HGVs, LDVs and HGVs moving spoil. Spoil was separated from HGV movements as the distances travelled are significantly shorter than HGVs delivering materials and would have overestimated GHG emissions.

Emission factors for transport and haulage have been taken from Defra's Annex 6 (Passenger Transport) and Annex 7 (Freight Transport)[37] Defra's vehicle emission factors are presented as $kgCO_2$ per vehicle km and are based on the laden weight of the vehicle for freight transport and the engine size for passenger transport. A variety of assumptions has been made in selecting vehicle emission factors and has been presented in Section 16.2.8 below.

16.2.6 Operational Phase Methodology

No quantitative assessment of direct GHG emissions during operation will be undertaken as part of the ESIA although a qualitative assessment of impacts and mitigation has been made.

[36] Accurate on 02/11/2011

[37] Note these emissions factors generally represent typical vehicle classes across Europe, and are cross referenced in other emission factor sources, such as the Greenhouse Gas Protocol.

16.2.7 Payback Time

The payback time of the project is defined as the length of time required for a scheme to become a net avoider of emissions rather than a net emitter. The payback time is determined by calculating the total amount of GHG emitted another means of power generating the equivalent amount of electricity per year as the proposed Project and classing these as avoided emissions. The total amount of emissions incurred in the construction phase is then compared to the avoided emissions

Payback time is calculated by dividing the total emissions over the lifetime of the Project by the total CO_2 avoided per year as a result of the scheme (i.e. emissions generated from equivalent thermal power) to determine the point at when the project becomes a net avoider of emissions.)

For the purpose of this assessment a comparison will be made with a conventional Combined Cycle Gas Turbine Plant (CCGT), typically the most efficient method of thermal power generation, and the National Grid mix of technologies.

16.2.7.1 Comparison with Gas CCGT

Typical emissions rates from thermal plants can be found in the IFC EHS for Thermal Power Plants. The total expected power production from each phase will be multiplied by the emission factor in the IFC EHS giving the total GHG production per year for a Gas CCGT of equivalent output as the phase of the project it is compared to. The calculated production of CO_2e from each phase of the Project is then divided by the total CO_2e production for the Gas CCGT showing the payback time, in years, for the Project. An emission rate of 0.396 $GgCO_2/GWh$ for electricity generated by CCGT has been assumed within this assessment.

16.2.7.2 Comparison with National Grid

The emissions from the Project will also be compared to the standard GHG emission factor for the supply of energy to the Georgian National Grid. This accounts for the mix of power generation methods in Georgia, which will include some thermal and some renewable technologies. Country specific estimations of emissions from imported electricity and heat are provided by the EBRD Methodology for Assessment of GHGs. The total emissions produced by the Georgian National Grid will be compared to those produced by the Project. An emission rate of 0.333 tCO_2/MWh has been assumed within the assessment

16.2.8 Assumptions

For the purpose of emission factor selection it has been assumed that HGVs are rigid in design and have a maximum laden weight of 20 tonnes. Defra's emission factors for HGVs state vehicles 'greater than 17 tonnes' and as such HGVs are assumed to be at 100% load for both the outward and return journey.

Emission factors for LDVs have assumed an average medium car with an unknown fuel type. For the purpose of calculating total vehicle movements across the construction lifetime of each phase it has been assumed that each month has 30 days and Shaukhevi and Khertvisi will last 3 years and Koromkheti will last 4 years. As spoil movements will have a different timescale it has been assumed that Shaukhevi will last 5 years, Koromkheti will last 4 years and Khertvisi will last 3 years. These timescales are based on the information presented in Chapter 2. The movement of HGVs carrying spoil has been assumed to be no more than 1 km. This distance has been estimated using an average distance of spoil movements as stated in the separate BoQs for each phase.

The emissions factors used represent a cautious estimate and could represent an overestimate of the construction emissions of the Project. In addition, there would be additional uncertainties in relation to emission factors appropriate for materials sourced in Georgia.

As there are two bills of quantities for Koromkheti, option 1, which states larger quantities of materials, price and transport has been assessed as this represents a conservative approach.

16.2.9 Assessment of Impact Significance

It is typical in an ESIA to assess the size of impacts and then attach a level of significance to this – such an assessment is not easily completed in relation to GHG emissions and can skew the interpretation of the results.

The global nature of emissions of GHG and the difficulty in linking the emissions of a single plant or project to a specific impact on receptors is difficult and unlike other environmental impacts. It is made more complicated due to the complexities of GHG emissions being closely related to economic growth, and in international agreement such as the Kyoto Protocol, nations with low emissions are afforded more scope to increase their emissions than more developed nations that already have high levels of emissions (indeed, the latter are expected to reduce their emissions).

The relationship of individual project emissions to global atmospheric emissions combined with the uncertainty about global atmospheric response is very complex and as such determining the significance of such individual emissions on a local scale is not possible.

Finally, the relationship of emissions from individual projects to national objectives or even international reduction targets is also difficult to resolve as the national / international policies contain provisions for growth and development as well as action plans for emissions reductions. For this reason there are currently no published guidelines for determining the significance of Project GHG emissions in ESIAs including those of the major international lenders such as the World Bank, the EBRD or the Asian Development Bank.

The Guidance Notes for IFC Performance Standard 3 suggest the following methods of evaluation of project GHG emissions, presented in Table 16.3.

Table 16.3: Suggested IFC Criteria for Assessing GHG Emission Impacts

IFC Criteria	Comments
The project's GHG emissions relative to the host country total national emissions to understand the magnitude of its own emissions.	Discussed in the relevant parts of this assessment.
The project's GHG emissions performance relative to the good international practice performance / host country national average performance.	The GHG emissions for the construction of all three HPP have been compared against other forms of energy generation as well as the national reported GHG emissions in Georgia.
The annual trend of the project's GHG emissions performance over time to monitor deterioration from the originally designed performance.	The operational phase of the Project is estimated to have negligible GHG emissions and so monitoring is not necessary. As the valleys will be cleared of existing trees it is not expected that the reservoirs will emit methane from the decay of flooded forestry.
Opportunities to further improve the project's GHG emissions performance.	This has been considered in the mitigation section of this assessment. Note that benefits could also extend to cost savings or

IFC Criteria	Comments
	expenditure for different emission reduction strategies.

Note: The European Bank for Reconstruction and Development guidance suggests a similar set of evaluation criteria.

The IFC guidance does not, however, recommend how to assign significance to any of the impacts associated with a project, with the guidance pointing only to a presentation of the impacts. Therefore in this assessment, the criteria presented in the IFC guidance have been used and an account of the emissions has been presented but no level of significance attached to the projects' emissions. The relevance of these emissions has been discussed in relation to the criteria presented in Table 16.3.

As an attempt to put the results of this assessment in perspective the emissions from the Project will be compared to the payback times calculated against a conventional CCGT and the average GHG emission factor for the production of energy from Georgia's National Grid.

16.3 Baseline Description

Georgia submitted its second national communication to the UNFCCC in 2009 which provided annual GHG emission estimates for the country in accordance with the IPCC methodologies. A summary of the national emissions of GHGs are presented in Section 16.2.2.

16.3.1 Georgia Energy Sector

The leading business sectors under the USSR included industry, agriculture and services. After the collapse of the Soviet Union many countries, including Georgia, were no longer economically supported. This led to a decline in these three primary business sectors and left the energy sector as the main source of GDP in Georgia.

In 2004, the energy sector was reformed by the creation of consistent policies and market economy principles. This enhanced the energy security in Georgia and the country, in 2009, was able to meet energy demands throughout the year. Hydropower is the main source of energy in Georgia making up 72% of the overall demand. The other 28% of the energy is generated by thermal power and other renewable resources, such as wind, solar, geothermal and biomass.

The improvement in the supply of energy throughout Georgia has led to a decline in uncontrolled deforestation for use as fuel, which was a problem in the 1990s. Decline in deforestation will lead to a higher carbon sequestration rate in Georgia as woodland is a natural sink of GHGs.

16.3.2 Greenhouse Gas Emissions

According to Georgia's Second National Communication (Second National Communication of the Republic of Georgia under the UNFCCC, Ministry of Environment and Natural Resources), Estimations of GHGs in Georgia began in 1987 and are presented up until 2006. Georgia's total GHG emissions are 49,874 Gg[38] CO_2e. in 1987. After 1990 the countries total GHG emissions drastically decrease from 49,874 Gg CO_2e to 11,750 Gg CO_2e in 2006. This decrease represents a decrease in all sectors apart from the waste sector where changes in emissions have been insignificant. The GHG emissions from the energy sector have shown the most significant decrease falling from 36,689 Gg CO_2e in 1987 to 5,964 Gg CO_2e in 2006. The values for 1987, 1997 and 2006 have been presented in Table 16.4.

Table 16.4: Summary of Georgia's GHG Emission Trends by sector in 1987 and 2006, Gg CO_2e

Sectors	1987	1997	2006
Energy	36,689	9,020	5,964
Industrial Processes	6,684	784	1,002
Agriculture	5,090	3,122	3,544
Waste	1,410	1,279	1,240
Total	**49,874**	**14,205**	**11,750**

Source: Second National Communication of Georgia

[38] 1 Gg is equal to 1000 tonnes

16.4 Assessment of Impacts

16.4.1 Overview

The contribution of GHGs from the Project has been presented in the section below.

16.4.2 Construction

16.4.2.1 Overview

The Project will involve the construction of tunnels, dams, weirs, powerhouses, substations and transport. This section will present the GHG emissions as CO_2e for each phase of the Project. Individual sites from each phase have been broken down in the tables below. The total emissions for each phase have been presented as the overall total and per year throughout the construction phase. Table 16.5 presents the results for Shaukhavi, Table 16.6 presents the results from Kormokheti and Table 16.7 presents the results from Khertvisi.

Table 16.5: Emissions of CO_2e emitted from the Shaukhevi Phase

Site	$GgCO_2e$
Didachara Dam	73
Skhalta Dam	37
SkhaltaHPP	7
Chirukhistsqali Weir	3
Chirukhistsqali Transfer Tunnel	30
Skhalta Transfer Tunnel D&B	118
Skhalta Transfer Tunnel TBM	74
Shuakhevi Headrace Tunnel	193
Shuakhevi Tunnel Adits	41
Shuakhevi Surge Shaft	12
Shuakhevi Pres Shaft	8
Shuakhevi Power House	90
Transport	8
Total (over 3 years)	694
Total per year	231

Table 16.6: Emissions of CO_2e emitted from the Koromkheti Phase

Site	$GgCO_2e$
Koromkheti Head Race Tunnel	423
koromkheti Contractors Adits	19
koromkheti Surge Shaft	17
koromkheti Pressure Shaft	2
Chavanistsqali Transfer Tunnel	9
Koromkheti Power House Access cab. Tunnel	15
Koromkheti Power House Transfer	5

Site	$GgCO_2e$
Cavern	
Koromkheti Power House	21
Khichauri Dam	25
Chvanistsqali weir	3
Akavreta weir	4
Transport	7
Total (over 4 years)	550
Total per year	138

Table 16.7: Emissions of CO_2e emitted from the Khertvisi Phase

Site	$GgCO_2e$
Khertvisi Headrace Tunnel	175
Khertvisi Surge Shaft	241
Macha. Transfer Tunnel	41
Khertvisi HPP	18
Khertvisi Surge Adit	2
Khertvisi Dam	29
Machalistsqali Dam	7
Transport	3
Total (over 3 years)	516
Total per year	172

16.4.3 Summary of Results

The total contribution to GHGs as a result of the construction of the Project has been presented in Table 16.8. Results have been presented for the calculated emissions and the calculated emissions plus an additional 50% to account for potential discrepancies between emission factors used and actual emissions and the potential change in the quantities of materials and vehicle movements.

Table 16.8: Total CO_2e Contribution from each Phase

Phase	$GgCO_2e$ per year	Total $GgCO_2e$
Shaukhevi HPP	231	694
Koromkheti HPP	138	550
Khertvisi HPP	172	516
Total	**541**	**1,760**

16.4.4 Operation

Under normal operation of the facility both direct and indirect GHG emissions may occur, however these emissions are not expected to be significant and therefore have not been assessed quantitatively. The potential sources of GHG emissions are presented in Table 16.9.

Table 16.9: Operation Phase GHG Emissions

Type of Emission	
Direct	**Flooding** Flooding vegetation can cause anaerobic decomposition. However the potential for this has been reduced through clearance of the valley sides as as discussed in Section 16.2.6.
	Auxiliary On site generators for backup purposes and to run any operations where power can not be sourced from the HPP. These will not normally be in operation.
	Ancillary Ancillary emissions may be associated with control room, maintenance area, office, security and health and safety system.
In Direct	**Electrical Consumption** The consumption of electricity generated from offsite sources is not expected to occur as energy consumed by the HPP is likely to have been generated by the HPP facilities and consumed before entering the national grid. .
	Transport Employees travelling to and from the HPP facilities.

16.4.5 Payback Time

The payback time of the Project determines the length of time it will take before the Project can be considered a net avoider of GHGs. The payback time has been calculated assuming emissions from a conventional CCGT and the Georgian National Grid and are presented below.

16.4.6 Payback Time compared to a CCGT

The payback time of the Project shows the length of time it will take before the Project becomes a net avoider of GHGs by comparing its total emissions against a more conventional powered thermal power plant. This section presents the payback time for each of the individual schemes and the Project overall

Table 16.10 presents the total GHG emitted from the proposed Project for both the construction and operational phase during its proposed 30 year lifetime.

Table 16.10: Total GHG emissions from the proposed Project

Phase	Total CO_2e) $GgCO_2e$
Shaukhevi HPP	694
Koromkheti HPP	550
Khertvisi HPP	516
Total	**1,760**

Table 16.11 presents the total amount of GHG emitted from a conventional CCGT providing the equivalent amount of electricity as the proposed Project. It has been assumed that the proposed Project will have a generating capacity of 1216.6 GWh/year. Therefore a conventional CCGT generating the equivalent

amount of electricity will produce 482 $GgCO_2$/year. Table 16.12 presents the overall payback period for the Project which has been calculated at 44 Months.

Table 16.11: GHG production from Conventional Gas CCGT

Phase	Power Produced (GWh/year)	Typical CO_2 ($GgCO_2$/GWh) Gas CCGT	Total $GgCO_2$/year from Gas CCGT	Total $GgCO_2$/lifetime from Gas CCGT[(a)]
Shaukhevi HPP	475.4	0.396	188	7124
Koromkheti HPP	480.1	0.396	190	7194
Khertvisi HPP	261.1	0.396	103	3913
Total	1,216.6	0.396	482	18231

Source: IFC EHS Thermal Power Plants

[(a)] Assumes lifetime of 45 years

Table 16.12: Payback time of the project when compared to a Gas CCGT

Phase	Total CO_2e) $GgCO_2$e	Total $GgCO_2$/year from Gas CCGT	Payback Time (months)
Shaukhevi HPP	694	188	44
Koromkheti HPP	550	190	35
Khertvisi HPP	516	103	60
Total	1,760	482	44

16.4.7 Payback for the National Grid factor

The steps to calculate emissions from the National Grid have been shown below. This method assumes the total of GHG emissions are the same as presented in Table 16.10 above. Table 16.13 presents the total GHG emissions produced when generating the equivalent amount of electricity as the Project assuming the average National Grid emission factor.

Table 16.13: CO_2 production from the National Grid

Phase	Power Produced (tMWh/year)	Emission Factor (grid produced) ($GgCO_2$/GWh)	Total $GgCO_2$/year)	Total $GgCO_2$/lifetime)[(a)]
Shaukhevi HPP	475.4	0.333	158	4,740
Koromkheti HPP	480.1	0.333	160	4,800
Khertvisi HPP	261.1	0.333	87	2,610
Total	1216.6	0.333	406	12,180

Source: EBRD Methodology for Assessment of GHG

[(a)] Assumes lifetime of 45 years

Table 16.14 presents the payback from the Project in comparison with the average National Grid emission factor. The payback time presented is higher than that for a conventional CCGT. This is because the National Grid emission factor for GHG production is lower than that of a conventional CCGT as a large proportion of Georgia's electricity is generated by existing hydropower.

Table 16.14: Total GHG contribution from the Project compared to the National Grid

Phase	Total $GgCO_2$/year	Total CO_2e) $GgCO_2e$ from National Grid	Payback Time (months)
Shaukhevi HPP	694	158	53
Koromkheti HPP	550	160	42
Khertvisi HPP	516	87	71
Total	**1760**	**405**	**52**

Source: EBRD Methodology for the Assessment of GHGs

16.4.8 Impact Significance

As previously stated, there are no established methods or criteria for the assessment of significance of GHG emissions from operation or construction. Therefore the impact significance has been discussed in terms of the payback time. As discussed above the overall payback time for the Project is 44 months when compared to a conventional CCGT and 52 months when compared to the National Grid emission average.

Given that the Projects lifetime is expected to be a minimum of the 45 years the Project will have a positive effect on global GHG emissions after 44 months compared to if the thermal generation had been built instead of the Project.

It can be concluded that over the lifetime of the project, the project will provide enough renewable electricity to offset the emissions incurred during the construction of the project, as compared to if a thermal power plant was instead constructed. In this context the project can be considered to have minimal negative impacts on GHG emissions

16.5 Mitigation and Enhancement Measures

16.5.1.1 Construction Phase

When selecting designs or choosing materials, preference should be given to materials that are recycled and can be reused or recycled again (with proven markets). Composites that can easily be broken down into reusable materials will also have lower end-of-life emissions. Any waste arising from the construction phase could also lead to emissions, depending on the nature of that waste. Organic materials that are land-filled lead to further emissions of GHGs.

In terms of whole-life GHG emissions, the modularity of the design can be important. Where replacements are needed in the asset, if they are designed to accommodate potential new technologies then this can reduce the emissions down the line. For example, if cabling was placed in a service trench rather than buried, they can be swapped out and replaced by more modern technologies easily saving energy and construction costs down the line.

The embedded mitigation measures, presented in Table 16.15, provide key mitigations to built into the project during the design phase or proposed to be addressed during the construction contractor procurement process. Table 16.16 provides a list of recommended mitigations that would be desirable to be built into the project during the design phase or proposed to be addressed during the construction contractor procurement process.

Table 16.15: Key Mitigations for Emissions from the Construction Phase

Type of Mitigation	
Embedded mitigation – mitigation which is built-in to the project during the design phase or proposed to be addressed during the construction contractor / supplier procurement process	**Procurement** For cement/concrete use, using of some substitute materials such as fly ash in order to reduce the impact from the cement used. There are potentially significant regional markets for fly ash which could prove cost-effective. 50% fly ash replacement in concrete can lower the embodied carbon of concrete by approximately one-third. Where possible, specifying recycled steel or reuse of other steel. Recycled steel has a lower embodied carbon than virgin steel therefore its use would reduce GHG emissions associated with construction.
	Access Roads Minimising the length of new roads required through careful planning and use of existing access. Consider what surfacing requirements are needed and consider the use of potential vehicles that might use the roads. Reviewing and assessing the proposed specification required for roads and consider whether hard surfacing is necessary.
	General Sustainable Construction Management Using best available technology for diesel generators and other plant to ensure the maximum efficiency and lowest fuel/energy use of the construction plant. Controlling exhaust emissions from vehicles operating within the site, including trucks, excavators, diesel generators or other plant equipment through regular servicing.

Source: IFC General EHS Guidelines

Table 16.16: Mitigation for Emissions from the Construction Phase

Type of Mitigation	
Additonal mitigation – mitigation which is desirable	**Procurement** Sourcing materials from local suppliers wherever possible. This is to avoid potentially long distance travel for materials. Using materials which can be recovered along the route such as stones and aggregates in preference to remote suppliers.
	Access Roads Reviewing and assessing the proposed specification required for roads and consider whether hard surfacing is necessary.
	General Sustainable Construction Management Efficiently planning the construction phase to minimise transportation requirements, workers and materials and optimising the use of resources to avoid potential wastage. Considering transport modes when determining logistics of construction. Requesting contractors to elaborate on their construction philosophy to address this point. Implementing toolbox talks that promote turning off of engines when not in use.

Source: IFC General EHS Guidelines

16.5.1.2 Operational Phase

Although no assessment of GHG emissions for the operation phase have been made, measures to reduce potential impacts are important in improving performance. The mitigation measures presented in this section focus on:

- Reforestation
- Electrical Consumption
- Transport.

Monitoring of methane from the reservoirs is not expected to be required as the valleys will be cleared of all forestry prior to flooding.

Table 16.17 presents a summary of operational mitigation measures to be implemented by the Project.

Table 16.17: Summary of Operational Mitigation Measures of the Project

Type of Mitigation	Provisions to Address Impacts & Effects
Direct	**Flooding** Forestry is a naturally occurring carbon sink. Planting new forestry to replace existing foliage that will be flooded provides an artificially inspired carbon sink reducing the carbon cost of construction.
	General Sustainable Management Using best available technology for diesel generators and other plant to ensure the maximum efficiency and lowest fuel/energy use of the construction plant. Implementing toolbox talks that promote turning off of equipment when not in use.
Indirect	**Electrical Consumption** Use electricity produced by the HPP facility as opposed to purchasing from other sources. If electricity is purchased: encouraging the purchase of sustainable energy sources and shutting down systems when possible and safe to do so.
	Transport Controlling vehicles travelling to and from the site through regular servicing and encouraging alternative transport methods.

Source: IFC General EHS Guidelines

16.6 Summary and Statement of Significance and Compliance

An assessment of the emissions of GHG from the Adjaristsqali Hydropower Cascade Project has been calculated. The total GHG emissions associated with each of the schemes has been calculated and the payback period for each of the schemes presented.

The calculated payback time for each of the schemes when compared to a conventional CCGT plant can be summarised as:

- Shaukhevi - payback time 44 months;
- Koromkheti - payback time 35 months; and.
- Khertivisi - payback time of 60 months.

While the Project will have some impact on GHG emissions the assessment has shown that the within 44 months the Project will become a net avoider of GHG if the same amount of electricity was generated by a conventional CCGT power plant. The outcome of the assessment suggests that based on the impact definitions presented in the EBRD methodology guidance, shown above in Section 16.2.2.3, this project is in line with the general classification of Medium-Low impact if the total emitted GHGs are spread evenly over the 30 year operational life time of the plant.

17. Cultural Heritage and Archaeology

17.1 Introduction

This Chapter describes the potential impacts of the construction and operation of a new Hydropower Cascade Scheme along the Adjaristsqali River upon known and potential Cultural Heritage aspects of the area and sets out the proposed mitigation in order to minimise the impact of the Project upon the cultural heritage resource.

17.1.1 General Approach

This Chapter is written in line with the International Finance Corporation (IFC) Performance Standard 8 Cultural Heritage 2012 and the European Bank for Reconstruction and Development's (EBRD) Environmental and Social Policy PR8 Cultural Heritage. A baseline assessment of all available data was undertaken by Gamma Consulting and was followed by walkover surveys which established whether above ground cultural heritage remains were present along the length of the scheme. This baseline information has been augmented by further documentary research.

17.2 Methodology and Assessment Criteria

17.2.1 Legislative Background

17.2.1.1 Georgian Legislation

The Cultural Heritage Law 2007 replaced the 1999 Law on the Protection of Cultural Heritage and protects the cultural heritage of Georgia by providing regulation within this area. Protection is provided to all immovable monuments, movable monuments as well as objects with monument signs and immovable monument protection zones irrespective of land ownership. The Law also specifies that costs for archaeological activities, supervision, preliminary investigation, historic cultural heritage determination, scientific research, publication and protection should be included in the design and construction costs for a project.

The Resolution on the Rules of the Issue of Permits for Execution of Works on Monuments of History and Culture and Archaeological Digs was passed in 2005 and is carried out at state level. The 2007 revision of the Cultural Heritage Law aimed to improve the application of this legislation. State supervision of compliance with the terms of permits and requirements in the field of cultural heritage is undertaken by the Ministry of Culture, Monument Protection and Sport.

Within Adjara, the Adjaran Ministry for Education, Culture and Sport is responsible for all programmes within the administrative borders of Adjara and the Cultural Heritage Preservation Agency of Ajara, established in 2011, provides local cultural heritage protection, study, maintenance, restoration and preventive conservation within the Autonomous Republic of Adjara. The Adjaran jurisdiction covers all monuments within the Autonomous Republic. Archaeological, fortification and cult objects' are covered by Georgian legislation.

17.2.1.2 International Requirements

The project will be conducted in line with IFC Performance Standard 8 Cultural Heritage 2012, which aims to 'preserve and protect cultural heritage by avoiding, reducing, restoring, where possible, and in some cases compensating for the adverse impacts that projects might cause to cultural heritage' (IFC 2012).

The project will also comply with EBRD's Environmental and Social Policy PR8 Cultural Heritage which aims to 'protect irreplaceable cultural heritage and to guide clients to avoid or mitigate adverse impacts on cultural heritage in the course of their business operations'.

17.2.2 Methodology

This section presents, and augments, the results of a cultural heritage baseline study and walkover survey undertaken by Gamma in 2011 followed by assessment of the potential impacts associated with the project. The following sources were consulted:
- National Agency of Cultural Heritage online database
- Cultural Heritage Preservation Agency of Adara online database
- UNESCO online database of World Heritage Sites
- Published and unpublished (grey literature) articles
- Various relevant websites (see references section).

17.2.3 Assessment of Impact Significance

Table 17.1 presents the definitions used in determining the sensitivity of cultural heritage features, and Table 17.2 sets out the definition used to determine the magnitude of impacts.

Table 17.1: Criteria for Determining Sensitivity

Sensitivity	Definition (considers duration of the impact, spatial extent, reversibility and ability to comply with legislation)
High	Sites of the highest importance, e.g. World Heritage Sites (including nominated sites), assets of acknowledged international and/or national importance and assets that can contribute significantly to acknowledged international research objectives
Medium	Undesignated archaeological sites; well preserved structures or buildings of historical significance, historic landscapes or assets of a reasonably defined extent and significance, or reasonable evidence of occupation / settlement, ritual, industrial activity etc
Low	Comprises undesignated sites with some evidence of human activity but which are in a fragmentary or poor state or assets of limited historic value but which have the potential to contribute to local research objectives, structures or buildings of potential historical merit
Negligible	Historic assets with very little or no surviving archaeological interest or historic buildings and landscapes of no historical significance.

Table 17.2: Criteria for determining Magnitude

Magnitude (positive or negative)	Definition (considers duration of the impact, spatial extent, reversibility and ability of comply with legislation)
Major	Severe damage or loss of the cultural heritage resource
Moderate	A high proportion of the cultural heritage resource damaged or destroyed
Minor	A small proportion of the cultural heritage resource damaged or destroyed
Negligible	The cultural heritage resource will not be affected, because of distance from the

Magnitude (positive or negative)	Definition (considers duration of the impact, spatial extent, reversibility and ability of comply with legislation)
	development, or method of construction

The significance of the effect is dependent upon the importance of a particular site and the amount of potential damage which may be caused by the Project. The assessment of potential impacts prior to mitigation follows criteria shown in Table 17.5. The residual effects (those remaining after mitigation) would be ascertained in terms of the criteria shown in Table 17.5 which assesses the impacts in relation to the importance of the remains.

The significance of impacts has been determined by the interaction between the magnitude of impacts and the sensitivity of receptors affected, as depicted in the significance matrix shown in Section 5.3.4.4.

Table 17.3: Criteria for Determining Magnitude of Impacts on Cultural Heritage Assets and/or Archaeological Sites

Categorisation	Determination
Major adverse / beneficial	A probable impact that affects many cultural heritage assets and/or archaeological sites and will continue beyond the project life.
Moderate adverse / beneficial	A possible impact that will likely affect either cultural heritage assets and/or archaeological sites beyond the local area of influence into the wider area of influence or continue beyond the project life.
Minor adverse / beneficial	An impact that may affect a small number of cultural heritage assets and/or archaeological sites or occurs exceptionally, mostly within the project area of influence and does not extend beyond the life of the project.
Negligible	An impact that is localised to a specific location within the project's site boundary and is temporary or unlikely to occur with no detectable affect on a cultural heritage asset and/or archaeological site

Source: Mott MacDonald / Gamma

17.2.4 Data Limitations

A desk based assessment relies on the accuracy of the data provided by the sources outlined in Section 17.2.3. There is always some degree of uncertainty in relation to these sources which include:

- The databases can be limited as they are not based on a systematic search of the region but rather they rely on recording above ground and easily visible remains;
- There are no records of archaeological investigations recorded within the databases;
- Some of the databases consulted contained contradictory information, where this occurs it is highlighted within the cultural heritage monument tables presented Appendix H;
- Documentary evidence is inevitably biased towards more recent time periods and many documents are inherently biased. Older primary sources often fail to accurately locate sites and place names change with time and are often duplicated in different locations;
- Grid coordinates for monuments are sometimes rounded to such an extent that the actual location of the item can be difficult to locate; and
- The presence of buried archaeology is not always obvious during walk over surveys. There is always the potential for unknown buried archaeology to be present on the site.

17.3 Baseline Description

17.3.1 Site Location

The site is located along the Adjaristsqali River valley to the south and east of the port city of Batumi in the Autonomous Republic of Adjara on the Black Sea littoral in the south-west of Georgia. The scheme runs over 80 km and crosses four of the five administrative units of Adjara - Khelvachauri, Keda, Shuakhevi and Khulo.

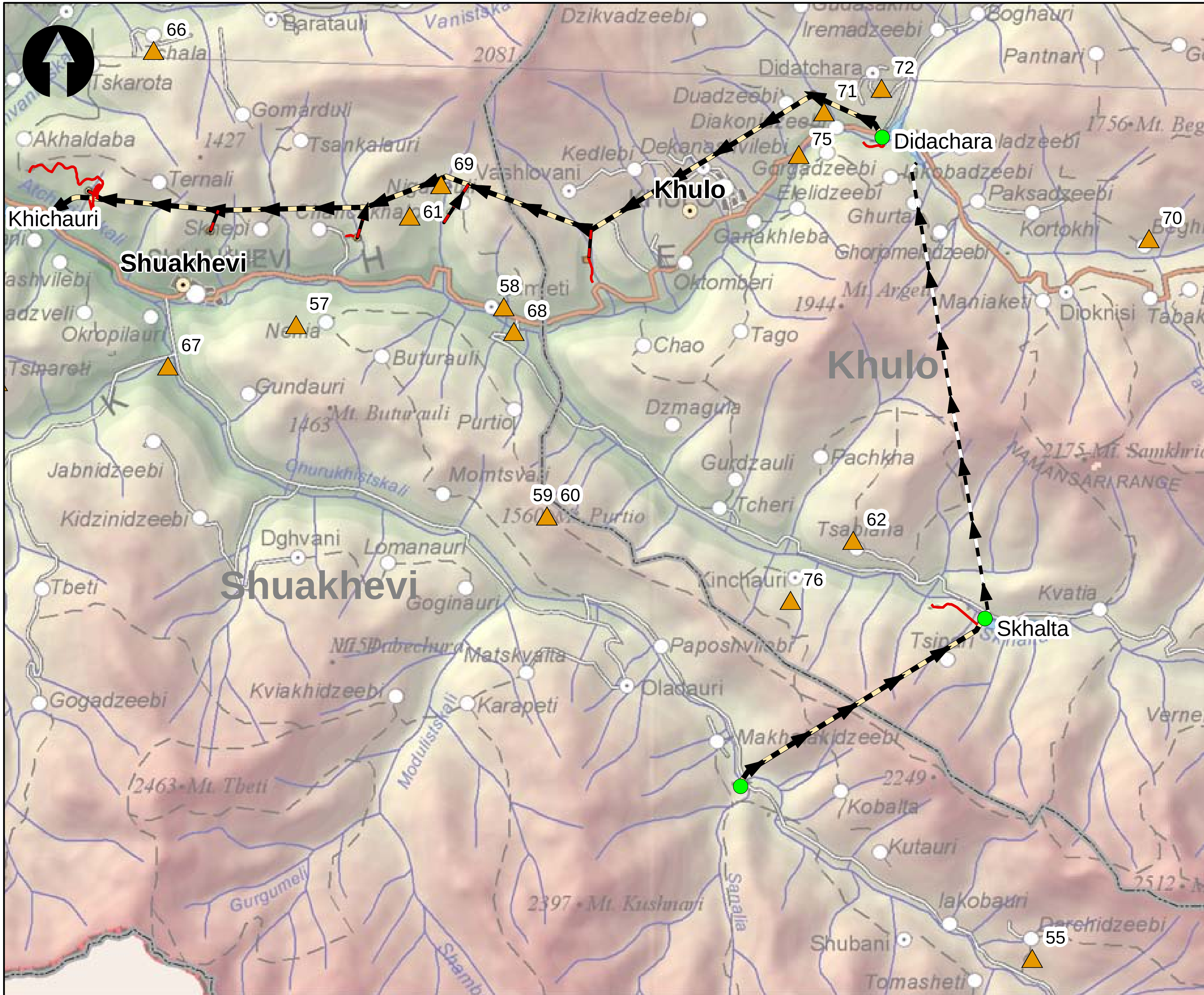
The scheme has been divided into three phases: Phase I – Shuakhevi, the easternmost area and upstream; Phase II – Koromkheti, the central area; Phase III – Khertvisi, the westernmost area and downstream.

Full details of the scheme are presented in Section 2 of this ESIA. The main impacts to the cultural heritage resource will arise from the construction of the proposed new reservoirs, the excavation of new quarries, road widening and improvement schemes, the construction of the scheme headquarters, construction facility sites including the construction of new buildings, the transfer tunnel excavation shafts (adits), foundations and supports of the dams and weirs, and new service trenches for underground utilities and services. The tunnelling itself will not disturb cultural heritage assets due to its considerable depth below the current ground surface; the tunnel will be located well-beneath any potential buried archaeological sites.

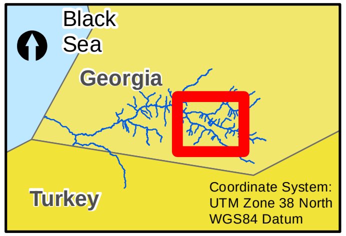
17.3.2 Archaeological and Historical Background

17.3.2.1 Overview

The following information derives from published and unpublished (grey literature) reports, websites, the Cultural Heritage Preservation Agency of Ajara and the National Agency for Cultural Heritage. A full list of known cultural heritage assets in the area is presented in Appendix H. Each of the cultural heritage assets listed have been illustrated in the following three maps.



Location Map



Legend

Monuments

Proposed Access Roads

Temporary Construction Structures

- Contractor Colony
- Existing Quarry
- Job Facility Area
- Office
- Proposed Quarry

Permanent Structures

- Portal
- Dam/Weir
- Powerhouse
- Reservoir
- Substation
- Surge Shaft

Underground Tunnel

- Adit Tunnel
- Headrace Tunnel
- Transfer Tunnel

Intake

0 500 1,000 2,000 3,000 4,000 Meters

P1	27/01/2012	For Information	WJG	PA	VH
Rev	Date	Description	Drawn	Ch'k'd	App'd

Client

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Mott MacDonald

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Gamma Consulting Limited
9, Merab Aleksidze Street,
Tbilisi 0193, Georgia

Drawing Title

Adjaristsqali Hydropower
Cascade Project
Shuakhevi Cultural Heritage

Scale @ A4	MM Project No.	Status
1:100,000	290039	PRE

GIS File
20120117_Shuakhevi_Cultural_Heritage.mxd

Drawing No.
MMD-290039-MNC-SHU-07-009

Rev
P1

Those sites located within 200 m of the Project are listed in Table 17.4 below.

Table 17.4: Cultural Heritage Assets within 200 m of development area

MM ref	Grid Ref UTM Zone 38N WGS84	Description	Date	Adjara Municipality	Scheme Phase	Source	Designation
1	227815, 4606318	Khertvisi (Zedobani) Winepress	AD XI century	Khelvachauri	Khertvisi - III	CHPAA	-
2	227837, 4603664	Khertvisi Winepress and Marani (location for storing wine in special pitchers)	AD XI-XIII Centuries	Khelvachauri	Khertvisi – III	CHPAA	-
35	236268, 4606070	Bridge, Kveda Makhuntseti village	IX-X century	Keda	Khertvisi –III	Gamma Consulting/Site Survey	National importance monument
36	236268, 4606070	Mosque, Kveda Makhuntseti village	XIX century	Keda	Khertvisi-III	Gamma Consulting/Site Survey	Local importance monument
69	270621, 4614221	Selim Khimshiashvili Castle. Nigazeuil village. This reference might be a duplicate of MM61, see Appendix H	Late Middle Ages	Shuakhevi	Shuakhevi –I	CHPAA	-
71	278071, 4615634	Diakonidzeebi village Fortress	Middle Ages	Khulo	Shuakhevi –I	Gamma Consulting/Site Survey	Local importance monument

Source: National Agency of Cultural Heritage

All of the recorded monuments represent upstanding archaeological and historical remains; there are no records of buried cultural heritage remains within the development area, however this does not preclude their existence. The potential for revealing previously unrecorded cultural heritage assets is discussed below.

17.3.2.2 Palaeoenvironmental

The majority of the proposed works will be located within river valleys of the Adjaristsqali and its tributaries. Any excavation within the floodplain of the river has the potential to contain palaeoenvironmental evidence, though within the river channel itself any palaeoenvironmental material is unlikely to be *in situ* and therefore its level of importance is greatly reduced.

Any developments within the low-lying settlements along the edge of the river, such as Khichauri, have the potential to contain well-preserved palaeoenvironmental deposits. These deposits, if they are present, are likely to be well-preserved as they are not located within the route of the normal river and its normal flooding area and therefore any sediment deposited through extreme flooding events will have settled on top of, and will therefore seal any underlying deposits, thereby preserving the lower deposit. The sensitivity rating for these deposits, should they be encountered, is medium.

17.3.2.3 Prehistoric

No significant prehistoric sites have been identified within the development area, however this is likely to be a reflection of a lack of archaeological and historical investigation rather than a reflection of a prehistoric barren land. Indeed, evidence from the Black Sea coast, to the west of the site, has shown extensive settlement at ports and trading centres during the later prehistoric period. Prehistoric settlement patterns would be expected to mirror that of the modern era, therefore they would be located close to the river on fertile farming land. The sensitivity rating for deposits and features of this period, should they be located within the project area, is medium.

17.3.2.4 Medieval

As a result of the Roman and subsequent Christian influence in the region, as well as earlier trade connections, a network of roads and trade routes were established, in particular a section of the Kirnati-Maradidi road is preserved to the south-west of the proposed Head Race tunnel in the Phase III, Khertvisi, section of the development. This has led to the assumption that this represents one of the main routes of the Silk Road (Anon 2011).

Intensive construction of churches is noted between the 10th and 16th centuries AD, and reflects developments throughout the Christian world. The earliest church within the area surrounding the proposed scheme is located in Furtio and dates to the 11th to 12th centuries (MM 59). During this period a large number of stone bridges were constructed and represent an increased investment in local infrastructure, extant examples within the Project area include the 11th to 12th century bridge at Keda-Makhuntseti (MM 35). The region produced large quantities of wine and many carved wine presses and wine cellars are also preserved, for example the winepress at Kokotauri (MM 26). Fortifications were also constructed along the Adjaristsqali valley and several are situated within the development area, including the fortress near Dzetsmani (MM 39), the fortress at Takidzeebi (MM 63) and at Nigazueli (MM 61). All of these fortresses have been dated to the medieval period and they indicate a perceived threat to the local ruling elite at this time. Irrigation channels are present in the area and these represent the agricultural traditions of medieval Georgia. The historical name of the region of Khulo is *Khula*, which means 'Trade House' indicating that a significant trading route and perhaps trading centre was established in the area during the medieval period. The sensitivity rating for deposits and features of this period, should they be located within the project area, is high.

17.3.2.5 16th century to 20th century

Adjara came under the control of the Ottoman Empire in the 1560s which resulted in the increased dissemination of Islam, and therefore the construction of mosques and other Islamic institutions. There are a number of 19th century mosques, also translated into English as 'Djame's, within the area surrounding the development and include the mosques at Dologani (MM 14), Keda Makhuntseti (MM 36), Dzetsmani (MM 40) and Kokotauri (MM 25). One mosque dated to the medieval period is recorded at Akho (MM 7), though this will not be affected by the Project. The Ottoman influence was diluted by the continued rule of the local nobility which resulted in the preservation of many Georgian traditions and the Georgian language. The Russian-Turkish wars of 1877-1878 resulted in a re-unified Georgia and Russian administrative governance and legislation was established in Adjara. Adjara continued to be administered by Russia and subsequently the USSR until its fall in 1993 and Adjara now forms an autonomous republic within Georgia.

There are a number of small graveyards located along the various river valleys, these are not recorded on modern maps as they probably represent extended family burial grounds and are not formal cemeteries.

The sensitivity rating for deposits and features of this period, should they be located within the project area, is high.

17.4 Assessment of Impacts

17.4.1 Construction

The majority of impacts to cultural heritage assets will occur during the construction phase of the project. There will be no direct impact to known cultural heritage assets as none of the project infrastructure or construction activities will occur within 200 m of any of the known cultural heritage features, however there is the potential for previously undiscovered, buried archaeological remains to be impacted by the Project. Section 17.3 presented the archaeological and historic background to the Project area and assessed the likelihood for the survival of remains dating to each prehistoric and historic period. The main focus of prehistoric and historic human activity was around the Black Sea Coast, however human occupation has also been recorded along the major river valleys of Georgia, it is therefore likely that the Adjaristsqali valley was no different. As stated in Section 17.3 all of the formally recorded cultural heritage assets are upstanding and visible remains; there are no recorded cultural heritage assets relating to archaeological or buried features and deposits, indicating that the archaeology of the Adjaristsqali valley and its tributaries has not been subjected to formal investigation. The potential for the survival of archaeological deposits within the valleys, and their states of preservation, is therefore untested but it is highly likely, given the archaeological and historical background of the region that previously unrecorded and or buried cultural heritage assets survive within the Project area. The most likely areas for their survival would be located in the flatter, low-lying areas of modern settlement, areas where the construction facilities and contractor's colonies will be located.

The scheme is divided into three phases:

- Phase I – Shuakhevi, the easternmost area and upstream
- Phase II – Koromkheti, the central area
- Phase III – Khertvisi, the westernmost area and downstream.

Each phase of works requires activities which have the potential to impact cultural heritage assets. The activities are presented in Table 17.5 below and their impact upon the potential cultural heritage resource, prior to mitigation, is assessed and graded:

Table 17.5: Impacts upon cultural heritage assets

Activity	Impact determination upon known cultural heritage assets	Potential Impact determination upon previously unrecorded, buried cultural heritage assets
Road widening	Negligible	Major adverse
Dam Construction	Negligible	Major adverse
Reservoir construction/area submergence	Negligible	Major adverse
Tunnel and adit portal excavation	Negligible	Major adverse

Activity	Impact determination upon known cultural heritage assets	Potential Impact determination upon previously unrecorded, buried cultural heritage assets
Construction facilities area including new industrial and residential buildings	Minor adverse	Major adverse
Colony sites providing housing and amenities for scheme workers and their families	Minor adverse	Major adverse
Construction of offices	Minor adverse	Major adverse
Spoil deposition	Negligible	Insignficannt
Construction of project headquarters (located in Koromkheti Phase II area)	Negligible	Major adverse
Provision of utilities including, telecommunications, water and electricity, possibly requiring the excavation of small service trenches	Negligible	Moderate adverse
Quarry excavation	Negligible	Major adverse
Stone bridge rehabilitation	Minor adverse	N/A

Source: Gross Energy Group

The excavation of the tunnels and adits themselves will not impact cultural heritage assets as they will be located at around 100 m below the current ground level and will either be excavated using drill and blast or TBM techniques therefore these activities will have a negligible impact upon known cultural heritage assets. The method of excavation will, however, require the excavation of access shafts (portals) which are likely to measure 50 m in diameter. These have the potential to disturb and remove any previously unrecorded and/or buried cultural heritage assets within their 50 m footprint which results in a major adverse impact detemination.

17.4.2 Operation

The operation of the proposed project has the potential to disturb cultural heritage assets in areas scheduled for planned submergence – water action has the potential to erode and abrade submerged material over time. The planned areas for submergence have been deliberately located in areas away from known cultural heritage assets and therefore the impact determination upon these assets is negligible. However, the effect of inundation upon previously unrecordedand/or buried cultural heritage assets has a moderate adverse impact determination.

The Project has the potential to impact the setting of cultural heritage assets. Section 18 of this report states that the most significant landscape impact will occur during the construction and widening of access roads to the adits and dams and the construction of the various new buildings, colony and facility areas. Monuments 35 and 36 are located within 250 m of a proposed contractor colony area, facility area and access road on the outskirts of Kveda Bzubzu village. Monument 35 is a bridge designated as a monument of national importance (Appendix H) which has probably been recorded with an incorrect grid reference as the grid reference does not show it near a river, however the bridge is shown on aerial photographs located directly adjacent to the proposed facility area. This will have a direct impact on the visual setting of the bridge and a minor adverse impact determination. The site of the new facility area is located on a shallow slope on Adjaristsqali and therefore it will be highly visible in all directions.

17.4.3 Decommissioning

Decommissioning the project will have no impact upon the cultural heritage resource because the activities associated with decomissionig will be confined to areas previously impacted during the construction phase of the Project. The construction phase of the project will either have removed all previously unrecorded and/or buried cultural heritage assets in those areas, or in the case of the discovery of nationally and internationally significant cultural heritage assets during the construction phase they might be subjected to preservation *in situ* in which case the Project will have been altered in order to avoid damage to these sites and as such decommissioning will have no impact.

17.4.4 Cumulative Impact

There will be no cumulative impact on the cultural heritage resource.

17.5 Mitigation and Enhancement Measures

17.5.1 Overview

Mitigation measures will comply with those recommended in the IFC Performance Standard 8 and the EBRD PR 8: Cultural Heritage. i.e. preservation *in situ* will be achieved where possible by avoiding identified cultural heritage assets and where this is not possible a suitable mitigation strategy will be proposed in order to minimise disturbance to the cultural heritage resource and to preserve the resource by record should there be no available alternative.

The proposed scheme is largely located within the heavily forested and hilly landscape of the Adjaristsqali River and its tributaries. Modern settlement and farmland is mainly situated along the valleys and on plateaux, it is highly probable that the modern settlement pattern reflects that of the past and cultural heritage assets associated with settlement are likely to be confined to these areas.

Within the wooded areas root disturbance is likely to have considerably disturbed the preservation of any potential cultural heritage assets. Human activity has been recorded in cave systems along many of the Georgian rivers and it is therefore possible that should similar cave systems exist along the Adjaristsqali and its tributaries, they might have been used as shelter or settlement for prehistoric and historic groups.

Tunnel settlement and vibration has the potential to have a slight impact upon cultural heritage assets within the surrounding landscape. It is recommended that cultural heritage assets located along the line of the new tunnels are monitored at stages during and after their excavation.

There are six recorded cultural heritage assets located within 200 m of the Project and which have the potential to be affected, in particular they have the potential to be affected should the size or location of the quarries, colony and facility areas be altered (Table 1.6). Four are located in Shuakhevi – Phase I of the scheme and the remaining four are situated within Khertvisi – Phase III. There are no cultural heritage assets located within 200 m of the Koromkheti – Phase II Scheme.

17.5.2 Generic Mitigation and Monitoring Measures

The scheme has been designed so as to limit the impact to cultural heritage assets, for example the historic stone bridges along the Adjaristsqali and its tributaries have been duly considered and submergence areas will be located away from these historic monuments.

In accordance with the Cultural Heritage Law of Georgia, an archaeological chance finds procedure will be developed for the construction phase. An outline chance finds procedure has been set out in the ESMP in Volume IV of the ESIA. This will be written into the contractor's Construction Environmental Management Plan.

The Autonomous Republic of Adjara Ministry for Education, Culture and Sport and the Department of Natural Resources, Historic Preservation Division (HPD) will be consulted prior to the commencement of any intrusive work.

17.5.3 Specific Mitigation Measures

The scheme will avoid disturbance of the known cultural heritage monuments presented in Table 17.4.

A 9th to 10th century bridge (MM 35) is located close to the proposed facility and contractor colony areas at the Khertvisi Dam site. The locations of these project components will be reassessed and if it is not possible to find a suitable alternative location advice will be sought during the detailed design of the proposed facility in order to minimise the the visual impact to the setting of the cultural heritage asset. It will not be possible to screen the proposed development and therefore the number of tall fences and walls will be limited, new buildings will be designed in sympathy with their surroundings and the use of concrete will be kept to a minimum.

Two stone bridges in the Khertvisi Phase III section of the Project are scheduled for rehabilitation. There is no indication of their date of construction. The date of their construction will be assessed prior to rehabilitation and should it be revealed that they are of historic origin they will rehabilitated in sympathy with their original construction method.

In order to ensure that no unrecorded graveyards are impacted by the Project a visual survey of the proposed areas will be undertaken during the detailed design stage.

17.6 Summary of Impacts, Mitigation and Residual Significance

The Project will have little impact upon the upstanding cultural heritage resource of the Adjaristsqali valley and its tributaries due to mitigation built into its design to avoid known cultural heritage assets.

The main impact to the potential buried cultural heritage resource will be through the shallower groundworks presented in Section 17.4.1 above. An archaeological chance finds procedure will be implemented throughout the development in accordance with Georgian national legislation.

The table below presents information of the impact, mitigation and residual significance of the proposed Scheme.

17.6.1 Residual Impacts

Table 17.6: Summary of Key Significant Impacts and Mitigations

Activity	Potential Impact	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual Significance
Road widening	Disturbance or damage to previously unrecorded and or buried cultural heritage assets.	Medium	Major	Major	A chance find strategy will be in action across the scheme during all groundworks, with the exception of tunnelling involving drill and blast or TBM methods. Any archaeological finds and sites will be reported immediately to the Georgian National Cultural Heritage Agency and to the Cultural Heritage Preservation Agency of Adjara.	Minor
Dam Construction	Disturbance or damage to previously unrecorded and or buried cultural heritage assets.	Medium	Major	Major		Minor
Reservoir construction/area submergence	Disturbance or damage to previously unrecorded and or buried cultural heritage assets.	Medium	Major	Major		Minor
Tunnel and adit excavation	Sites 1, 2, 69, 71	Low	Negligible	Insignificant	None – the tunnel will be excavated well below the archaeological level.	Insignificant
	Disturbance or damage to previously unrecorded and or buried cultural heritage assets.	Medium	Major	Major	A chance find strategy will be in action across the scheme during all groundworks, with the exception of tunnelling involving drill and blast or TBM methods. Any archaeological finds and sites will be reported immediately to the Georgian National Cultural Heritage Agency and to the Cultural Heritage Preservation Agency of Adjara.	Minor
Construction facilities area including new industrial and residential buildings	Impact on setting of Sites 35 and 36	Low	Minor	Insignificant	Mitigation to include either relocation or sympathetic design.	Minor
	Disturbance or damage to previously unrecorded and or buried cultural heritage assets.	Medium	Major	Major	A chance find strategy will be in action across the scheme during all groundworks, with the exception of tunnelling involving drill and blast or TBM methods. Any archaeological finds and sites will be reported immediately to the Georgian National Cultural Heritage Agency and to the Cultural Heritage Preservation Agency of Adjara.	Minor

Activity	Potential Impact	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual Significance
Colony sites providing housing and amenities for scheme workers and their families	Impact on setting of Sites 35 and 36	Low	Minor	Insignificant	Mitigation to include either relocation or sympathetic design.	Minor
	Disturbance or damage to previously unrecorded and or buried cultural heritage assets.	Medium	Major	Major	A chance find strategy will be in action across the scheme during all groundworks, with the exception of tunnelling involving drill and blast or TBM methods. Any archaeological finds and sites will be reported immediately to the Georgian National Cultural Heritage Agency and to the Cultural Heritage Preservation Agency of Adjara.	Minor
Construction of offices	Impact on setting of Sites 35 and 36	Low	Minor	Insignificant	Mitigation to include either relocation or sympathetic design.	Minor
	Disturbance or damage to previously unrecorded and or buried cultural heritage assets.	Medium	Major	Major	A chance find strategy will be in action across the scheme during all groundworks, with the exception of tunnelling involving drill and blast or TBM methods. Any archaeological finds and sites will be reported immediately to the Georgian National Cultural Heritage Agency and to the Cultural Heritage Preservation Agency of Adjara.	Minor
Spoil deposition	None	Negligible	Negligible	Negligible	None	Insignificant
Construction of project headquarters (located in Koromkheti Phase II area)	Disturbance or damage to previously unrecorded and or buried cultural heritage assets.	Medium	Major	Major	A chance find strategy will be in action across the scheme during all groundworks, with the exception of tunnelling involving drill and blast or TBM methods. Any archaeological finds and sites will be reported immediately to the Georgian National Cultural Heritage Agency and to the Cultural Heritage Preservation Agency of Adjara.	Minor
Provision of utilities including, telecommunications, water and electricity, possibly requiring the excavation of small service trenches	Disturbance or damage to previously unrecorded and or buried cultural heritage assets.	Medium	Medium	Moderate		Minor

Activity	Potential Impact	Sensitivity Score (Conservation value)	Magnitude Score	Impact Significance	Mitigation	Residual Significance
Quarry excavation	Disturbance or damage to previously unrecorded and or buried cultural heritage assets.	Medium	Major	Major		Minor
Stone bridge rehabilitation	Disturbance or damage to potentially previously unrecorded cultural heritage assets	Medium	Minor	Minor	The two stone bridges will be assessed for date and cultural heritage significance prior to any rehabilitation. Should they be significant the rehabilitation will either be conducted in keeping with the stone structures or an alternative route will be sought.	Minor

17.7 Proposed Monitoring and Reporting

A chance find strategy will be implemented across all three phases of the scheme during all groundworks, with the exception of tunnelling involving drill and blast or TBM methods. Any archaeological finds and sites will be reported immediately to the Georgian National Cultural Heritage Agency and to the Cultural Heritage Preservation Agency of Ajara. The main contractor will be responsible for actioning this.

17.8 Statement of Significance and Compliance

There is an overall moderate potential for the impact of cultural heritage assets throughout the three development phases. The Project will not impact recorded cultural heritage assets as it has been designed to avoid known assets, however there is a moderate potential for the Project to disturb previously unrecorded and or buried heritage assets. The implementation of the chance finds procedure will reduce the residual impact upon previously unrecorded cultural heritage assets to minor. There are no recorded archaeological investigations along the Adjaristsqali valley and its tributaries and as such the buried cultural heritage resource is untested, however it is likely that any archaeological remains will be located in low-lying, relatively flat areas along the valley sides, in areas that are currently settled.

The chance finds procedure which will be implemented through the development complies with the Georgian Cultural Heritage Law, the guidance set out in IFC section 8 on Cultural Heritage and Section 8 of the EDRB guidance on Cultural Heritage.

18. Landscape and Visual Amenity

18.1 Introduction

This chapter describes the potential impacts of the construction and operation of the Project upon the existing landscape character and visual amenity of the area and sets out available mitigation measures to minimise the impact of the Project.

18.1.1 General Approach

It is common to use a zone of visual influence (ZVI) in calculating visual impact. This is defined as the extent of potential visibility to or from a specific area or feature.

Characteristics of the proposed Project including the large scale, the number of components requiring different ZVIs, the valley terrain affecting views, accessibility issues affecting some areas and a lack of access roads, created difficulties in identifying the real extent of a meaningful ZVI. To address the potential impacts on visual amenity for the purposes of the Project therefore, the indicative spatial scope has been defined as a maximum area of approximately 1-2 km from the proposed dam sites, new roads and powerhouses. This will be referred to as the Project area of influence for the purposes of this Chapter.

The Environmental and Social Impact Assessment (ESIA) commenced in 2011 with an overview of the existing baseline landscape conditions. The initial site visits were conducted in June 2011 with trees in full leaf. The assessment has considered visual impacts during construction phase as well as the operational phase, taking into account changes in landscape at different times as result of the Project (refer to Chapter 2 for a detailed description of the Project programme).This assessment does not cover the proposed upgrading and/or new as these will be the subject of a separate landscape assessment as part of the ESIA undertaken by the Georgian State Electric System (GSE).

18.2 Methodology and Assessment Criteria

18.2.1 Legislative Background

The relevant international guidelines for this Project are those set out by EBRD and the IFC. While neither set of guidelines refer specifically to landscape and visual impacts, both have guidelines (EBRD's PR8 and IFC's PS8) on cultural heritage which specifically include consideration of unique natural features and landscapes that embody cultural values. The following summarises the objectives of both EBRD and IFC standards:

- Protect cultural heritage from adverse impacts of project activities;
- Promote equitable sharing of benefits from use of cultural heritage;
- Support conservation of cultural heritage in context of project financing; and
- Promote awareness of and appreciation of cultural heritage where possible.

EBRD and IFC also state that protecting landscapes is also important due to their role in maintaining biological diversity.

In addition to consideration of the above objectives, this assessment has been carried out in accordance with the European Landscape Convention developed by the Council of Europe (ETS 176, Florence 2000), the aims of which are '*to promote landscape protection, management and planning, and to organise European co-operation on landscape issues*'. This was the first international convention to focus specifically on landscape. The Convention has not been signed by the Georgian government since it is not part of Europe, but in the absence of international guidelines on landscape applying to Georgia it is reasonable to apply the principles set out in the Convention. It is particularly relevant as the Project is in close proximity to the border with Turkey who signed the Convention in 20 October 2000. The Convention acknowledges '*that the landscape is an important part of the quality of life for people everywhere: in urban areas and in the countryside, in degraded areas as well as in areas of high quality, in areas recognised as being of outstanding beauty as well as everyday areas*'. The recognition that all landscapes are potentially important, irrespective of location or condition, has been considered in the planning of this Project with respect to the assessment of landscape effects. It is also recognised that protecting landscapes is an important part of maintaining biological diversity. Consideration of changes to landscapes as a result of land use changes and potential impacts on biodiversity are covered in Chapter 8.

The assessment of landscape and visual effects are separate but linked procedures. Landscape is assessed as an environmental resource and visual effects are considered as one of the interrelated effects on population, as defined in Article 3 of the European Directive on environmental assessment (85/337/EEC). Both aspects have been considered in this assessment.

The following activities have been included in the landscape and visual effects assessment for the Project:
- Allocation of values to the landscape features;
- An assessment of the sensitivity of people exposed to the views;
- Determination of the magnitude of impact and the likely significance of the Project on the landscape and visual amenity of the area; and
- The identification of appropriate mitigation and or compensation as appropriate.

18.2.2 Assessment of Impact Significance

18.2.2.1 Determining Sensitivity and Magnitude

An appraisal of the landscape character and visual amenity has been undertaken through fieldwork and desk study to provide sufficient information against which to accurately predict levels of potential impact and assess the significance of such impacts.

The assessment methodology has been informed by the large scale of the proposed Project. The study area has been divided into broad landscape types characterised by similar features, such as:
- Undisturbed areas of remote wilderness;
- River landscape areas;
- Towns and populated areas; and
- Agricultural areas.

The landscape features likely to be affected by the Project have been evaluated in relation to their value and sensitivity to change in order to help assess the relative significance of the landscape impacts associated with the development. The assessment evaluated the value and sensitivity to change of the landscapes potentially affected by the Project according to the criteria set out in Table 18.1.

Table 18.1: Criteria for Assessing Landscape Value

Potential Value	Typical Descriptors and Examples
High	Landscapes which by nature of their character, quality and recognised value could be sensitive to change, and could not be substituted. Typically these would be of high quality and likely to be designated, but this value may also be present outside designated areas, especially at the local scale.

Potential Value	Typical Descriptors and Examples
Medium	Landscapes which by nature of their character, quality and value would be moderately sensitive to change, with some features or elements that could be substituted. Typically these would be fairly commonplace, but maybe locally designated, or their value may be expressed through non-statutory local publications.
Low	Landscapes which by nature of their character, quality and value may not be particularly sensitive to change, and which could be substituted or improved. Typically these would be partly degraded or damaged landscapes which are not designated.
Negligible	Landscapes which by nature of their character, quality and value are unlikely to be sensitive to change, and which could be easily substituted or improved. Typically these would be degraded landscape areas containing few, if any, apparent features of value.

Source: Mott MacDonald

The assessment evaluated the sensitivity of visual receptors to a change in their view according to the criteria set out in Table 18.2.

Table 18.2: Criteria for Assessing Visual Sensitivity

Sensitivity	Typical Examples
High	Occupiers of residential properties and associated outdoor areas (e.g. gardens, courtyards). Users of nationally protected areas, recreational scenic trails or users of designated tourist routes.
Medium	Workers in predominately outdoor professions (e.g. farmers and horticulturalists). Users of secondary or minor roads in scenic areas, schools and outdoor recreational areas (e.g. sports grounds).
Low	Workers in predominately indoor professions (e.g. factories and offices). Users of main roads or passengers in public transport on main arterial routes.
Negligible	No receptors

Source: Mott MacDonald

The magnitude of impact of the Project on the landscape and visual amenity of the area have been categorised using the criteria in Table 18.3.

Table 18.3: Criteria for Assessing Magnitude of Impact

Magnitude of Impact	Typical Criteria
Major Adverse	Total loss or large scale damage to existing character or views, and/or the addition of new but uncharacteristic conspicuous features and elements.
Moderate Adverse	Partial loss or noticeable damage to existing character or views, and/or the addition of new but uncharacteristic noticeable features and elements.
Minor Adverse	Slight loss or damage to existing character or views, and/or the addition of new but uncharacteristic features and elements.
Negligible / No Adverse	Barely noticeable loss or damage to existing character or views / No noticeable loss, damage or alteration to character or views.

Source: Mott MacDonald

18.2.2.2 Assigning Significance

The significance has been determined by the interaction between the magnitude of impacts and the sensitivity of receptors affected (refer to Section 5.4), as depicted in the significance matrix in Section 5.4.3.3.

18.2.3 Data Limitations

In undertaking the Landscape and Visual Impact Assessment (LVIA) the following assumptions have been made:

- The baseline data for some sections of the proposed development has been taken from available aerial photography of the valley and photographs taken during site visits; and
- Given the scale of the Project and its linear character, it has been assumed that illustrating the Project area of influence with photomontages is not appropriate at this stage.

18.2.4 Landscape and Visual Consultation Requirements

Local consultation has taken place with municipality heads, communities and NGOs. There is no legal requirement in Georgia to specifically consult at scoping stage with any government bodies. Refer to Chapter 6 for a summary of consultation activities.

18.3 Baseline Description

18.3.1 Overview

The Project consists of three schemes located within four different municipalities along a 90 km stretch of river valley. The Project extends from the confluence of the Adjaristsqali River and the Chorokhi River in the west to the confluence of the Adjaristsqali River and Ghorjomi River in the east. The area is largely rural with main towns limited to Khulo, Shuakhevi and Keda. The Project consists of five dams (Skhalta 22 m high; Didachara 39 m, Khichauri 19 m, Chvanistsqali 10 m and Khertvisi 8 m), three weirs, three main powerhouses, 70 km of tunnel, and approximately nine new access roads of around 1 km in length.

The Didachara, Khichauri and Khertvisi dams are on the Adjaristsqali River and the additional Project infrastructure will be constructed on five important tributaries thereof:

- The Skhalta River to the south east of the Project area of influence where a 22 m dam is proposed;
- The Chirukhistsqali River, to the west of the Skhalta River, where a small 3 m weir is proposed;
- The Chvanistsqali River to the north east of the Project area of influence, where a low dam of 10 m is proposed immediately upstream of its confluence with the Adjaristsqali River;
- The Akavreta River south of Keda where the 5 m weir is proposed; and
- The Machakhlistsqali River at the south western end of the scheme where a 5 m weir is proposed.

Refer to Chapter 2 for information on the location of Project sites and associated infrastructure. The baseline description within this sub-section provides information regarding the landscape character and visual amenity within the Project area of influence.

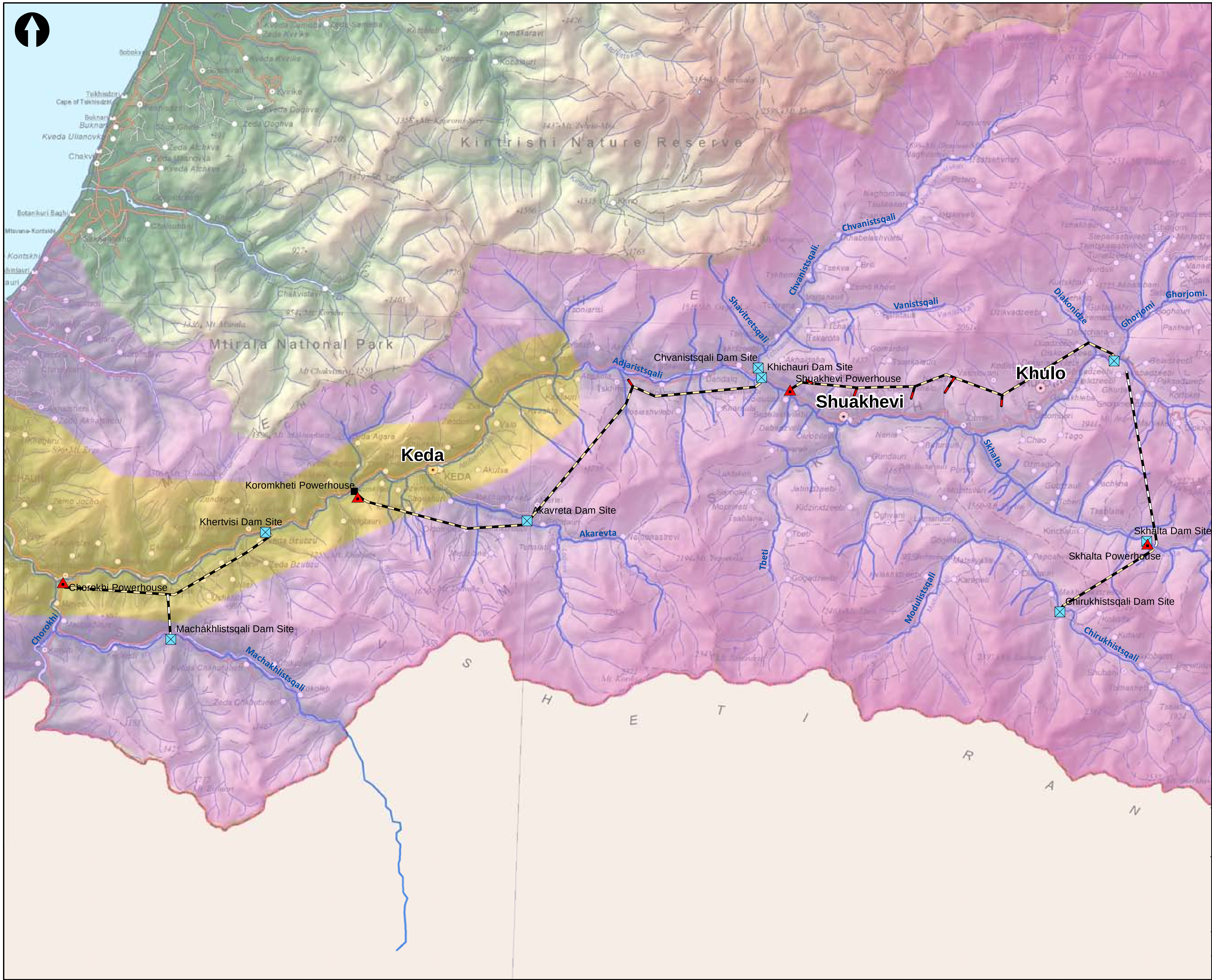
18.3.2 Landscape Character

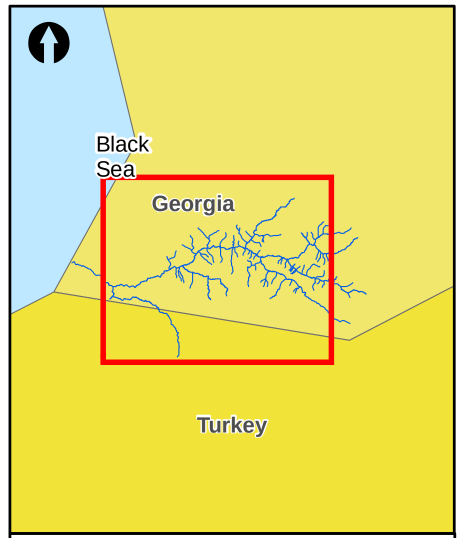
18.3.2.1 Overview

The existing landscape consists of steep wooded slopes running down to the wide braided gravel watercourses of the Adjaristsqali and Skhalta Rivers and narrower rocky tributaries. This basic terrain varies in terms of slope steepness, extent of farming and housing development and remoteness. Site observations have confirmed that the downstream reaches of the Adjaristsqali River have the shallowest slopes and are the most developed whilst the upstream reaches of all the rivers are the least developed and most continuously forested.

Very broadly the landscape character falls into two values:

- ‘High Value’ on the Adjaristsqali River upstream of the town of Khichauri, the Skhalta River, and on the tributaries of the Chirukhistsqali, Chvanistsqali, Akavreta and Machakhlistsqali Rivers. In addition there is a section of high quality landscape on the Adjaristsqali where it flows through a steep gorge immediately downstream of the village of Khichauri. This high value is a function of the relative lack of development, unspoiled forest cover, wilderness quality and dramatic terrain; and
- ‘Medium Value’ on the downstream two-thirds of the Adjaristsqali River, west of the Khichauri gorge stretch and the most downstream/confluence areas of the tributaries. This is a function of the shallowness of slopes and relative density of development.





Location Map

Legend

Selected Towns

Landscape Quality

- High
- Medium

Tunnel Type

- Adit Tunnel
- Headrace Tunnel
- Transfer Tunnel

Structure

- Dam
- Powerhouse
- Tailrace Outlet

Coordinate System:
UTM Zone 38 North
WGS84 Datum

0 2 4 6 8 10 Km

Rev	Date	Description	Drawn	Ch'k'd	App'd
P1	17/01/2012	For Information	WJG	EMC	JP

Adjaristsqali Georgia LLC
1. Abashidze Street 6
6010 Batumi
Georgia

Mott MacDonald

Mott MacDonald House
8-10 Sydenham Road
Croydon, Surrey, CR0 2EE
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Project Title

Adjaristsqali Study Area

Drawing Title

Landscape Character Area

Scale @ A3	MM Project No.	Status
1:178,525	290039	PRE

GIS File
12012012_Landscape.mxd

Drawing No.
MMD-290039-ENV-LAND-00-00-0001

Rev
P1

18.3.2.2 High Value Landscape

The very wide upstream valleys of the Adjaristsqali and Skhalta Rivers consist of braided gravel channels across the entire valley floor from which rise steep heavily wooded slopes (see view of Skhalta valley, Figure 18.2 below). Deciduous moist forest on the valley sides is dominated by oak, sumach, rhododendron, hornbeam and beech. This deciduous forest grades into pine and spruce forest as the altitude increases. The terrain is rugged and the area is remote with relatively few houses or roads. Much of the aesthetic value of the easternmost reaches of the Project area of influence is afforded by the mountains many of which reach over 2,000 m in height, with Mount Kheva in Shuakhevi reaching 2,800 m.

Figure 18.2: View of Skhalta valley

Source: Mott MacDonald

Figure 18.3: View of Chvanistsqali valley

Source: Mott MacDonald

The smaller tributaries of the Chvanistsqali, Akavreta and Machakhlistsqali are equally attractive but in a different and gentler form. They contain riverside meadowland, walnut orchards, attractive vernacular farmhouses and in some places, notably on the Akavreta, dramatic riverside cliffs. The Chvanistsqali valley is shown in Figure 18.3. The damp meadows and woodland edges support wild colonies of many flowers long cultivated in European gardens: delphinium, monkshood, leopards bane and Campanula lactiflora. This vegetation is considered as too lush and full of stalk for good hay but acceptable as sileage. All these smaller rivers are clean and fast flowing over rocks and boulders and often overhung with lush vegetation.

18.3.2.3 Medium Value Landscape

The lower reaches of the Adjaristsqali River, which more generally relate to ‘Medium Value’ landscape, are still relatively wooded but the valley sides are notably shallower than in the upstream valley. Houses, roads, small power lines and farmland are much more frequent than in the upstream areas especially around the town of Keda and the villages of Vaio and Khichauri (view of Keda provided in Figure 18.4).

Figure 18.4: View of Keda

Source: Mott MacDonald

Figure 18.5: View of historic bridge near proposed Khertvisi Reservoir

Source: Mott MacDonald

There is one spectacular gorge on the lower Adjaristsqali River, downstream of Khichauri and a smaller rocky gorge upstream of the proposed Khertvisi reservoir. The upper of these areas near Khichauri village stands out as a pocket of 'High Value' landscape in contrast to the 'Medium Value' landscape immediately downstream of it.

There are at least five historic bridges on the Adjaristsqali River together with a number on the tributaries. None of them will be destroyed and nor is the landscape setting of any of them compromised (see view of bridge, Figure 18.5). One of the bridges is located approximately 1 km upstream of the proposed Khertvisi reservoir, which is too distant to have an impact on the setting of the bridge and would in any case not create a major intrusion on the landscape.

18.3.3 Visual Amenity

The visual baseline study identified a number of potential visual receptors (people with a view of the Project). Due to the winding nature of the valley, the number of Project components visible to people from a single location will be limited although a cumulative effect will occur if tourists travel the length of the valley in one trip.

The main visual receptors will be residents living in the Project area of influence. The region is in development as a tourist destination for people within and outwith Georgia and tourists are also considered receptors. The Machakhlistsqali valley in the south western part of the project area is proposed as a National Park and therefore of higher sensitivity. Potential receptors are listed with an assessment of sensitivity in Table 18.4 below.

Table 18.4: Sensitivity of Visual Receptors

Receptors	Sensitivity
Residents of the valleys of the Adjaristsqali, Skhalta, Chirukhistsqali, Chvanistsqali, Akavreta and Machakhlistsqali valleys.	Medium
Local people working in predominately outdoor occupations (such as farmers or herders).	Medium
Local people making recreational use of the landscape or tourists to the mountains, proposed national parks and valleys within the Project area of influence.	High

Receptors	Sensitivity
Road travellers through the area.	Low

Source: Mott MacDonald

18.4 Assessment of Impacts

This Section discusses landscape and visual amenity impacts of the various Project components and is divided into construction, operational and decommissioning phase impacts.

18.4.1 Construction Impacts

The landscape and visual impacts that may arise from the construction of the Project include works at the proposed dam and weir sites, tunnel faces, adits and powerhouses, and any associated works such as temporary or permanent access roads, spoil deposits quarries. The effects are likely to include:

- Removal of the existing vegetation;
- Temporary construction compounds and presence of plant and associated equipment;
- Localised light pollution;
- Excavation and cuts in hillsides from development of tunnel and adit portals, access roads and new permanent roads where the existing highway will be flooded by reservoirs;
- New quarries and/or reopening of old quarries which at the worst scenario could leave a permanent scar on the hillsides especially since, once opened, they are likely to continue in use; and
- Change in tranquillity of the surrounding landscape.

Activity Related Impacts on Landscape Character

Some of the construction phase impacts will be temporary in nature, such as views of construction workers, plant and operations. These may be visible from 1 km away but will only be a presence in the landscape for a three year period in any one location due to the phasing of construction. The magnitude of these impacts is considered to be minor adverse and the value of the landscape varies according to location, between high and medium value. The significance of the impact is determined also by the visual receptor, which according to Table 18.4 varies between low to high sensitivity. Overall, the significance of the temporary construction phase impacts are considered to be **moderate adverse**.

Physical Impacts on Landscape Character

There will be other landscape character changes caused during the construction phase which will be effectively permanent. These include quarries and cuts in the mountainside for the construction of roads, for tunnel faces and adits. There will also be permanent spoil disposal sites many of which are expected to be in the river bed which will be used throughout the tunnel boring and blasting process.

Potential quarry sites have been identified based on desktop review and site visits (refer to Chapter 11), but until detailed design and further investigations into the quality of materials available at these sites, it is not possible to determine the type, location or scale of quarrying. There may be excavations of gravel from the normally dry areas of the river bed/floodplain in which case they will soon fill in again at times of flood and not create any adverse visual impact. On the other hand some blasting for rock from the mountain sides may be necessary especially if there is a mismatch in programme timing between availability of rock from tunnel boring and need for it for use in the construction of dams and weirs. The Project will aim to use as much of the tunnel excavation materials as part of the dam civil works which will reduce the need for both quarrying and spoil disposal. If this is not possible, initial investigations indicate that a number of quarries may be developed from river margins and valley sides.

Large quarries, if they are necessary, may have a visual envelope of at least 2 km especially from the opposite sides of the valleys and in the most downstream areas where the valleys are more open, but the landscape value is lower.

Where tunnel spoil cannot be used in construction it will be deposited in specifically designated spoil disposal sites, up to a total of 14 (see Chapter 12 for details). Many of these are expected to be in the river bed and the impact on the landscape character will depend largely on the amount of spoil deposited at each site and whether the colour and type of rock making up the spoil matches with that in the river bed.

Access roads, tunnel faces and adits will necessitate the clearing of vegetation for their construction. The access roads to remote sites will be entirely new and potentially permanent, for example if they are maintained by the municipalities or required for maintenance during operation. Access roads typically ascend and descend valley sides in a series of hairpin bends. Figure 18.6 illustrates how the access roads may look immediately after construction. The tunnel faces and adits during the construction phase will be obvious cuts into the mountainsides, many of which are likely to be visible to residents, especially those on opposing sides of the valleys. For all of these features during the construction phase there will be an impact on vegetation, as additional areas will be cleared around the feature to provide a working area.

Figure 18.6: Typical view of access road up steep valley side, soon after construction

Source: Mott MacDonald

The physical impacts are considered to be adverse of moderate magnitude as they will be noticeable but not all seen at the same time due to the nature of the valley's geomorphology and geometry. Given the medium to high value of the landscape character, this will result in a worst case significance of **major adverse**, where there are changes to the landscape such as quarrying or roads.

18.4.2 Operational Impacts

18.4.2.1 Overview

It has been identified that there is the potential for there to be operational landscape and visual impacts, which will vary in significance according to their location within areas of High or Medium Landscape value as defined in section 0 above. The following operational phase and permanent project features have been identified as likely to have an impact:

- Permanent removal of the existing vegetation;
- Creation of reservoirs causing changes to the environmental setting;
- Dam and weir structures crossing perpendicular to the natural valley contours;
- Tunnel access portals;
- Reduced river flows; and
- Cumulative impacts.

The long views down valleys of the larger dam structures (Didachara, Skhalta and Khichauri) could be visible for as much as 2 km, but typically bends in the valley will cause the dams and reservoirs to fall out of sight rapidly and therefore may only be visible for 500 m or less. The dams and reservoirs may be more visible from higher elevations and mountain tops, but there are very few receptors at higher elevations with direct views into the steeper valley. The large dams will either be grey concrete structures or constructed of local rock materials. The reservoirs behind the dams will have a less adverse visual impact since they will resemble natural lakes in the valley bottom although with a 10 m drawdown they will not have a fledge of natural green vegetation along their margins. The smaller intakes which are typically 3-5 m high will be low weirs across the rivers with no reservoirs and will soon fall out of sight with a bend in the river. Two of the schemes will have a surface powerhouse of approximately 2-3 storeys high and each powerhouse will have a switchyard, all of which will be noticeable.

The reduction of flow on a number of sections of river as the water is diverted down an adjacent tunnel will mean that in late summer and mid winter what was previously a full river will consist predominantly of exposed rock and gravel. In other places however, there is a wide river bed which has only a limited channel full of water at any one time and the reduction of flow in these places is likely to be less noticeable.

Finally it is also normal to assess the visual impact in terms of significant receptors. In this context these will include houses, towns and villages, notably Keda, Khichauri and Vashovani where these receptors have significant views of the major infrastructure components. There will also be significant views from the main roads up the valley especially the Batumi-Akhaltsikhe highway. Where this road runs along the left bank of the Chirukhi valley in the vicinity of the proposed Chirukhi weir it climbs to gain spectacular views of high forested mountains. However in this particular location the impact of the engineering is comparatively low.

The most significant impacts are likely to be the new access roads and the five main dams.

18.4.2.2 Roads

The roads will have a large footprint as they will zig-zag up the valley sides. They may create erosion which could need to be reinforced with concrete and rip-rap, or this could possibly be done with planting. It is expected that much of the area to the sides of the replacement main road and access roads will green over in approximately 5 years so that the impact is less than in the construction phase. However, there are five new feeder roads which are still expected to have a moderate adverse impact. This is due to the high landscape value and, although there will be greening over of the roads, an impact of minor magnitude is forecast. The access roads will be visible to a variety of receptors including those with high and low sensitivity and so the overall impact is considered to be **moderate adverse**.

18.4.2.3 Dams

The impact of the dams will be largest for those located in the Project area of influence classified as being of high value,, namely the Skhalta (21 m), Didachara (36 m), Khichauri (17 m) and Chvanistsqali (10 m) dams. Other dams and/or weirs, that are lower, will have a less significant impact. The dam locations with a very approximate indication of dam or weir crest are illustrated in Figures 18.6 to 18.14 with the impact of each dam assessed separately.

Skhalta Dam

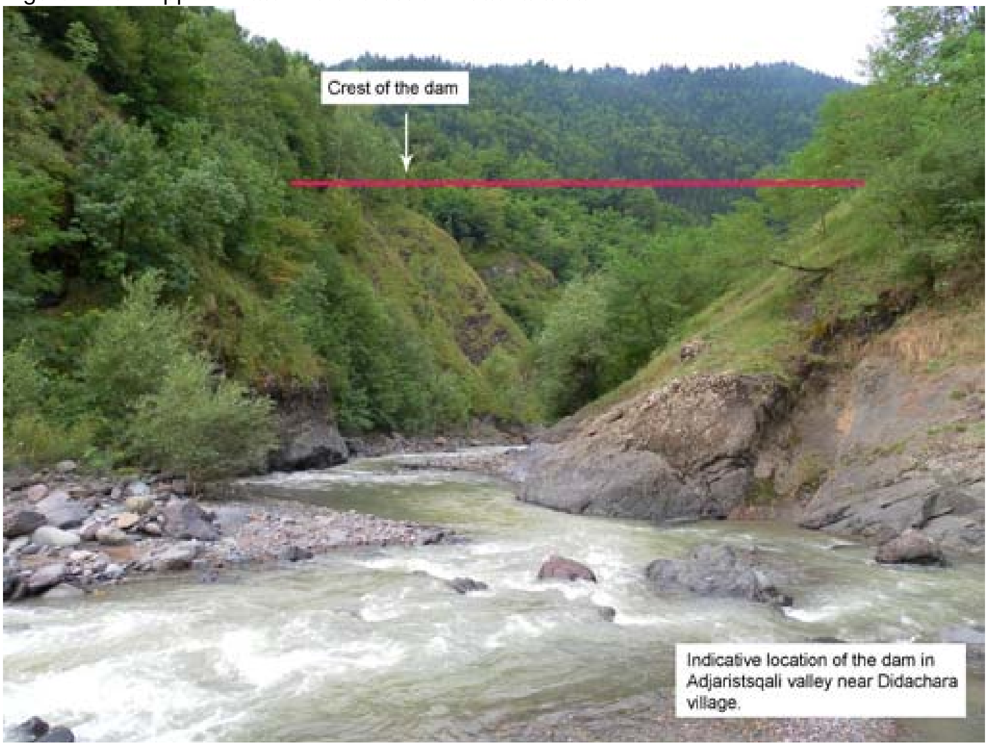
As is shown in Figure 18.7, the Skhalta Dam crosses a very wide braided river bed with dramatic forested mountain slopes coming straight down to the water's edge. It will be visible for a long way down the valley. There will be a slight loss of the existing landscape character but one of the additional features added will be a lake which will appear to be largely natural, so the magnitude of the impact is considered to be moderate. In this landscape of high value, the resulting impact of the Skhalta dam and reservoir on the landscape character will be **major adverse**. Skhalta will have a limited number of sensitive receptors so it is thought that the visual impact will be **minor adverse**. The overall impact significance will be **major adverse**.

Figure 18.7: Approximate line of crest of Skhalta dam

Didachara Dam

Didachara dam is shown in Figure 18.8. It is located on a relatively narrow rocky stream in a less dramatically high valley than the Skhalta dam but still within steep rocky and forested cliffs. The Didachara dam will be the highest dam in the Project, at 36 m. The landscape is considered to be of high value and the magnitude of the impact is moderate adverse resulting in a landscape character impact significance of **major adverse**. In the vicinity of Didachara dam there are a large number of residential receptors who will have views of the dam and reservoir although the dam and reservoir will be obscured further down the valley since the river bends quickly out of sight resulting in a **moderate adverse** visual impact. The overall significance is concluded to be **major adverse**.

Figure 18.8: Approximate line of crest of Didachara dam

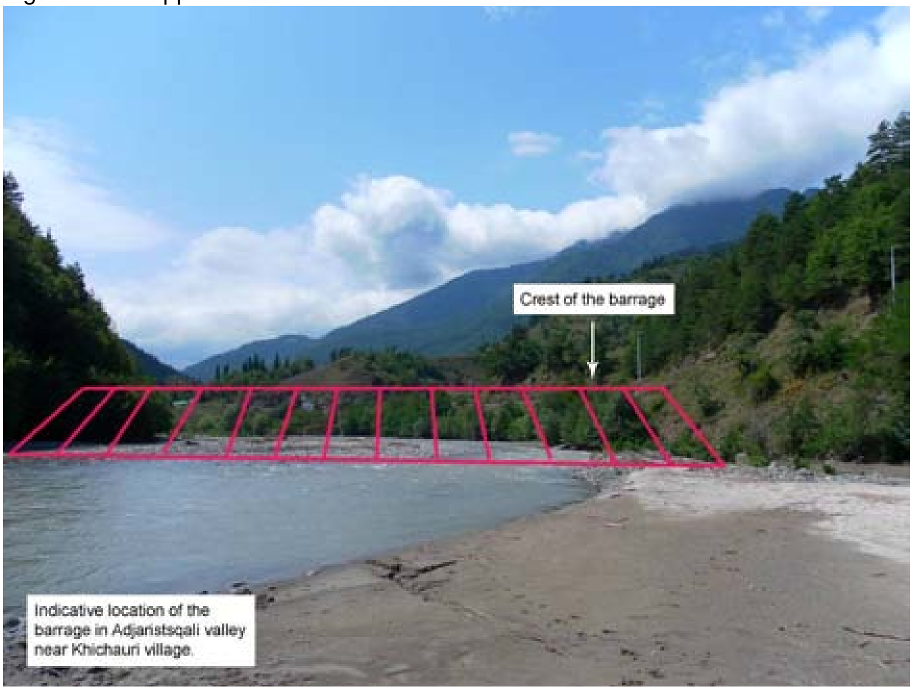


Source: Mott MacDonald

Khichauri Dam

Khichauri dam, shown in Figure 18.9, crosses a wide river bounded by relatively shallow but wooded slopes on the right bank and steeper slopes on the left bank. The landscape value at this location is classified as high and the magnitude of the impact of the dam and reservoir is considered to be moderate adverse, resulting in a **major adverse** impact significance on landscape character. As there are relatively few residential properties in this area, the impact of Khichauri dam and reservoir on visual receptors is considered to be **minor adverse**. The overall significance is concluded to be **major adverse**.

Figure 18.9: Approximate line of crest of Khichauri dam

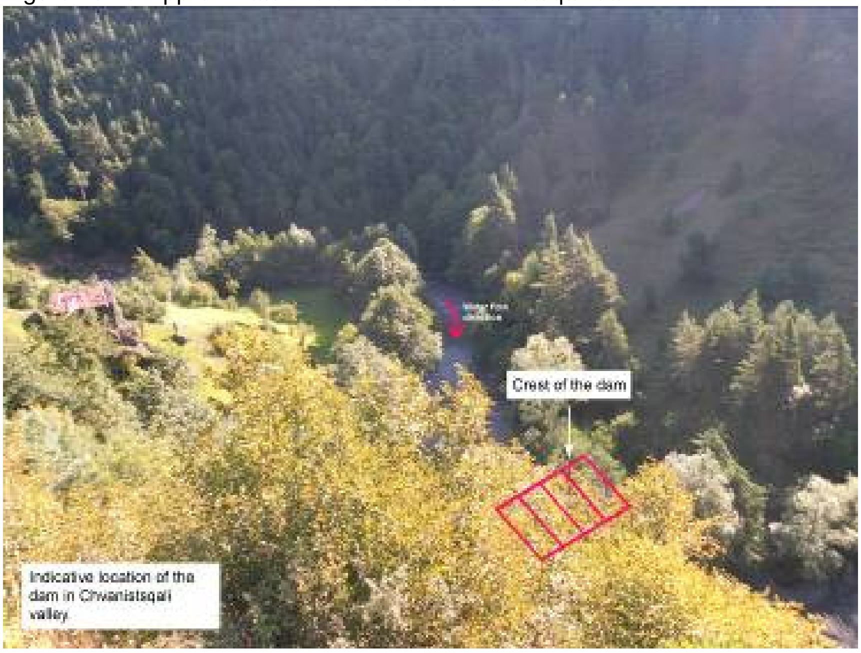


Source: Mott MacDonald

Chvanistsqali Dam

Chvanistsqali dam which is 10 m high, shown in Figure 18.10 is in a steep and relatively narrow gorge on a tributary of the Adjaristsqali. The landscape value in this location is considered to be of high value and the impact is moderate in magnitude. The impact on landscape character is therefore considered to be **major adverse**. There are few residential receptors that will be able to see the dam, resulting in a **moderate adverse** visual impact. Overall the significance is concluded to be **major adverse.**

Figure 18.10: Approximate line of crest of Chvanistsqali dam



Source: Mott MacDonald

Khertvisi Dam

Khertvisi dam, which will be 8 m in height, is shown in Figure 18.11. It is within the area classified as medium landscape value. The magnitude of the impact of the dam and reservoir is predicted to be moderate adverse as the dam is relatively low so the impact significance on landscape character will be **moderate adverse**. There are a number of residential receptors in the area so the visual impact is predicted to be **minor adverse**, and the overall impact is concluded to be **moderate adverse**.

Figure 18.11: Approximate line of crest of Khertvisi barrage

Source: Mott MacDonald

Chirukhistsqali Weir

Chirukhistsqali weir, shown in Figure 18.12, is in a relatively narrow stream through alder trees. The landscape value in this location is high. The weir will be only 3 m in height and there will be no reservoir. The magnitude of the impact is considered to be minor resulting in a **moderate adverse** impact on landscape character. There are few residential receptors so the visual impact is predicted to be **minor adverse**. The overall impact of the Chirukhistsqali weir is therefore concluded to be **moderate adverse**.

Figure 18.12: Approximate line of crest of Chirukhistsqali weir

Source: Mott MacDonald

Akavreta Weir

Akavreta weir, shown in Figure 18.13, is in an intimate valley with forested cliffs and meadows. The landscape value here is considered to be high due to the steep cliff on one bank of the river. The weir will be only 3 m in height and there will be no reservoir. The magnitude of the impact is considered to be minor resulting in an impact on landscape character of **moderate adverse**. Due to the cliffs it will not be visible to many receptors resulting in a negligible impact on visual receptors. The overall impact of the Akavreta weir is therefore concluded to be **moderate adverse**.

Figure 18.13:Approximate line of crest of Akavreta weir

Source: Mott MacDonald

Machakhlistsqali Weir

Machakhlistsqali weir will be 5 m in height and its location is shown in Figure 18.14. It will be in a tumbling rocky river with farmed meadows on one side and wooded cliffs on the other. The landscape character in this area is classified as high and the impact magnitude is considered to be minor resulting in a **moderate adverse** impact on landscape character. There are few visual receptors resulting in a **minor adverse** visual impact. The overall significance of the impact is therefore concluded as being **moderate adverse**.

Figure 18.14:Approximate line of crest of Machakhlistsqali weir

Source: Mott MacDonald

18.4.3 Decommissioning

The Project is likely to be rehabilitated to extend its life rather than decommissioned. The activities during rehabilitation will cause a temporary disruption to the visual amenity of the landscape.

If the Project is decommissioned, there will also be de-construction activities which will cause a temporary disruption to the visual amenity of the landscape. As the Project is likely to become an inherent part of the landscape over its lifetime, any decommissioning will have to take into consideration removal of the structures so that no further significant changes to the landscape occur. As part of this, the flow of the river will need to be reinstated in order to limit any potential of the reservoir filling with sediment and causing an undesirable change to the landscape. The overall impact on landscape character and visual amenity at decommissioning is considered to be minor adverse with the residual impact after decommissioning being moderate beneficial impact.

18.4.4 Cumulative Impacts

On the Chirukhistsqali River, upstream of this Project's Chirukhi weir there is an HPP under construction. Due to the bends in the river valley in this location, there is not expected to be a cumulative impact as a result. There is a planned ski resort in the Chvanistsqali valley so there will be a number of new receptors which are of high sensitivity, although their primary reason for visiting will be sports, not scenery.

There is also a proposed new hydropower scheme on the Choroki River immediately downstream of the Khertvisi power cavern but since this is in the most developed part of the Adjaristsqali valley within an area of medium landscape value they should not worsen the impact of this Project's proposals in the area to more than the current assessed impact.

18.5 Mitigation and Monitoring Measures

18.5.1 Approach to Landscape and Visual Mitigation

18.5.2 Overview

Areas of sensitive landscapes have been considered as part of the site identification process and avoided where possible. Iterative design has eliminated a large number of proposals in tributary valleys in sensitive locations. Waste rock from excavations is proposed to be put in river beds where the impact will be as low as possible and sympathetic traditional design is proposed for power houses. The scale of the proposed Project implies that tree planting or earth bunds would not be appropriate measures to mitigate the impacts of the dams on landscape character and visual amenity of the surrounding areas, however the below section discusses areas where localised vegetative screening may provide mitigation opportunities.

18.5.3 Mitigation Measures

The following specific mitigation measures have been applied to the landscape and visual aspects of this Project and have been or will be integrated into the design:

- **Iterative design in relation to selection of final dam and weir locations** - This is arguably the most important mitigation in relation to landscape. As outlined in the description of the landscape baseline many of the tributary valleys of the Adjaristsqali contain some of the most attractive and least developed landscapes. At an early stage six of the higher intakes proposed on tributary valleys in the areas of high landscape value were eliminated from the Project. As part of the iterative design process, six additional intakes from small high tributaries and in areas of high value landscape were dropped from the Project. This has been a very beneficial mitigation incorporated into the Project design process.
- **Iterative design in relation to design of final dams, weirs, power houses and roads** - Iterative design between engineers and landscape architects in relation to roads, dams, weirs and other structures will take place in relation to precise footprint and ground shaping. The power houses will be built to resemble the existing riverside power house at Asti which resembles a pink-washed traditional house (see Figure 18.15 showing Asti power house.)
- **Disposal of rock waste from tunnel** - If at all possible the rock waste from the tunnel will be disposed of within the river beds which will therefore disguise the waste to the greatest extent possible as well providing mitigations to the potential biodiversity impacts.
- **Tree and shrub planting** - There will be opportunities to carry out tree planting and encourage natural regeneration on all new cuttings and exposed hillsides which have been created by roads, tunnel faces and adits. Species might include oak, beech, hornbeam, alder and native climbers such as *Hedera colchica.* A landscape planting strategy will be developed in consultation with the forestry authority and local landowners and will set out to reduce erosion problems near proposed structures. The project budget will include sufficient budget to meet the planting requirements set out in the landscape planting strategy. Newly planted areas will also be fenced off from grazing cattle and other animals. The landscape planting strategy will be linked to the proposed biodiversity planting strategy. In some places, where permanent access is needed for maintenance of tunnels, the cuttings will be tarmaced over to prevent re-growth and maintain accessibility.

Figure 18.15:View of the existing Asti power house

18.6 Summary of Impacts, Mitigation and Residual Significance

The main visual impacts will be the dams and creation of new reservoirs, new access roads, lower water flows on certain sections of rivers, powerhouses, any quarries and spoil disposal sites, and construction impacts. The greatest impacts will be from the new dams, particularly the three largest ones, and from the new roads constructed to the adits.

Table 18.5 sets out the impacts identified within this Chapter, and their significance. It also sets out appropriate mitigation measures and identifies the residual significance of impacts.

18.6.1 Residual Impacts

Table 18.5: Summary of Key Significant Impacts and Mitigations

Activity	Potential Impact	Sensitivity Score (Conservation value)	Magnitude Score	Sensitivity of visual receptors	Impact Significance	Mitigation	Residual Significance
Construction phase							
Construction activities	Visibility of workers, plant and operations	High – medium dependent on location	Minor adverse	Low to high	Moderate adverse	Construction sites to be kept tidy. Clause in contractual documentation passing responsibility onto Contractors.	**Minor adverse**
Cutting mountainside for roads, tunnels and adits	Loss of vegetation, visible rock faces and earth	High – medium dependent on location	Moderate adverse	Low to high	Major adverse	Clearing of vegetation around construction sites to be minimised. Landscape planting strategy to identify appropriate re-vegetation.	**Moderate adverse**
Operational phase							
Maintenance of access roads	Large visible footprint of road and potential for erosion which would need to be reinforced.	High	Minor adverse	Low to high	Moderate adverse	Planting of trees in strategic locations to hide road from view on opposing side of valley.	**Minor adverse**
Operation of Skhalta dam and reservoir	Visible dam and reservoir, loss of vegetation in reservoir, exposure of dry river margins or stretches.	High	Moderate adverse	Sensitive receptors will be limited in number, low to medium sensitivity	Major adverse	Landscape planting strategy with appropriate re-vegetation	**Moderate adverse**
Operation of Didachara dam and reservoir	Visible dam and reservoir, loss of vegetation in reservoir, exposure of dry river margins or stretches.	High	Moderate adverse	High	Major adverse	Landscape planting strategy with appropriate re-vegetation	**Moderate adverse**
Operation of Khichauri dam and reservoir	Visible dam and reservoir, loss of vegetation in reservoir, exposure of dry river margins or stretches.	High	Moderate adverse	Sensitive receptors will be limited in number, low to medium sensitivity	Major adverse	Landscape planting strategy with appropriate re-vegetation	**Moderate adverse**

Activity	Potential Impact	Sensitivity Score (Conservation value)	Magnitude Score	Sensitivity of visual receptors	Impact Significance	Mitigation	Residual Significance
Operation of Chvanistsqali dam and reservoir	Visible dam and reservoir, loss of vegetation in reservoir, exposure of dry river margins or stretches.	High	Moderate adverse	Sensitive receptors will be limited in number, low to medium sensitivity	Major adverse	Landscape planting strategy with appropriate re-vegetation	**Moderate adverse**
Operation of Khertvisi dam and reservoir	Visible dam and reservoir, loss of vegetation in reservoir, exposure of dry river margins or stretches.	Medium	Moderate adverse	High	Moderate adverse	Landscape planting strategy with appropriate re-vegetation	**Minor adverse**
Operation of Chirukhistsqalii weir	Visible weir, loss of vegetation near weir	High	Minor adverse	Sensitive receptors will be limited in number, low to medium sensitivity	Moderate adverse	Landscape planting strategy with appropriate re-vegetation	**Minor adverse**
Operation of Akavreta weir	Visible weir, loss of vegetation near weir	High	Minor adverse	Sensitive receptors will be limited in number, low to medium sensitivity	Moderate adverse	Landscape planting strategy with appropriate re-vegetation	**Minor adverse**
Operation of Machakhlistsqali weir	Visible weir, loss of vegetation near weir	High	Minor adverse	Sensitive receptors will be limited in number, low to medium sensitivity	Moderate adverse	Landscape planting strategy with appropriate re-vegetation	**Minor adverse**

18.7 Proposed Monitoring and Reporting

This section discusses the monitoring and reporting required for landscape and visual amenity impacts and mitigations.

The main mitigation measure is the landscape planting strategy which will be planned and implemented in order to re-vegetate cuttings in the mountainside and to conceal access roads where possible. As part of the strategy, a monitoring programme will check the success and growth of vegetation on a six-monthly basis. Should there be problems with vegetation growth; alternative strategies will be employed so that the overall original aim is met. The responsibility for monitoring vegetation growth and planning alternatives if required will belong to the Environmental, Health and Safety Manager employed by AGL.

Contractors will be required to maintain clean and tidy sites through clauses in contract documentation and will be regularly monitored by AGL's Environmental, Health and Safety team.

AGL will report on the success of the landscape planting strategy within its annual reports on environmental and social sustainability.

18.8 Statement of Significance and Compliance

Although the Project does not impact upon any areas of 'cultural heritage' as referred to in the IFI requirements, it does incorporate mitigation and remedial actions in order to minimise the significant impacts upon the landscape and visual amenity, in line with IFC and EBRD policy. The overall significance on landscape character and visual amenity is however predicted to be moderate adverse. The following table specifies actions which the Project will undertake in order to demonstrate compliance.

Table 18.6: IFC/EBRD Requirements and Project Compliance

Principles of IFC PS8 Cultural Heritage and EBRD PR8 Cultural Heritage	How Project Compliance will be Achieved
Protect cultural heritage from adverse impacts of project activities	Many areas have been avoided through iterative design and impacts have been reduced through planned re-vegetation wherever possible.
Promote equitable sharing of benefits from use of cultural heritage	The Project is expected to pay a property tax in the local municipalities which will help to share the benefits. In addition a skills mapping exercise is underway which aims at employing local people as much as possible in the construction phase. Refer to Chapter 7 for more information on benefit sharing and skills mapping.
Support conservation of cultural heritage in context of project financing	The impacts that will affect natural heritage will be minimised as far as possible through design and re-vegetation.
Promote awareness of and appreciation of cultural heritage where possible	This will be considered as part of community engagement activities.