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**CONTOURGLOBAL®**



## **Environmental Services**

### **Assessment of the Environmental and Social Compliance of the Vorotan Hydropower Cascade, Armenia**



## **Environmental Liability Assessment Report**

**Final Version**

**FICHTNER**

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# 1. Executive Summary

In August 2015, ContourGlobal Hydro Cascade CJSC acquired Vorotan Complex of Hydroelectric Power Stations CJSC. ContourGlobal contracted FICHTNER, Stuttgart to prepare an Assessment of the Environmental and Social Compliance of the Vorotan Hydropower Cascade, including a Health and Safety Regulatory Compliance Assessment Report, an Environmental Liability Assessment Report, a Hazardous Substances Assessment Report and a Gap Analysis Report.

## 1.1 Legal Framework

Environmental liability of Hydropower Plants (HPPs) in the Republic of Armenia (RA) may arise from the pollution of the environment that can occur in the two main fields of a HPP's activities i.e. water use and waste management.

The main legal acts governing the relationships concerned with water use are as follows:

- The Water Code of RA (2002)
- The RA Law "On National Water Program"
- The RA Law "On the Fundamentals of National Water Policy" (2005)
- RA Government Decision N 1147-N of 28 July 2005 "On the Regulations of Defining Water Standards"
- RA Government Decision N 982-N "of 10 July 2003 "On Approving the Procedure for Use of Absorbent Pits, Exhausted Mines and Open Shafts for Discharge of Wastewater and Drainage Water and Outflow Permission"
- RA Government Decision N 75-N of 27 January 2011 "On Defining the Norms for Securing Water Quality of Each Basin Management Area Depending on the Features of the Specific Area"
- RA Government Decision N 118-N of 14 January 2010 "On Defining The Measures for Application of Advanced Technologies, Improvement of Monitoring, Reduction and Prevention of Pollution of Water Resources"
- RA Government Decision N 927-N of 30 June, 2011 "On Defining Assessments of the Demand of Water Used for Drinking-Household and Agricultural Purposes as well as Environmental Flows for Water Basin Areas of the Republic of Armenia"
- RA Government Decision N 354-N of 13 March, 2003 "On Approving the Procedure for Determination of Quantities and Regimes of Water Intake from Water Resources for Water Users"
- Order of RA Minister of Nature Protection N 464-N of 10 December, 2003 "On Approving the Methodology of Calculation of Allowed Marginal Outflow Quantities Discharged onto Water Resources"

The main legal acts governing the relationships concerned with waste management are as follows:

- RA Law "On Waste" (2004);
- RA Law "On Refuse Collection and Sanitary Cleaning"
- RA Government Decision No 874-N "On Approving the List of Hazardous Wastes of the Republic of Armenia" dated 20 May, 2004
- RA Government Decision No 47-N "On Defining Procedure for Waste Passportization" dated 19 January, 2006
- Order No 19-N of RA Minister of Nature Protection "On Defining the Form of Sample Passport of Waste" dated 2 February, 2007
- Order No 342-N of RA Minister of Nature Protection "On Approving the List of Industrial (Including Mining) and Consumption Waste Generated in the Territory of the Republic of Armenia" dated 26 October, 2006
- Order N 430-N of RA Ministry of Nature Protection "On Defining the List of Waste Classified by Risk Level" dated 25 December, 2006
- Order No 112-N of the Ministry of Nature Protection dated 22 August, 2002
- Order N 20-N of the Minister of Healthcare "On Defining Sanitary Rules and Norms N 2.1.7.001-09 "Hygienic Requirements to the Management of Hazardous Waste and Storage and Transportation of Hazardous Chemical Substances" dated 26 October, 2009.

More details of the main legal acts are given in Appendix I.

## 1.2 Project Description

The Vorotan Complex of Hydroelectric Power Stations is a complex of three hydroelectric power stations (Spandaryan, Shamb, and Tatev HPPs) with an overall capacity of 404.2 MW and an average annual power generation of 1.16 billion kWh. The Vorotan Cascade is among the main power generation complexes in Armenia, providing both peak and base load generation, and performing grid stabilization services. The complex is located in the eastern part of Syunik region of the Republic of Armenia, some 240 km to the south-east of Yerevan. Vorotan Cascade is located at the Vorotan River. It is comprised of four reservoirs (Spandaryan, Angeghakot, Tolors, and Shamb/Tatev Reservoirs), the Tatev Daily Regulation Reservoir, and the named Hydropower Plants.

The Cascade has a total head of 1,223 m. The design of the Vorotan Cascade began in 1954, construction started in 1961. In 1970 the first power station, Tatev HPP, was put into operation, followed by Shamb HPP in 1978 and Spandaryan HPP in 1989.

## 1.3 Baseline

### 1.3.1 Basic studies

The Environmental Liability Assessment Report is based on the following reports:

- Burns and Roe Enterprises (1999): Environmental Assessment of Vorotan Cascade Rehabilitation Project, prepared for Hagler Bailly, submitted to US Agency for International Development. October 1999.
- Norplan (2013): ContourGlobal Vorotan Cascade of Hydropower Plants - Technical, Environmental and Hydrological Due Diligence. March 2013.
- IFC (2015): Vorotan Hydros - Environmental & Social Review Summary (published online).

### 1.3.2 Waste management in Armenia

About 60 landfills (dump sites) can be found in the country. The waste management sector in Armenia is regulated by the “Law on Waste” and by 30 legal acts deriving from it, but there are no capacities for recycling, neutralization, and elimination of hazardous waste. Solid waste management is poorly organized in Armenia. Most of the solid waste is dumped in provisional dump sites and landfills without any segregation or recycling. Solid waste including hazardous waste is generally not disposed of in accordance with internationally accepted practices. Waste is either burned or just dumped. This is also true for the Municipal Waste Dumping Site at Goris.

The current situation concerning waste management at Vorotan Cascade installations in general is bad. All wastes ever generated have been stored at site since decades. Thus, old equipment as old circuit breakers, ceramic parts and steel, but also old batteries and oil not suitable for further use are stored somewhere at the site. In addition, a functioning drainage system is missing at all Vorotan sites.

### 1.3.3 Ecological flow

Ecological flow is the minimum water regime needed to maintain ecosystems and their benefits where there are competing water uses in regulated rivers. Therefore, its assessment is variable depending on the hydrology and physical constitution of the river as well as on its water use by residents. Due to this very individual set of characteristics of each river and its flow, it is virtually impossible to find a global homogeneous practice for the definition of the amount of water needed to maintain its functioning. It also has to be considered that taking out water from a river will change the ecology of the river in any case, independent from the amount of water that is left in the original water bed. This makes the definition of an ecological or environmental flow very variable, depending on the ecological status that is strived for.

Despite these difficulties and the fact that most of the scientists consider all values of minimum flow to be too low in order to really maintain the ecology of a river/creek and require an individual evaluation of needed minimum flow, very often a look-up table is used to assess the suitable ecological flow.

In Armenia, it is stipulated to use the average value of the 10-day minimum daily water flow (Government Decision N 927-N, Chapter “Assessment of Environmental Flow” Points 4 and 5). That means that in determining the environmental flows, the average flow of the 10 days (consecutive) with the lowest flow of the year should be taken into consideration.

At Spandaryan Reservoir 0.5 m<sup>3</sup>/s is released into the old Vorotan River bed and at Angeghakot Reservoir it is 0.4 m<sup>3</sup>/s. At Tolors Reservoir there is no ecological / minimum flow, only about 2 l/s as filtration water and some water taken for the irrigation channel reach the old Sisian river bed. For this study, exact flow data of Vorotan River were not available. In the Water Use Permits no amount for needed ecological / minimal flow is mentioned. In addition to the released water from Spandaryan and Angeghakot reservoirs, sufficient water for irrigation purposes is provided downstream. Thus, a final assessment about the issue ecological / minimum / sanitation flow is not possible in the framework of this study.

## **1.4 Field Investigation, Observed Gaps, and Measures**

### **1.4.1 Methodology**

The field survey was conducted from 28<sup>th</sup> September to 2<sup>nd</sup> October 2015 by two Fichtner Health, Safety and Environmental (HSE) Specialists partly together with a Health and Safety Specialist and an Environmental Specialist from ContourGlobal. Mr. Artsrun Mirzatunyan attended the field survey as representative of the Government of RA. During this site visit, installations like dam sites, power houses, water outlets etc. were inspected and relevant authorities were consulted. Attention was turned to health, safety and environmental (HSE) relevant aspects.

Outcome of the field survey is a list of measures to solve the most obvious problems related to health, safety and environmental aspects. The implementation of all listed measures is directed to fulfill Armenian legal requirements. This is also true for compliance with IFC Performance Standards, World Bank EHS Guidelines, etc.

Where possible, single cost estimates are given; in other parts estimated lump sums have been calculated. These cost estimates (lump sum prices) also include all measures not being listed in detail. In order to cover other uncertainties, which might come up during the rehabilitation works, a high percentage of miscellaneous/contingencies (30%) was taken.



The catalogue of measures was developed to raise the HSE standards being applied and bring them as close as possible to an internationally acceptable level. This also includes the compliance with Armenian standards.

Because of the tight time frame a real bill of quantities for all needed measures during this field survey was not performed. For the HSE Specialists it was also not possible to assess the general quality of buildings and structures, e.g. the quality of concrete and in which extent the buildings or parts of building are dilapidated in a sense that the proposed measures cannot be implemented because of principal structural (statical) problems. For assessment of the quality of equipment, technical installations and electrical devices see the Consultancy Services for the Rehabilitation of the Vorotan Cascade Hydropower Plants, Fichtner 2012.

The costs were calculated under the precondition that local workforces are used as much as possible. These local workforces shall be trained by international ContourGlobal staff how to perform needed rehabilitation works (e.g. not to patch but replace equipment if needed). In addition, where possible, needed equipment shall be purchased in Armenia or from neighboring countries.

Some of the measures as the purchase of new PPE for the staff are already on the way but the costs are also given within these reports as agreed. The same applies for some of the rehabilitation measures e.g. at HPP Shamb and HPP Tatev main buildings which are already included in the Consultancy Services for the Rehabilitation of the Vorotan Cascade Hydropower Plants, Fichtner 2012.

#### 1.4.2 Water reservoirs

Main gaps observed at the Water Reservoirs / Dam Sites include:

- Dumping of all kind of waste near to reservoirs or river
- Lack of adequate sanitary facilities and of sewage treatment
- Lack of screens at intake structures to save aquatic lives (especially fishes)
- Lack of proper measurement of ecological flow
- Transformer at Tatev Daily Regulation Reservoir has oil leakages and no drainage system below

Recommended actions include:

- Clean area and buildings by collecting disposed waste
- Segregate hazardous waste and transport to storage areas at HPPs
- Contract next available certified waste disposal company for collecting household waste
- Provide toilet as well as bathroom with hand wash basin and shower
- Provide Small Waste Water Treatment Plant
- Install intake screen (including cleaning equipment) or electric Fish Repelling Systems at intake of Water Reservoirs

- Install automatic measurement device (e.g. ultrasonic) for measurement of ecological flow at outlet control building

#### 1.4.3 Hydropower plants

Main gaps observed at the Hydropower Plants include:

- Dumping of all kind of waste near to HPPs or river
- Lack of adequate sanitary facilities and of sewage treatment
- No or not enough spill fighting material available
- Some of the concrete spill walls around transformers and circuit breakers are broken
- All stormwater is led directly to the river

Recommended actions include:

- Clean area and buildings by collecting disposed waste
- Segregate hazardous waste and transport to storage areas at HPPs
- Contract next available certified waste disposal company for collecting household waste
- Provide adequate number of toilets separate for men and women as well as bathroom with hand wash basin and shower
- Provide spill-fighting material near to oil-containing equipment and in battery rooms
- Refurbish spill walls to avoid any leakages
- Install oil-separator

#### 1.4.4 Main office building at Goris

In the garages / warehouses of the main office of ContourGlobal Hydro Cascade in Goris several items (including hazardous substances, gas cylinders, etc.) are stored in inadequate conditions. Storage areas have to be refurbished and ventilated and stored items to be segregated.

### 1.5 Institutional Framework and Necessities

In order to implement an HSE Management System (HSEMS) an HSE officer responsible for Health, Safety and Environmental issues at the entire Vorotan Cascade shall be employed. This HSE officer shall be experienced in Hazardous Waste Management and will be responsible for monitoring the functionality and condition of all equipment and installations corresponding to Health, Safety and Environmental issues, training of workers and performing public awareness campaigns in villages located near to the Water Reservoirs. He will be responsible for the permanent on-site monitoring of implementation of the measures outlined in this study and shall work in close cooperation with the external internationally experienced auditor.

Regular trainings of staff shall be conducted by the HSE officer including special requirements at dam sites or in HPPs. These trainings shall include different environmental aspects (e.g. waste management, management of Small Waste Water Treatment Plants, spill prevention, cleaning of intake screens, use of measurement device for ecological flow, etc.) as well as H&S issues (see Health and Safety Assessment).

The HSE officer will be responsible for regular monitoring of functionality and condition of all installations at Vorotan Cascade regarding environmental aspects (e.g. waste management, management of Small Waste Water Treatment Plants, spill prevention and handling of spilled material, measurement and adequate level of ecological flow, etc.) as well as H&S issues (see Health and Safety Assessment).

The HSE officer will also be responsible for conducting awareness campaigns in villages near to Water Reservoirs (see Health and Safety Assessment).

Implementation of the proposed measures shall be monitored by an internationally experienced external auditor. Audits shall be performed four times per year for a period of two years.

## 1.6 Summary of Costs

Cost for implementation of proposed measures in <b>Environmental Liability Assessment Report:</b>	<b>1,277,500 USD</b>
+ 30 % contingency:	<b>1,660,750 USD</b>
<b>Costs</b> summed up from Health and Safety Regulatory Compliance Assessment Report, Environmental Liability Assessment Report, and Hazardous Substances Assessment Report	<b>4,683,640 USD</b>
<b>Total costs</b> including external monitoring over a period of two years	<b>4,783,640 USD</b>

Costs for employment of an HSE officer will be about 25,000 USD per year (including costs for the use of cars and infrastructure of ContourGlobal Hydro Cascade CJSC).

The implementation of all listed measures is directed to fulfill Armenian legal requirements. This is also true for compliance with IFC Performance Standards, World Bank EHS Guidelines, etc.

## 2. Introduction

In August 2015, ContourGlobal Hydro Cascade CJSC acquired Vorotan Complex of Hydroelectric Power Stations CJSC. ContourGlobal contracted FICHTNER, Stuttgart to prepare an Assessment of the Environmental and Social Compliance of the Vorotan Hydropower Cascade, including a Health and Safety Regulatory Compliance Assessment Report, an Environmental Liability Assessment Report, a Hazardous Substances Assessment Report and a Gap Analysis Report.

## 3. Legal Framework

This Chapter presents the legal framework for environmental management in the Republic of Armenia (RA).

Following independence in 1991, the environmental legislation of RA was reviewed, with the aim of developing a more comprehensive state policy towards ecological protection and sustainable use. Until today, a number of national laws of RA were implemented to regulate the protection of the environment.

Environmental liability of Hydropower Plants (HPPs) in RA may arise from the pollution of the environment that can occur in the two main fields of a HPP's activities i.e. water use and waste management.

### 3.1 Water Use

The main legal acts governing the relationships concerned with water use are as follows:

- The Water Code of RA (2002)
- The RA Law "On National Water Program"
- The RA Law "On the Fundamentals of National Water Policy" (2005)
- RA Government Decision N 1147-N of 28 July 2005 "On the Regulations of Defining Water Standards"
- RA Government Decision N 982-N "of 10 July 2003 "On Approving the Procedure for Use of Absorbent Pits, Exhausted Mines and Open Shafts for Discharge of Wastewater and Drainage Water and Outflow Permission"
- RA Government Decision N 75-N of 27 January 2011 "On Defining the Norms for Securing Water Quality of Each Basin Management Area Depending on the Features of the Specific Area"
- RA Government Decision N 118-N of 14 January 2010 "On Defining The Measures for Application of Advanced Technologies, Improvement of Monitoring, Reduction and Prevention of Pollution of Water Resources"
- RA Government Decision N 927-N of 30 June, 2011 "On Defining Assessments of the Demand of Water Used for Drinking-Household and

Agricultural Purposes as well as Environmental Flows for Water Basin Areas of the Republic of Armenia"

- RA Government Decision N 354-N of 13 March, 2003 "On Approving the Procedure for Determination of Quantities and Regimes of Water Intake from Water Resources for Water Users"
- Order of RA Minister of Nature Protection N 464-N of 10 December, 2003 "On Approving the Methodology of Calculation of Allowed Marginal Outflow Quantities Discharged onto Water Resources"

More details of the main legal acts concerning water use are given in Section 9.1 (Appendix I).

## 3.2 Waste Management

Amongst the principles embedded in Armenian regulatory framework of waste management is protection of human health and environment from adverse effects of waste (RA Law "On Waste", article 6, part 1, point a). This principle is implemented by the mechanisms provided by the legislation.

The main legal acts are as follows:

- RA Law "On Waste" (2004);
- RA Law "On Refuse Collection and Sanitary Cleaning"
- RA Government Decision No 874-N "On Approving the List of Hazardous Wastes of the Republic of Armenia" dated 20 May, 2004
- RA Government Decision No 47-N "On Defining Procedure for Waste Passportization" dated 19 January, 2006
- Order No 19-N of RA Minister of Nature Protection "On Defining the Form of Sample Passport of Waste" dated 2 February, 2007
- Order No 342-N of RA Minister of Nature Protection "On Approving the List of Industrial (Including Mining) and Consumption Waste Generated in the Territory of the Republic of Armenia" dated 26 October, 2006
- Order N 430-N of RA Ministry of Nature Protection "On Defining the List of Waste Classified by Risk Level" dated 25 December, 2006
- Order No 112-N of the Ministry of Nature Protection dated 22 August, 2002
- Order N 20-N of the Minister of Healthcare "On Defining Sanitary Rules and Norms N 2.1.7.001-09 "Hygienic Requirements to the Management of Hazardous Waste and Storage and Transportation of Hazardous Chemical Substances" dated 26 October, 2009.

More details of the main legal acts concerning waste management are given in Section 9.1 (Appendix I).

For comparison of the national legislation of the Republic of Armenia with international regulations see the referring Gap Analysis Report.

## 4. Project Description

In August 2015, ContourGlobal Hydro Cascade CJSC acquired Vorotan Complex of Hydroelectric Power Stations CJSC. Vorotan Complex of Hydroelectric Power Stations (CHPS) is a complex of three hydroelectric power stations with an overall capacity of 404.2 MW and an average annual power generation of 1.16 billion kWh. The Vorotan Cascade is among the main power generation complexes in Armenia, providing both peak and base load generation, and performing grid stabilization services. The complex is located in the eastern part of Syunik region of the Republic of Armenia, some 240 km to the south-east of Yerevan (see Map 1).

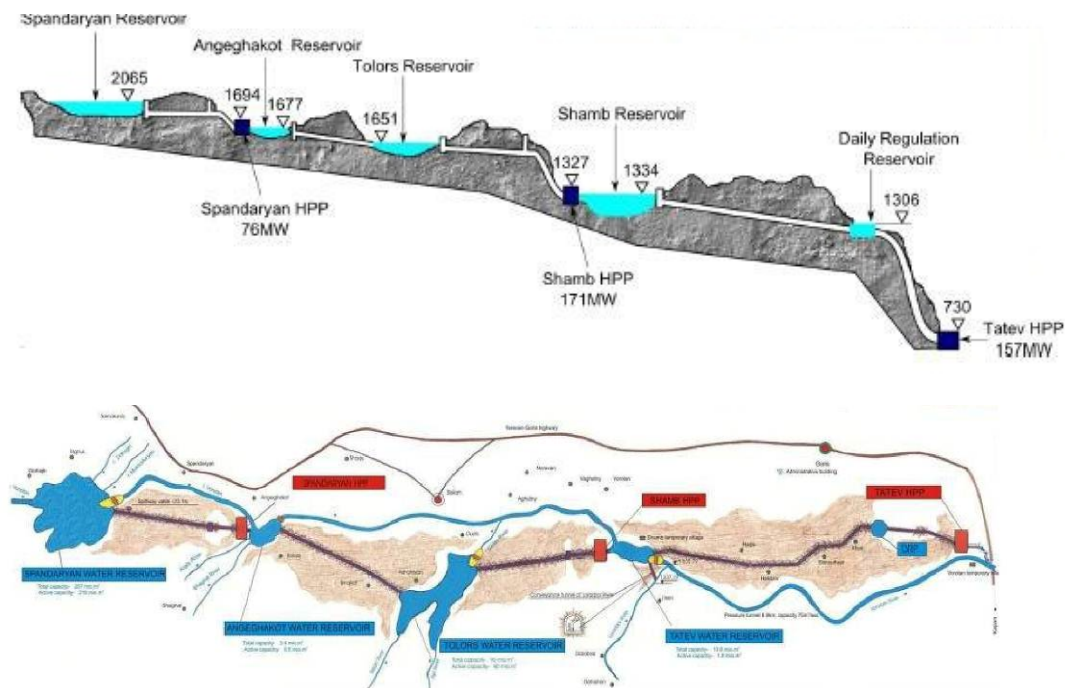


**Map 1:** Location of the Vorotan Complex of HPS in the Republic of Armenia

The Cascade has a total head of 1,223 m. The design of the Vorotan CHPS began in 1954, construction started in 1961. In 1970 the first power station, Tatev HPP, was put into operation, followed by Shamb HPP in 1978 and Spandaryan HPP in 1989.

Vorotan CHPS is located at the Vorotan River. It is comprised of four reservoirs and one Daily Regulation Reservoir (see Figure 1). The Spandaryan Reservoir is the upper reservoir of the cascade. Highest water level is at 2,063 m a.s.l.; minimum water level is 2,030 m. The water is directed through an 8.1 km long pressure tunnel and a 2.17 km long penstock to Spandaryan HPP. The discharge from Spandaryan HPP and water from Vorotan River is retained by Angeghakot dam forming the Angeghakot Reservoir. Highest water level is at 1,677.4 m a.s.l.; minimum water level is 1,664.5 m. Water flows from this reservoir via a 10.5 km long

gravity fed tunnel to the Tolors Reservoir, which is also fed by the Sisian and Ayri Rivers. Highest water level is at 1,651.5 m a.s.l.; minimum water level is 1,625.5 m. From the Tolors Reservoir, the water is supplied to the Shamb HPP via a 6.9 km long pressure tunnel and a penstock of 1.26 km in length. Below the Shamb HPP is the Shamb Reservoir (also named Tatev Reservoir) which is also fed by water from Laradzor River. Highest water level is at 1,335.4 m a.s.l.; minimum water level is 1,333.8 m. From this reservoir water flows through an 18.4 km long gravity fed tunnel to the Daily Regulation Reservoir of the Tatev HPP, from where the water is directed to Tatev HPP via a 1,900 m long pressure penstock.



**Figure 1:** Design of the Vorotan Complex of HPS

The principal characteristics of the three hydroelectric power plants are given in Table 1.

**Table 1:** Principal characteristics of the HPPs of Vorotan Cascade

Hydroelectric Power Plant (HPP)	Rated Capacity [MW]	Number and Capacity of Units [MW]	Turbine	Water storage [mill. m <sup>3</sup> ] total / live	Design Head [m]
Spandaryan	76	2 x 38.0	Francis	257 / 218	300
Shamb	171	2 x 85.5	Francis	96 / 80	267
Tatev	157.2	3 x 52.4	Pelton	13.6 / 1.8	552

The power plants of the Vorotan CHPS are connected by 220 kV lines to the main substation Shinuhayr near Goris, except for Tatev which is connected at 110 kV voltage level. Beside this, HPP Shamb and HPP Spandaryan are connected by loop circuits to the 220 kV line between the substations

Shinuhayr and Eghegnadzor. From Shinuhayr two 220 kV transmission lines leave to Meghri substation interconnecting to the Iranian grid.

## **5. Baseline**

### **5.1 Basic Studies**

Technical, environmental and social due diligence documents prepared for rehabilitation of Vorotan Cascade Hydropower Plants have been considered:

- Burns and Roe Enterprises (1999): Environmental Assessment of Vorotan Cascade Rehabilitation Project, prepared for Hagler Bailly, submitted to US Agency for International Development. October 1999.
- Norplan (2013): ContourGlobal Vorotan Cascade of Hydropower Plants - Technical, Environmental and Hydrological Due Diligence. March 2013.
- IFC (2015): Vorotan Hydros - Environmental & Social Review Summary (published online)

The Norplan (2013) due diligence report concludes that the environmental management of the Vorotan HPP is not in compliance with ContourGlobal's environmental and social policies and standards. Thus, an Environmental and Social Management System for the Vorotan HPPs shall be developed including an emergency preparedness and response plan. Pollution prevention and control system shall be improved as part of the rehabilitation. Land contamination and hazardous material shall be assessed.

### **5.2 Waste Management in Armenia**

About 60 landfills (dump sites) can be found in the country. The waste management sector in Armenia is regulated by the "Law on Waste" and by 30 legal acts deriving from it, but there are no capacities for recycling, neutralization, and elimination of hazardous waste. Solid waste management is poorly organized in Armenia. Most of the solid waste is dumped in provisional dump sites and landfills without any segregation or recycling. Solid waste including hazardous waste is generally not disposed of in accordance with internationally accepted practices. Waste is either burned or just dumped. This is also true for the Municipal Waste Dumping Site at Goris (see below).





In order to change the situation Armenia is a party of the Basel Convention “On the Control of Transboundary Movements of Hazardous Wastes and their Disposal” since 1999 and the Government of the Republic of Armenia ratified in 2003 the Stockholm Convention “On Persistent Organic Pollutants”. A National Implementation Plan was developed based on the Article 7 of the Stockholm Convention published in 2005. In 2004 the Law on waste was put into force which defines the state policy in the area of waste use, aimed at preventing the harmful impact of waste on the environment and human health, while maximizing its use as a secondary raw material.

However, up to now a suitable recycling system for any waste is not available in Armenia at all. Valuable waste as used oil is sometimes sold to private persons, steel and iron is exported to e.g. Iran for recycling purposes.

The battery producing company (Battery ELBAT) has planned to build up recycling facilities. The new factory should be able to recycle the sulfuric acid of old batteries for reuse or to neutralize it and melt the lead for reuse in new batteries. However, consultations held with the company in September 2014 revealed, that the planned factory will not be built in near future.

Consequently, the current situation concerning waste management at Vorotan Cascade installations in general is bad. All wastes ever generated have been stored at site since decades. Thus, old equipment as old circuit breakers, ceramic parts and steel, but also old batteries and oil not suitable for further use are stored somewhere at the site. In addition, a functioning drainage system is missing at all Vorotan sites.

### 5.3 Ecological Flow

Ecological flow is the minimum water regime needed to maintain ecosystems and their benefits where there are competing water uses in regulated rivers. Therefore, its assessment is variable depending on the hydrology and physical constitution of the river as well as on its water use by residents. Due to this very individual set of characteristics of each river

and its flow, it is virtually impossible to find a global homogeneous practice for the definition of the amount of water needed to maintain its functioning. It also has to be considered that taking out water from a river will change the ecology of the river in any case, independent from the amount of water that is left in the original water bed. This makes the definition of an ecological or environmental flow very variable, depending on the ecological status that is strived for.

Despite these difficulties and the fact that most of the scientists consider all values of minimum flow to be too low in order to really maintain the ecology of a river/creek and require an individual evaluation of needed minimum flow, very often a look-up table is used to assess the suitable ecological flow.

In many countries an applicable method for the calculation is given by its legislative bodies for practical reasons. Some examples are given below:

- Germany: between 30 % and 50 % of the mean minimum flow measured over years
- Greece: more than 30 % of the mean summer flow
- France: 1/10 of the annually mean flow and 1/20 in rivers with more than 80 m<sup>3</sup>/s
- Turkey: In former times 1 % of the mean annual flow, today 10 %

In Armenia, it is stipulated to use the average value of the 10-day minimum daily water flow (Government Decision N 927-N, Chapter “Assessment of Environmental Flow” Points 4 and 5). That means that in determining the environmental flows, the average flow of the 10 days (consecutive) with the lowest flow of the year should be taken into consideration.

An older method used the minimum flow level equal to 75 % of the 95<sup>th</sup> percentile of previously recorded water flow levels. In application of this method, the minimum flow of Vorotan is set as 2.01 m<sup>3</sup>/s, with an average flow of 50 % probability estimated at 22.42 m<sup>3</sup>/s.<sup>1</sup>

At Spandaryan Reservoir 0.5 m<sup>3</sup>/s is released into the old Vorotan River bed and at Angeghakot Reservoir it is 0.4 m<sup>3</sup>/s. At Tolors Reservoir there is no ecological / minimum flow, only about 2 l/s as filtration water and some water taken for the irrigation channel reach the old Sisian river bed. For this study, exact flow data of Vorotan River were not available. In the Water Use Permits (see Section 9.2 – Appendix II) no amount for needed ecological / minimal flow is mentioned. In addition to the released water from Spandaryan and Angeghakot reservoirs, sufficient water for irrigation purposes is provided downstream (see Section 6.6 in Health and Safety Assessment). Thus, a final assessment about the issue ecological / minimum / sanitation flow is not possible in the framework of this study.

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<sup>1</sup> World Bank – Document 23658: Armenia – towards an Integrated Water Resource Management, 2001

## 6. Field Investigation, observed Gaps, and Measures

### 6.1 Methodology

The field survey was conducted from 28<sup>th</sup> September to 2<sup>nd</sup> October 2015 by two Fichtner Health, Safety and Environmental (HSE) Specialists partly together with a Health and Safety Specialist and an Environmental Specialist from ContourGlobal. Mr. Artsrun Mirzatunyan attended the field survey as representative of the government of RA. During this site visit, installations like dam sites, power houses, water outlets etc. were inspected and relevant authorities were consulted (see Records of Meetings – Appendix III). Attention was turned to health, safety and environmental relevant aspects. Also, a catalogue of measures was developed to raise the HSE standards being applied and bring them as close as possible to an internationally acceptable level. This also includes the compliance with national, Armenian, standards.

Because of the tight time frame a real bill of quantities for all needed measures during this field survey was not performed. For the HSE Specialists it was also not possible to assess the general quality of buildings and structures, e.g. the quality of concrete and in which extent the buildings or parts of building are dilapidated in a sense that the proposed measures cannot be implemented because of principal structural (statical) problems. For assessment of the quality of equipment, technical installations and electrical devices see the Consultancy Services for the Rehabilitation of the Vorotan Cascade Hydropower Plants, Fichtner 2012.

Outcome of the field survey is a list of measures to solve the most obvious problems related to health, safety and environmental aspects. . The implementation of all listed measures is directed to fulfill Armenian legal requirements. This is also true for compliance with IFC Performance Standards, World Bank EHS Guidelines, etc.

Where possible, single cost estimates are given; in other parts estimated lump sums have been calculated. These lump sums are based on the vast experience that Fichtner's Engineering Specialists have gained during decades in many developing countries. Further they rely on findings and observations that Fichtner's Engineering Specialists obtained during a project in 2003 "Substitution to the Nuclear Power through the Development of the Hydropower Capacity of Armenia" (EUROPEAID/112946/C/SV/AM) and during Consultancy Services for the Rehabilitation of the Vorotan Cascade Hydropower Plants in 2012. These cost estimates (lump sum prices) also include all measures not being listed in detail. In order to cover other uncertainties, which might come up during the rehabilitation works, a high percentage of miscellaneous/contingencies (30 %) was taken.

The costs were calculated under the precondition that local workforces are used as much as possible. These local workforces shall be trained by international ContourGlobal staff how to perform needed rehabilitation works (e.g. not to patch but replace equipment if needed). In addition, where

possible, needed equipment shall be purchased in Armenia or from neighboring countries.

Some of the measures as the purchase of new PPE for the staff are already on the way but the costs are also given within these reports as agreed. The same applies for some of the rehabilitation measures e.g. at HPP Shamb and HPP Tatev main buildings which are already included in the Consultancy Services for the Rehabilitation of the Vorotan Cascade Hydropower Plants, Fichtner 2012.

Overview maps and detailed maps of Water Reservoirs and HPPs of the Vorotan Cascade, based on high resolution (0.5 m) satellite pictures, are given in Section 9.4 (Appendix IV).

## 6.2 Water Reservoirs

### 6.2.1 Spandaryan Reservoir

At Spandaryan Reservoir the gaps given in Table 2 have been observed:

**Table 2:** Gaps observed at Spandaryan Reservoir, proposed measures and prices

Observed Gaps	Proposed Measure	Estimated price
All kind of waste dumped near reservoir (Photo 1)	Clean area and buildings by collecting disposed waste	Done by trained staff
	Segregate hazardous waste and transport to storage areas at HPPs. For storage / disposal of hazardous waste see Hazardous Substances Assessment	Done by trained staff
	Provide waste collection bins and signs	500 USD
	Contract next available certified waste disposal company for collecting household waste	Administration of ContourGlobal
No adequate sanitary facilities / no sewage treatment (Photo 2)	Provide toilet as well as bathroom with hand wash basin and shower according to IFC / EBRD Guidance Note <sup>2</sup>	For costs see Health and Safety Assessment
	Provide Small Waste Water Treatment Plant	
No screen at intake structure in place to save aquatic lives (especially fishes)	Install intake screen (including cleaning equipment) at intake of Water Reservoir	300,000 USD
It was reported that villagers sometimes use poison for fishing	Implement awareness raising campaigns in nearby villages regarding negative impacts of use of poison for fishing	HSE officer
No spill fighting material available	Provide spill-fighting material near to oil-containing equipment	500 USD

<sup>2</sup> see IFC / EBRD Guidance Note on Workers' Accommodation (2009)

Observed Gaps	Proposed Measure	Estimated price
Old lamp bulbs containing mercury	For storage / disposal of mercury containing lamp bulbs see Hazardous Substances Assessment	For costs see Hazardous Substances Assessment
Measurement of ecological flow does not work properly	Install automatic measurement device (e.g. ultrasonic) for measurement of ecological flow at outlet control building including recording module	20,000 USD
Eternit roof of pit latrine probably contains asbestos (Photo 3)	For storage and disposal of asbestos see Hazardous Substances Assessment	For costs see Hazardous Substances Assessment
On slope above intake control building erosion problems (landslides) can be seen (Photo 4 and Map 3). Existing wall is not high enough (Photo 5)	Extend existing retaining wall in height	1,000 USD
Leakages of hydraulic oil at outlet control building (Photo 6 and Map 3)	Reconstruction of building and improvement / tightening of hydraulic devices	5,000 USD
	For storage / disposal of used oil see Hazardous Substances Assessment	For costs see Hazardous Substances Assessment



**Photo 1:** Waste dumped near to reservoir



**Photo 2:** Pit latrine





**Photo 3:** Eternit roof of pit latrine probably containing asbestos



**Photo 4:** Erosion on slope above intake control building



**Photo 5:** Retaining wall behind intake control building



**Photo 6:** Oil leakages at outlet control building

## 6.2.2 Angeghakot reservoir

At Angeghakot Reservoir the gaps given in Table 3 have been observed:

**Table 3:** Gaps observed at Angeghakot Reservoir, proposed measures and prices

Observed Gaps	Proposed Measure	Estimated price
All kind of waste dumped near reservoir and river or stored in buildings (Photo 7)	Clean area and buildings by collecting disposed waste	Done by trained staff
	Segregate hazardous waste and transport to storage areas at HPPs. For storage / disposal of hazardous waste see Hazardous Substances Assessment	Done by trained staff
	Provide waste collection bins and signs	500 USD
	Contract next available certified waste disposal company for collecting household waste	Administration of ContourGlobal

Observed Gaps	Proposed Measure	Estimated price
No adequate sanitary facilities / no sewage treatment	Provide toilet as well as bathroom with hand wash basin and shower according to IFC / EBRD Guidance Note	For costs see Health and Safety Assessment
	Provide Small Waste Water Treatment Plant	
No screen at intake structure in place to save aquatic lives (especially fishes) (Photo 8)	Install intake screen (including cleaning equipment) at intake of Water Reservoir	300,000 USD
No spill fighting material available	Provide spill-fighting material near to oil-containing equipment	500 USD
Old lamp bulbs containing mercury	For storage / disposal of mercury containing lamp bulbs see Hazardous Substances Assessment	For costs see Hazardous Substances Assessment
Measurement of ecological flow is done by visual estimation	Install automatic measurement device (e.g. ultrasonic) for measurement of ecological flow including recording module	20,000 USD



Photo 7: Waste stored in transformer room



Photo 8: Water intake

### 6.2.3 Tolors reservoir

At Tolors Reservoir the gaps given in Table 4 have been observed:

**Table 4:** Gaps observed at Tolors Reservoir, proposed measures and prices

Observed Gaps	Proposed Measure	Estimated price
All kind of waste dumped near reservoir or stored in buildings (Photo 9)	Clean area and buildings by collecting disposed waste	Done by trained staff
	Segregate hazardous waste and transport to storage areas at HPPs. For storage / disposal of hazardous waste see Hazardous Substances Assessment	Done by trained staff
	Provide waste collection bins and signs	500 USD
	Contract next available certified waste	Administration of

Observed Gaps	Proposed Measure	Estimated price
	disposal company for collecting household waste	ContourGlobal
No adequate sanitary facilities / no sewage treatment (Photo 9)	Provide toilet as well as bathroom with hand wash basin and shower according to IFC / EBRD Guidance Note	For costs see Health and Safety Assessment
	Provide Small Waste Water Treatment Plant	
No screen at intake structure in place to save aquatic lives (especially fishes) (Photo 10)	Install intake screen (including cleaning equipment) at intake of Water Reservoir	300,000 USD
No spill fighting material available	Provide spill-fighting material near to oil-containing equipment	500 USD
Old lamp bulbs containing mercury (Photo 11)	For storage / disposal of mercury containing lamp bulbs see Hazardous Substances Assessment	For costs see Hazardous Substances Assessment
Old transformer no longer used in workers' building	Remove old transformer. For storage of old oil see Hazardous Substances Assessment	----



**Photo 9:** Pit latrine and waste dump



**Photo 10:** Water intake



**Photo 11:** Lamp bulb containing mercury



#### 6.2.4 Shamb/Tatev reservoir

At Shamb/Tatev Reservoir the gaps given in Table 5 have been observed:

**Table 5:** Gaps observed at Shamb/Tatev Reservoir, proposed measures and prices

Observed Gaps	Proposed Measure	Estimated price
All kind of waste dumped near reservoir or stored in buildings	Clean area and buildings by collecting disposed waste	Done by trained staff
	Segregate hazardous waste and transport to storage areas at HPPs. For storage / disposal of hazardous waste see Hazardous Substances Assessment	Done by trained staff
	Provide waste collection bins and signs	500 USD
	Contract next available certified waste disposal company for collecting household waste	Administration of ContourGlobal
No adequate sanitary facilities / no sewage treatment	Provide toilet as well as bathroom with hand wash basin and shower according to IFC / EBRD Guidance Note	For costs see Health and Safety Assessment
	Provide Small Waste Water Treatment Plant	
No screen at intake structure in place to save aquatic lives (especially fishes)	Install intake screen (including cleaning equipment) at intake of Water Reservoir	300,000 USD
No spill fighting material available	Provide spill-fighting material near to oil-containing equipment	500 USD
Old lamp bulbs containing mercury	For storage / disposal of mercury containing lamp bulbs see Hazardous Substances Assessment	For costs see Hazardous Substances Assessment

#### 6.2.5 Daily regulation reservoir of Tatev HPP

At Daily Regulation Reservoir of Tatev HPP the gaps given in Table 6 have been observed:

**Table 6:** Gaps observed at Daily Regulation Reservoir of Tatev HPP, proposed measures and prices

Observed Gaps	Proposed Measure	Estimated price
All kind of waste dumped near reservoir or stored in buildings	Clean area and buildings by collecting disposed waste	Done by trained staff
	Segregate hazardous waste and transport to storage areas at HPPs. For storage / disposal of hazardous waste see Hazardous Substances Assessment	Done by trained staff
	Provide waste collection bins and signs	500 USD
	Contract next available certified waste disposal company for collecting household waste	Administration of ContourGlobal
No adequate sanitary facilities / no sewage	Provide toilet as well as bathroom with hand wash basin and shower according to	For costs see Health and Safety

Observed Gaps	Proposed Measure	Estimated price
treatment	IFC / EBRD Guidance Note	Assessment
	Provide Small Waste Water Treatment Plant	
No spill fighting material available	Provide spill-fighting material near to oil-containing equipment	500 USD
Old lamp bulbs containing mercury	For storage / disposal of mercury containing lamp bulbs see Hazardous Substances Assessment	For costs see Hazardous Substances Assessment
Transformer has oil leakages and no drainage system below (Photo 12 and Map 13)	Install concreted and banded area below transformer. Transformer shall be exchanged during technical rehabilitation (not priced here). For storage / disposal of old oil and oil spilled soil see Hazardous Substances Assessment	1,500 USD



**Photo 12:** Old leaking transformer without drainage system

## 6.3 Hydropower Plants

### 6.3.1 Spandaryan HPP

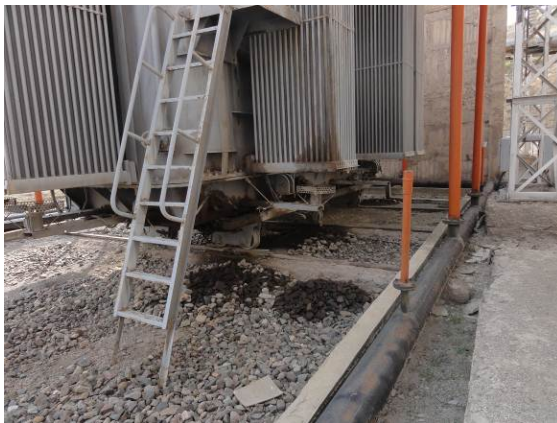
A drainage system is installed below the transformers and circuit breakers at the substation of Spandaryan HPP. The drainage liquid is led to a pool with 40 m<sup>3</sup> capacity. This pool contains currently mainly water; the system seems to work well.

At Spandaryan HPP the gaps given in Table 7 have been observed:

**Table 7:** Gaps observed at Spandaryan HPP, proposed measures and prices

Observed Gaps	Proposed Measure	Estimated price
Fish from Spandaryan Reservoir are killed in turbines (Photo 13).	Install intake screen (including cleaning equipment) or electric Fish Repelling Systems at intake of Water Reservoir	See Table 2
All kind of waste dumped near to river or near to HPP (Photo 14 and Map 5)	Clean area by collecting disposed waste	Done by trained staff
	Segregate hazardous waste and install roofed, concreted and bunded storage areas at HPP	Done by trained staff; For costs of storage area see Hazardous Substances Assessment
	Provide waste collection bins and signs	500 USD
	Contract next available certified waste disposal company for collecting household waste	Administration of ContourGlobal
It was reported that oil filled fabrics or tissues are burned for disposal	Oil filled fabrics or tissues have to be collected as waste and disposed of accordingly	Done by trained staff
All sewage and waste water is led directly to the river without treatment	Provide Small Waste Water Treatment Plant	For costs see Health and Safety Assessment
Old lamp bulbs containing mercury	For storage / disposal of mercury containing lamp bulbs see Hazardous Substances Assessment	For costs see Hazardous Substances Assessment
No spill fighting material available	Provide spill-fighting material near to oil-containing equipment and in battery rooms	For costs see Health and Safety Assessment
Small amounts of oil were found on gravel beneath transformers. Oil-spilled gravel is removed from time to time (Photo 15)	Oil-spilled gravel has to be treated as waste and disposed of accordingly	Done by trained staff
In different rooms as well as outside on HPP site many materials are stored for possible use as spare parts	If these materials are disposed of, they have to be segregated and accordingly stored or disposed of. See Hazardous Substances Assessment	Done by trained staff
Old batteries used for telecommunication purposes are still stored in a room of the HPP (Photo 16)	Remove old batteries. For storage / disposal of batteries see Hazardous Substances Assessment	Done by trained staff
Some of the concrete spill walls around transformers and circuit breakers are broken (Photo 17)	Refurbish spill walls to avoid any leakages	10,000 USD
Service company is refining used oil from time to time at HPP site	Refining of used oil has to be done on a concreted and bunded area to prevent oil spills	
All stormwater is led without treatment directly to the river	Install oil-separator	

Observed Gaps	Proposed Measure	Estimated price
Air tanks for compressors have an oil-water mix inside. This is led directly to the river (Photo 18)	These mixtures together with other discharges of the HPP have to be cleaned and the oil has to be separated. Install an oil-separator	

**Photo 13:** Killed fish at outlet channel**Photo 14:** Waste dumped behind wall**Photo 15:** Oil leakages below transformer**Photo 16:** Old batteries to be removed**Photo 17:** Broken spill wall below circuit breakers**Photo 18:** Oil-water mix from tanks is led to river

### 6.3.2 Shamb HPP

At Shamb HPP the gaps given in Table 8 have been observed:

**Table 8:** Gaps observed at Shamb HPP, proposed measures and prices

Observed Gaps	Proposed Measure	Estimated price
All kind of waste dumped near to river or near to HPP	Clean area by collecting disposed waste and restore riverbank	2,000 USD; to be done by subcontractor
	Coordinate cleaning with local self-governing bodies and with regional environmental inspectorate	Administration of ContourGlobal
	Segregate hazardous waste and install roofed, concreted and bunded storage areas at HPP	Done by trained staff; For costs of storage area see Hazardous Substances Assessment
	Provide waste collection bins and signs	500 USD
	Contract next available certified waste disposal company for collecting household waste	Administration of ContourGlobal
It was reported that oil filled fabrics or tissues are burned for disposal	Oil filled fabrics or tissues have to be collected as waste and disposed of accordingly	Done by staff
Sewage water goes to a pool without outlet, from where the liquid part is trickling to the soil.	Provide Small Waste Water Treatment Plants	For costs see Health and Safety Assessment
Cable ducts may contain asbestos	For storage / disposal of asbestos see Hazardous Substances Assessment	For costs see Hazardous Substances Assessment
Asbestos plates have been found in electrical equipment (Photo 19)		
Old lamp bulbs containing mercury	For storage / disposal of mercury containing lamp bulbs see Hazardous Substances Assessment	For costs see Hazardous Substances Assessment
No spill fighting material available	Provide spill-fighting material near to oil-containing equipment and in battery rooms	For costs see Health and Safety Assessment
	Monitor condition of spill-fighting material regularly	HSE officer
In oil refinery station a lot of unused materials were found	If these materials will be disposed of, they have to be segregated and accordingly stored or disposed of. See Hazardous Substances Assessment	Done by trained staff
Oil spills go through drainage system directly to the river (e.g. oil spill in 2007)	Drainage water has to go to an oil-separator. Install oil-separator	5,000 USD



Observed Gaps	Proposed Measure	Estimated price
Oil spills outside the refinery station (Photo 20 and Map 10)	Collect oil-spilled material and dispose of accordingly. Install a concreted and bunded area to prevent oil spills. Provide spill-fighting material	



Photo 19: Asbestos plates inside electrical devices



Photo 20: Oil leakages at oil refinery station

### 6.3.3 Tatev HPP

Unusable old oil of all HPPs of the Vorotan Cascade is stored at Tatev HPP in an oil-tank. Currently there are about 10.2 tons of old oil stored.

At Tatev HPP the gaps given in Table 9 have been observed:

**Table 9:** Gaps observed at Tatev HPP, proposed measures and prices

Observed Gaps	Proposed Measure	Estimated price
All waste is dumped nearby on waste dumping sites near to the river, which are also used by villagers (Photo 21 and Map 14)	Clean area by collecting disposed waste and restore riverbank	4,000 USD; to be done by subcontractor
	Coordinate cleaning with local self-governing bodies and with regional environmental inspectorate	Administration of ContourGlobal
	Segregate hazardous waste and install roofed, concreted and bunded storage areas at HPP	Done by trained staff; For costs of storage area see Hazardous Substances Assessment
	Provide waste collection bins and signs	500 USD
	Contract next available certified waste disposal company for collecting household waste	Administration of ContourGlobal
It was reported that oil filled fabrics or tissues are burned for disposal	Oil filled fabrics or tissues have to be collected as waste and disposed of accordingly	Done by trained staff

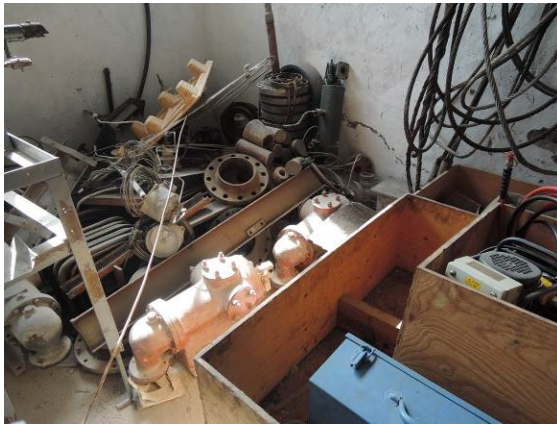
Observed Gaps	Proposed Measure	Estimated price
All sewage and waste water is led without any treatment directly to the river	Provide Small Waste Water Treatment Plants	For costs see Health and Safety Assessment
Cable ducts may contain asbestos	For storage / disposal of asbestos see Hazardous Substances Assessment	For costs see Hazardous Substances Assessment
Old lamp bulbs containing mercury	For storage / disposal of mercury containing lamp bulbs see Hazardous Substances Assessment	For costs see Hazardous Substances Assessment
No spill fighting material available	Provide spill-fighting material near to oil-containing equipment and in battery rooms	For costs see Health and Safety Assessment
One turbine is currently creating an oil-water mix, due to oil leakages. Mixture is daily collected and oil is separated for reuse three times per month	Refurbishment of turbine necessary	Current work done by staff. Part of refurbishment works
An oil-separator for drainage water is installed but does not to work (Photo 22)	Refurbishment and upgrade of existing system	2,500 USD
Scrap metal is stored on the HPP site.	Scrap metal will be sold for recycling purposes	No costs
In a storage building many different materials are stored for possible use as spare parts (Photo 23)	If these materials are disposed of, they have to be segregated and accordingly stored or disposed of. See Hazardous Substances Assessment	Done by trained staff
Asbestos plates have been found in electrical equipment (Photo 24).	For storage / disposal of asbestos see Hazardous Substances Assessment	For costs see Hazardous Substances Assessment



**Photo 21:** Waste dumping near to Vorotan River



**Photo 22:** Oil separator and drainage water pipe



**Photo 23:** Material stored as spare parts



**Photo 24:** Asbestos plates inside electrical devices

## 6.4 Main Office Building at Goris

In the garages of the main office of ContourGlobal Hydro Cascade in Goris several items are stored which will require special treatment. Gaps observed there are given in Table 10:

**Table 10:** Gaps observed at main office of ContourGlobal in Goris, proposed measures and prices

Observed Gaps	Proposed Measure	Estimated price
Different kind of material and wastes are stored in inadequate conditions (Photo 25)	Segregate all wastes. Dispose household wastes. Sell scrap metal	Done by trained staff
	For storage of hazardous substances see Hazardous Substances Assessment	For costs see Hazardous Substances Assessment
	Label hazardous substances accordingly and install warning signs	
Evidence for oil spills from old transformer	Provide adequate spill absorbent material	





**Photo 25:** Different types of waste stored at garages

## 7. Institutional Framework and Necessities

In order to implement an HSE Management System (HSEMS) an HSE officer responsible for Health, Safety and Environmental issues at the entire Vorotan Cascade shall be employed. This HSE officer shall be experienced in Hazardous Waste Management and will be responsible for monitoring the functionality and condition of all equipment and installations corresponding to Health, Safety and Environmental issues, training of workers and perform public awareness campaigns in villages located near to the Water Reservoirs. He is responsible for the permanent on-site monitoring of implementation of the measures outlined in this study and shall work in close cooperation with the external internationally experienced auditor.

Regular trainings of staff shall be conducted by the HSE officer including special requirements at dam sites or in HPPs. These trainings shall include different environmental aspects (e.g. waste management, management of Small Waste Water Treatment Plants, spill prevention, cleaning of intake screens, use of measurement device for ecological flow, etc.) as well as H&S issues (see Health and Safety Assessment).

The HSE officer will be responsible for regular monitoring of functionality and condition of all installations at Vorotan Cascade regarding environmental aspects (e.g. waste management, management of Small Waste Water Treatment Plants, spill prevention and handling of spilled material, measurement and adequate level of ecological flow, etc.) as well as H&S issues (see Health and Safety Assessment).

The HSE officer is also responsible for conducting awareness campaigns in villages near to Water Reservoirs (see Health and Safety Assessment).

Implementation of the measures proposed in Chapter 6 shall be monitored by an internationally experienced external auditor. Audits shall be performed four times per year for a period of two years.

## 8. Summary of Costs

Cost for implementation of proposed measures in <b>Environmental Liability Assessment Report</b> :	<b>1,277,500 USD</b>
+ 30 % contingency:	<b>1,660,750 USD</b>
<b>Costs</b> summed up from Health and Safety Regulatory Compliance Assessment Report, Environmental Liability Assessment Report, and Hazardous Substances Assessment Report	<b>4,683,640 USD</b>
<b>Total costs</b> including external monitoring over a period of two years	<b>4,783,640 USD</b>

Costs for employment of an HSE officer will be about 25,000 USD per year (including costs for the use of cars and infrastructure of ContourGlobal Hydro Cascade CJSC).

The implementation of all listed measures in Chapter 6 is directed to fulfill Armenian legal requirements. This is also true for compliance with IFC Performance Standards, World Bank EHS Guidelines, etc.

## 9. Appendix

### 9.1 Appendix I: Expert Report regarding Armenian Legislation

#### 9.1.1 Water Use

The main legal acts governing the relationships concerned with water use are given in Section 3.1.

The main purpose of the Water Code as stated in its article 6, is the conservation of the national water reserve, the satisfaction of water needs of citizens and economy through effective management of useable water resources, securing ecological sustainability of the environment, as well as the provision of a legal basis to achieve the objectives of the Code. The RA Law "On National Water Program" stipulates that by the use purpose the water resources are classified in the following types of water - drinking-household, irrigation, industrial, energy, fishery and recreative (article 10, part 1, point 7). In addition, article 6 of RA Law

"On the Fundamentals of National Water Policy" defines the principles of national water policy amongst which are the principles "polluter pays the price" and "user pays the price".

The license for electricity production and the water use permit are the permission documents a HPP needs for operation.

According to the article 21 of the Water Code any person must acquire a "water use permit" issued for any type of water use, except of cases determined the Code. As the article 32 of the Water Code stipulates, the water use permit is a document containing, amongst other things, prescriptions for quantity of water used, time periods for water use, water standards to be followed, any special measures to be taken to promote efficient water use, protect and improve water quality, and conserve wetlands, significant coastal habitats and associated biodiversity, control mechanisms to support compliance with water use permit requirements, etc. The analysis of articles 34, 37, 67, 99 and 114 shows that within the water use relationships the violation of the norms set by the water use permit by a water user is the main source of liabilities envisaged by law.

The relevant clauses of the above mentioned articles are as follows:

- All water application and extraction must be used only for the purposes stated in the water use permit and not exceed the quantity reasonably required for efficient use as determined by the Water Resources Management and Protection Body;
- Failure to perform envisaged duties will be considered a breach of the terms of water use permit with all remedies available at law applying;
- In case of violation of the established water standards the water use is considered illegal and a liability, established by legislation, shall apply;
- Primary requirements to the protection of water resources among others are maintenance of the balance in the given ecosystem by the protection of water resources in case of use; protection of water resources from pollution, littering, infection and depletion; wastewater discharge solely in case of conformance with the requirements of the Water Code; proscription of emission, outflow or burial of radioactive and toxic waste in water resources. In case of violation of these requirements the use of the water resource must be restricted, suspended or prohibited in accordance with the legislation.

The terms and conditions of the water use permit are determined based on the legal norms stipulated by the legislation.

### **Water standards**

The water resources management and protection body jointly with the corresponding stakeholder state management bodies develops the drafts of water quality standards. Water quality standards may vary according to the specifics of various locales. Water quality standards can be established in each water basin management area. Standards based on water use also can

be established, including: agricultural, industrial and household standards. The water standards must depict the terms of degradation, depletion, and contamination prevention of water resources, as well as the terms of establishment of minimum environmental flows.

As clause 2 of point 5 of article 121 states the within three years after official publication of the Water Code the Government of RA must approve the regulations for defining water standards. Based on the mentioned clause, on 28 July 2005, the Government adopted decision N 1147-N "On the Regulations of Defining Water Standards". According the point 4 of the Regulations of Defining Water Standards the standards of industrial water resources are developed by the authorized body of the field of industry (Ministry of Economy). The quantities of allowed marginal outflow of hazardous substances in the wastewaters discharged into the surface water resources must be developed by the authorized body of the field of environmental protection (Ministry of nature protection). The national water standards are approved (adopted) by the National Body of Standardization in accordance with the RA Law "On Standardization". As per the RA Government Decision N 883-N dated 4 July 2012 "The National Institute of Standards" CJSC is recognized as The National Body of Standardization (<http://www.sarm.am/en>)

### **Allowed Marginal Outflow**

Construction of absorbent pits and wells for the discharge of wastewater and drainage water is prohibited by the Water Code. Wastewater and drainage water has to be directed into wastewater collection systems in procedures prescribed in the wastewater removal contract (RA Water Code, article 104, paragraphs 2 and 3). However, in cases when wastewater removal services are not available the wastewater may be discharged into surface water resource but in strict compliance with the legislation. RA Government Decision N 982-N "On Approving the Procedure for Use of Absorbent Pits, Exhausted Mines and Open Shafts for Discharge of Wastewater and Drainage Water and Outflow Permission" adopted on 10 July 2003 based on the clause 2 of point 5 of article 121 of Water Code. The decision stipulates conditions for using already existing absorbent pits, exhausted mines and open shafts (remnants of mining industry). By the same decision the Government obliged the Ministry of Nature Protection to adopt the methodology of calculation of allowed marginal outflow quantities of the wastewater discharged into water resources. The methodology was adopted on 10 December, 2003 by the order N 464-N of the Minister of Nature Protection "On Approving the Methodology of Calculation of Allowed Marginal Outflow Quantities Discharged onto Water Resources". This methodology is also applicable to the sewage discharged into sewage collector and which will not pass further treatment/cleaning.

According to the article 24 of RA Law "On National Water Program" the norms for securing water quality are defined based on the health requirements as well as for prevention of degradation, exhaustion and pollution of water resources, provision of environmental flows and include

the allowed marginal quantities of all probable pollutant substances and indicators of their yearly decrease. The norms for securing water quality are defined by the RA Government for each basin management area depending the features of the specific area. Thus the RA government by its decision N 75-N of 27 January 2011 "On Defining the Norms for Securing Water Quality of Each Basin Management Area Depending on the Features of the Specific Area " amongst the water quality norms of other river basins defined also the water quality norms for Vorotan river basin rivers of Southern basin management area (Annex 20). The norms are to be reviewed ones in every 6 years.

The water quality as it is defined by the above mentioned Government decision N 75-N should not be depredated by the wastewater outflow. This should be taken into account in calculation of allowed marginal outflow quantities of the wastewater discharged into water resources which is done, as mentioned above, in accordance with the Ministerial Order N 464-N of 10 December, 2003. In maintaining water quality norms and depending on calculations, a water user, in our case HPP, may need to use some technologies for reduction and prevention of pollution of water resources. This issue is regulated by the RA Government Decision N 118-N "On Defining The Measures for Application of Advanced Technologies, Improvement of Monitoring, Reduction and Prevention of Pollution of Water Resources" adopted on 14 January 2010 based on the part 5 of Article 21 of The RA Law "On National Water Program".

### **Minimum Environmental Flows and Water Intake Quantities and Regimes**

The Water Code (article 121, point 5, clause 14) and The RA Law "On National Water Program" (article 30, part 2) prescribe the RA Government the adoption of rules for assessment and determination of minimum for water basin areas of RA. Thus, assessment of the environmental flows is carried out in accordance with the RA Government Decision N 927-N "On Defining Assessments of the Demand of Water Used for Drinking-Household and Agricultural Purposes as well as Environmental Flows for Water Basin Areas of the Republic of Armenia" dated 30 June, 2011.

Water intake quantities and regimes are determined in accordance with the RA Government Decision N 354-N " On Approving the Procedure for Determination of Quantities and Regimes of Water intake from Water Resources for Water Users" adopted on 13 March, 2003 based on the article 121, point 5, clause 42 of the Water Code

### **Conservation of Biodiversity**

As the paragraph 2 of article 32 of the Water Code states the Water Resources Management and Protection Body (Water Resources Management Agency of the Ministry of Nature protection of RA) may attach reasonable conditions which are not in conflict with the Code to the permit to insure that the proposed water use upholds the objectives of this

Code and remains within socially and ecologically sustainable limits. For HPP the provision of special facilities for protection of fish is just one example. The mentioned structures and facilities are envisaged by the building code RABC 33-01-2014 "Hydro-technical Structures. Main Provisions" approved by the order N 64-N of the Minister of Urban Development of RA on 3 March, 2014. According to the code the hydro-technical structures should secure protection of flora and fauna, in particular, provide for fish passage and protection structures.

**The observation of the above mentioned standards, norms and calculations is the main environmental obligation of HPP as a water user in the field of water use relationships that is documented in the form of a water use permit. The violation of the terms and conditions of water use permit, as mentioned earlier, will lead to liability (civil, administrative and/or criminal)**

### **Civil Liability**

The basis for civil liability is stipulated in article 5 (Basic Principles of Management, Use and Protection of Water Resources and Water Systems) point 23 of the Water Code (compensation of the costs of polluted waters treatment by a polluter) and, as mentioned above, article 6, point 12 of RA Law "On the Fundamentals of National Water Policy". Thus, article 116 of the Code states that the persons violating requirements of this Code are obliged to compensate the damages caused due to the violation. According to the article 117, If a person that pollutes water resources within reasonable time-period fails to comply with the direction given in the violation notice by the Water Resources Management and Protection Body within a reasonable period of time, then the Water Resources Management and Protection Body may be entitled to ensure the remedies stated in the violated notice which are necessary to mitigate damage caused to water resources, including protection of the national water reserve and water quality standards. In this case Water Resources Management and Protection Body, according to the procedures established by the legislation shall submit a claim to the court to reimburse costs from any person who is or was responsible for, or who directly or indirectly contributed to the pollution or any person who negligently failed to prevent the activity or the process being performed or undertaken; or the situation from occurring. Compensation of the damages is carried out in accordance with the Chapter 60 of RA Civil Code.

### **Administrative and/or Criminal Liability**

Administrative and/or criminal liability for violation of the Water code is envisaged by the article 114. As far as the environmental liability is concerned the following points of the article are worthy of mentioning:

Criminal or administrative responsibility may be incurred for failing to follow the terms of a valid water use permit and/or conducting a water use without first securing a necessary water use permit; polluting waters above

quotas established by the legislation of the Republic of Armenia; violation of water-protective regime within watershed, which caused water pollution, erosion and other harmful phenomena.

Relevant articles:

- The RA Code of Administrative Violations
  - Article 61: Violation Rules of Protection of Water Resources, Doing Unauthorized Works Effecting Water Resources.
  - Article 62: Violation of Water Intake, Supply and Use Rules
  - Article 632: Using Water Without Water Permit or Failing to Follow the Terms of Water Use Permit
- The RA Criminal Code
  - Article 287: Water Pollution
  - Article 293: Violation of Rules of Fish Protection

### 9.1.2 Waste management

The main legal acts governing the relationships concerned with waste management use are given in Section 3.2.

As defined by RA Law "On Waste" one of the obligations of legal and physical entities and private entrepreneurs in the area of waste management is to place waste only in the areas specially provided for that by the law (article 20, point b). In addition, RA Law "On Refuse Collection and Sanitary Cleaning" states that refuse collection fee payers amongst other things are also obliged to store and place refuse in places assigned or provided for it (article 20, part 2, point 3).

There are two main types of waste according to the legislation of the Republic of Armenia. The waste can be **hazardous waste** and **Industrial and consumption waste**, which is actually non-hazardous waste (RA Law "On Waste", article 4, points 1 and 4):

- The former is provided by RA Government Decision No 874-N "On Approving the List of Hazardous Wastes of the Republic of Armenia" dated 20 May, 2004;
- The latter is provided by the Order No 342-N of RA Minister of Nature Protection "On Approving the List of Industrial (Including Mining) and Consumption Waste Generated in the Territory of the Republic of Armenia" dated 26 October, 2006.

#### **Industrial and Consumption Waste**

According to the Ministerial Order No 342-N of RA Ministry of Nature Protection industrial and consumption waste is classified into four main categories:

- Organic Waste of Natural Origin,
- Waste of Mineral Origin,
- Waste of Chemical Origin and
- Utility Waste.

In accordance with the article 3 of RA Law "On Refuse Collection and Sanitary Cleaning" industrial and consumption waste are covered by the term "refuse" (non-household refuse). The obligation of legal and physical entities and private entrepreneurs to place waste only in the specially provided areas with respect to industrial and consumption waste is fulfilled through the mechanisms provided by the RA Law "On Refuse Collection and Sanitary Cleaning". Refuse collection is an activity, which means collection, storage, transportation and disposal of refuse generated within settlements in a landfill (RA Law "On Refuse Collection and Sanitary Cleaning", article 3, part 1, point 1) and that is carried out in expense of community budget by either immediately community institutions or an operator chosen for community needs in accordance with procedure established by the legislation on procurement (RA Law "On Refuse Collection and Sanitary Cleaning", article 8, part 1). Household refuse is collected and stored in places of common use of community specially provided or assigned for that purpose, and in receptacles provided by community or operator i.e. in refuse bins or containers, refuse chambers, with maintenance of defined requirements of sanitary-hygienic rules and norms (RA Law "On Refuse Collection and Sanitary Cleaning", article 10, part 1). The procedure for refuse collection, including the minimum timetable for refuse collection, the places for arrangement of refuse bins or containers, the types and quantity thereof are approved by the community council, further to the submission by the chief of community with maintenance of the requirements of sanitary-hygienic rules and norms defined by the legislation of the Republic of Armenia. Meanwhile, refuse is transported before the container is entirely full (RA Law "On Refuse Collection and Sanitary Cleaning", article 10, part 4). Thus, the obligation of the refuse producers to place waste only in the specially provided areas is fulfilled by placing refuse in places provided by article 10, part 1 of RA Law "On Refuse Collection and Sanitary Cleaning". A waste producer may require the community, operator or organization to reimburse refuse collection expenses incurred in expense of own means as result of improper performance of obligations by refuse collection organizer (RA Law "On Refuse Collection and Sanitary Cleaning", article 20, part 1, point 4).

### **Hazardous Waste**

The Article 4 of RA Law on waste defines hazardous waste as waste having physical, chemical and biological characteristics that are or might be dangerous to human health and environment and require special treatment methods, modes and means. RA Government provide lists of hazardous and restricted waste (Article 7 of the Law on Waste) The Ministry of Nature protection develops lists of hazardous and restricted waste, provides the list of waste classified by risk level (Article 8 of the Law on Waste). In fulfillment of obligations defined by the Law on Waste, RA Government on



adopted Decision No 874-N “On Defining the List of Hazardous Waste of the Republic of Armenia” and RA Ministry of Nature Protection on 25 December, 2006 issued Ministerial Order N 430-N “On Defining the List of Waste Classified by Risk Level”. The order classifies hazardous waste in four categories and provides documentation format for waste declaration, notification and removal.

Article 9 of RA Law "on Waste" provides the authorities of the Ministry of Healthcare. According to the mentioned article the Ministry has authority to develop public health safety requirements to be incorporated into the normative- technical documents on waste management; elaborate sanitary and epidemic rules, norms and hygienic standards aimed at prevention of dangerous and adverse effects of waste on human health in the process of waste production, collection, transportation, storage, processing, recycling, removal, disinfection and landfill; oversee implementation of these requirements;

Based on the mentioned provision among provisions of other legal acts, on 29 October, 2009 the Order N 20-N of the Minister of Healthcare "On Defining Sanitary Rules and Norms N 2.1.7.001-09 “Hygienic Requirements to the Management of Hazardous Waste and Storage and Transportation of Hazardous Chemical Substances”" was issued. The mentioned sanitary rules and norms define the sanitary-hygienic requirements to the management (prevention of waste generation, collection, transportation, storage, processing, reprocessing, recycling, removal, disinfection and landfilling) of hazardous chemical waste and to the storage and transportation of hazardous chemical substances. The management of hazardous chemical waste storage and transportation of hazardous chemical substances is differentiated by I to IV categories of risk level stipulated by the Ministerial Order N 430-N “On Defining the List of Waste Classified by Risk Level”

The scope of regulation of the order includes:

- Sanitary requirements to the temporary storage and transportation of hazardous chemical waste,
- Sanitary-hygienic requirements to the structure and maintenance of facilities concerned with destruction, disinfection and landfilling of hazardous chemical waste,
- Sanitary-hygienic requirements to the placement and structure of hazardous chemical waste stores,
- Requirements to the storage and supply of hazardous chemical substances,
- Requirements to the work safety of the workers of the sphere of hazardous waste and hazardous chemical substances management,

Passportization is required for legal entities and private entrepreneurs that produce hazardous waste. This requirement is based on RA Government Decision No 47-N “On Defining Procedure for Waste Passportization” dated 19 January, 2006. Waste passports are prepared by the heads of organizations and private entrepreneurs and coordinated with the Ministry

of Nature Protection that defines the form of sample passport (Ministerial Order No 19-N “On Defining the Form of Sample Passport of Waste” dated 2 February, 2007). Passports are made for all types of hazardous waste that an entity produces. The waste passports are to be approved for all types of hazardous waste. Waste passports must cover the information as defined by the Decision and are issued in two copies – one for the entity generating waste and the other for the authorized body for filing. The holders of waste passports will have to review the passports in case the waste generator has additional or new information on the given waste.

The legal framework stipulating obligations for legal entities and private entrepreneurs to submit reports consists of RA Government Decrees N 47-N “On Defining Procedure for Waste Passportization ” dated 19 January and Order No 112-N of the Ministry of Nature Protection dated 22 August, 2002. The later approved the forms for administrative statistical data reporting.

#### **Administrative and/or Criminal Liability**

Relevant articles:

- The RA Code of Administrative Violations
  - Article 431: Failure to Organize Timely Refuse Collection, Placing Refuse in Unauthorized Places, Failure to Provide Necessary Conditions for Refuse Collection.
  - Article 2011: Violation of Rules of Transportation and Removal of Hazardous and Other Type of Waste.
  - Article 2012: Illegal Circulation of Hazardous and Other Type of Waste.
  - Article 201.3: Failure to Coordinate Waste Passports.
- The RA Criminal Code
  - Article 284: Violation of the Safety Rules of Handling Hazardous Chemical and Biological Substances and Waste.

## 9.2 Appendix II: Water Use Permits

Annex 1

to the decree # 218-Ն of the  
RA Government as of March 07, 2003

### **MINISTRY OF NATURE PROTECTION OF THE REPUBLIC OF ARMENIA**

**WATER RESOURCES MANAGEMENT AGENCY OF THE REPUBLIC OF  
ARMENIA**

**WATER PERMIT # 000259**

**5-1-Ձ/Կ-Մ-Ե**

**CONTOURGLOBAL HYDRO CASCADE CJSC**

**SHAMB HPP**

**MINISTER OF NATURE  
PROTECTION OF RA A.  
GRIGORYAN**

Head of the water resources management and protection  
authority

Issued on August 21, 2015

Extended until

Head of the water resources management and protection  
authority

**CONTOURGLOBAL HYDRO  
CASCADE CJSC**

**GENERAL DIRECTOR GARRY  
LEVESLEY** Recipient of water permit

Valid till August 21, 2018

Recipient of water permit

1. Address of water user: 9, G. Lusavorich 9, Yerevan, Armenia; tel.: +374 93000311
2. Place of water use: administrative territory of Shamb workers' village community, Syunik region, Armenia
3. Place of water intake: administrative territory of Shamb workers' village community, Syunik region, Armenia
4. Purpose of water use: energy (operation of HPP)

5. Volume of water use, including: a) surface water: Vorotan and Sisian rivers through Tolors water reservoir, 502,402.0 thousand m<sup>3</sup> p. a., 1,376,445.0 m<sup>3</sup> p. d., 15,931.0 l/sec; b) ground waters: n/a
6. Period and regime of water use: 365 days p. a. 24 hours p. d.
7. Controls of compliance with the terms of water permit: (i) control and recording of the volume of water intake; (ii) purpose use of water resources; (iii) ensuring minimum water flow adequate for wildlife and water quality at intake.
8. Allowed volume of sewage/waste water discharged into water bodies or their catchment basin: Vorotan river: 502,402.0 thousand m<sup>3</sup> p. a., 1,376,445.0 m<sup>3</sup> p. d., 15,931.0 l/sec
9. Description of discharge: no qualitative or quantitative changes in water due to operation of HPP
10. Allowed concentrations of hazardous substances in waste water: no qualitative changes in water due to operation of HPP
11. Water standards and/or related publications: publication of results of qualitative and quantitative monitoring (if any) of water resources in local mass media
12. Special measures for efficient use of water resources, improvement of water quality, protection of vital super-moist adjacent ecosystems and biodiversity: deploying fish passageways at intake and allowing minimum water flow adequate for wildlife and water quality at intake
13. Requirements for registration, monitoring and adjustment of water use: (i) deploy a water gauge at intake and seal/lock it in accordance with the established procedure; (ii) maintain a water use register and report to the Ministry of Nature Protection on annual basis according to the 2-unu form
14. Guarantees against harm to water resources: compensation pursuant to the legislation of RA for damages caused through violation of the RA Water Code
15. Water permit-related charges and payment schedule: government duty receipt # U/Հ
16. The water permit is subject to registration in the state water cadastre within \_\_\_ days.

The water permit is registered with the state water cadaster. Registration book N 6, note N271

This water permit is prepared in two copies.

\*In cases provided for by the Law of the Republic of Armenia “On Earth Subsurface”, an agreement on use of earth subsurface is required for the use of ground waters.

# 000259, August 21, 2015

## ADDITIONAL TERMS FORMING INDISPENSABLE PART OF WATER PERMIT

These terms have been developed pursuant to article 32 of the Water Code of the Republic of Armenia and are binding upon the holder of the permit.

1. ContourGlobal Hydro Cascade CJSC (Shamb HPP) shall:
  - a) Ensure compliance with the requirements of the RA legislation in relation to receipt of water permit # 000259 and use of water resources
  - b) In emergency situations and in the event of drought ensure compliance with the requirements of the Water Resources Management Agency of the Ministry of Nature Protection of RA aimed at protection of environment and public interest
  - c) Not restrict water use rights of traditional users using water resources before issuance of the permit # 000259
  - d) Ensure the required conditions for the appropriate employee of the Water Resources Management Agency of the Ministry of Nature Protection of RA to check compliance with the terms of water permit
  - e) In case of request for use of water for drinking and irrigation purposes the company shall upon request provide the water permit to the Water Resources Management Agency to have the water use volumes reviewed.
  - f) To cancel the Water permit N 000057 ՋԹ, issued on 22 April 2014
2. Ensure compliance with the RA Government decree # 118-Ն as of January 14, 2010 “On Application of Modern Technologies, Improvement of Monitoring of Water Resources and Reduction and Prevention of Pollution”.
3. Upon request of the Water Resources Management Agency the terms of this water permit are subject to review during development of the plan for management of the given basin.

4. Coordinates of intake and discharge points:

X = 46°02'26.3" Y = 39°29'07.3" H = 1,662 m

X = 46°07'51.3" Y = 39°28'23.2" H = 1,353 m

Minister of Nature Protection of the  
Republic of Armenia

A. Grigoryan

August 21, 2015

General Director of ContourGlobal  
Hydro Cascade CJSC

Garry Levesley

August 21, 2015

Annex 1

to the decree # 218-Ն of the  
RA Government as of March 07, 2003

**MINISTRY OF NATURE PROTECTION  
OF THE REPUBLIC OF ARMENIA**

**WATER RESOURCES MANAGEMENT AGENCY OF THE REPUBLIC OF  
ARMENIA**

**WATER PERMIT # 000258**

**5-1-Ջ/Կ-Մ-Ե**

**CONTOURGLOBAL HYDRO CASCADE CJSC**

**TATEV HPP**

**MINISTER OF NATURE  
PROTECTION OF RA A.  
GRIGORYAN**

Head of the water resources management and protection  
authority

**Issued on August 21, 2015**

**Extended until**

Head of the water resources management and protection  
authority

**CONTOURGLOBAL HYDRO  
CASCADE CJSC**

**GENERAL DIRECTOR GARRY  
LEVESLEY** Recipient of water permit

**Valid till August 21, 2018**

Recipient of water permit

1. Address of water user: Gr. Lusavorich 9, Yerevan, Armenia; tel.: +374 93000311
2. Place of water use: administrative territory of Vorotan workers' village community, Syunik region, Armenia
3. Place of water intake: administrative territory of Vorotan workers' village community, Syunik region, Armenia
4. Purpose of water use: energy (operation of HPP)
5. Volume of water use, including: a) surface water: Vorotan river through Shamb water reservoir, 584603.7 thousand m<sup>3</sup> p. a., 1601654.0 m<sup>3</sup> p. d., 18538.0 l/sec; b) ground waters: n/a
6. Period and regime of water use: 365 days p. a. 24 hours p. d.
7. Controls of compliance with the terms of water permit: (i) control and recording of the volume of water intake; (ii) purpose use of water resources;

- (iii) ensuring minimum water flow adequate for wildlife and water quality at intake.
8. Allowed volume of sewage/waste water discharged into water bodies or their catchment basin: Vorotan river: 584603.7 thousand m<sup>3</sup> p. a., 1601654.0 m<sup>3</sup> p. d., 18538.0 l/sec
  9. Description of discharge: no qualitative or quantitative changes in water due to operation of HPP
  10. Allowed concentrations of hazardous substances in waste water: no qualitative changes in water due to operation of HPP
  11. Water standards and/or related publications: publication of results of qualitative and quantitative monitoring (if any) of water resources in local mass media
  12. Special measures for efficient use of water resources, improvement of water quality, protection of vital super-moist adjacent ecosystems and biodiversity: deploying fish passageways at intake and allowing minimum water flow adequate for wildlife and water quality at intake
  13. Requirements for registration, monitoring and adjustment of water use: (i) deploy a water gauge at intake and seal/lock it in accordance with the established procedure; (ii) maintain a water use register and report to the Ministry of Nature Protection on annual basis according to the 2-unu form
  14. Guarantees against harm to water resources: compensation pursuant to the legislation of RA for damages caused through violation of the RA Water Code
  15. Water permit-related charges and payment schedule: government duty receipt # U/Հ
  16. The water permit is subject to registration in the state water cadastre within \_\_\_ days.

The water permit is registered with the state water cadaster. Registration book N 6, note N270

This water permit is prepared in two copies.

\*In cases provided for by the Law of the Republic of Armenia “On Earth Subsurface”, an agreement on use of earth subsurface is required for the use of ground waters.



# 000258, August 21, 2015

## ADDITIONAL TERMS FORMING INDISPENSABLE PART OF WATER PERMIT

These terms have been developed pursuant to article 32 of the Water Code of the Republic of Armenia and are binding upon the holder of the permit.

1. ContourGlobal Hydro Cascade CJSC (Tatev HPP) shall:
  - a. Ensure compliance with the requirements of the RA legislation in relation to receipt of water permit # 000258 and use of water resources
  - b. In emergency situations and in the event of drought ensure compliance with the requirements of the Water Resources Management Agency of the Ministry of Nature Protection of RA aimed at protection of environment and public interest
  - c. Not restrict water use rights of traditional users using water resources before issuance of the permit # 000258
  - d. Ensure the required conditions for the appropriate employee of the Water Resources Management Agency of the Ministry of Nature Protection of RA to check compliance with the terms of water permit
  - e. In case of request for use of water for drinking and irrigation purposes the company shall upon request provide the water permit to the Water Resources Management Agency to have the water use volumes reviewed.
  - f. To cancel the Water permit N 000056 ՋԹ, issued on 22 April 2014.
2. Ensure compliance with the RA Government decree # 118-Ն as of January 14, 2010 “On Application of Modern Technologies, Improvement of Monitoring of Water Resources and Reduction and Prevention of Pollution”.
3. Upon request of the Water Resources Management Agency the terms of this water permit are subject to review during development of the plan for management of the given basin.
4. Coordinates of intake and discharge points:

X = 46°09'48.4"    Y = 39°27'28.0"    H = 1,344 m

X = 46°22'18.3"    Y = 39°25'38.3"    H = 741 m

Minister of Nature Protection of the  
Republic of Armenia

A. Grigoryan

August 21, 2015

General Director of ContourGlobal  
Hydro Cascade CJSC

Garry Levesley

August 21, 2015

## Annex 1

to the decree # 218-Ն of the  
RA Government as of March 07, 2003

**MINISTRY OF NATURE PROTECTION  
OF THE REPUBLIC OF ARMENIA**

WATER RESOURCES MANAGEMENT AGENCY OF THE REPUBLIC OF  
ARMENIA

WATER PERMIT # 000260

5-1-Ձ/Կ-Մ-Ե

CONTOURGLOBAL HYDRO CASCADE CJSC

SPANDARYAN HPP

MINISTER OF NATURE  
PROTECTION OF RA A.  
GRIGORYAN

Head of the water resources management and protection  
authority

Issued on August 21, 2015

Extended until

Head of the water resources management and protection  
authority

CONTOURGLOBAL HYDRO  
CASCADE CJSC

GENERAL DIRECTOR GARRY  
LEVESLEY Recipient of water permit

Valid till August 21, 2018

Recipient of water permit

1. Address of water user: 9, G. Lusavorich str., Yerevan, Armenia; tel.: +374 93000311
2. Place of water use: administrative territory of Shaghat community, Syunik region, Armenia
3. Place of water intake: administrative territory of Shaghat community, Syunik region, Armenia
4. Purpose of water use: energy (operation of HPP)
5. Volume of water use, including: a) surface water: Vorotan river through Spandaryan water reservoir, 298,200.0 thousand m<sup>3</sup> p. a., 816,987.0 m<sup>3</sup> p. d., 9,456.0 l/sec; b) ground waters: n/a
6. Period and regime of water use: 365 days p. a. 24 hours p. d.

7. Controls of compliance with the terms of water permit: (i) control and recording of the volume of water intake; (ii) purpose use of water resources; (iii) ensuring minimum water flow adequate for wildlife and water quality at intake.
8. Allowed volume of sewage/waste water discharged into water bodies or their catchment basin: Vorotan river: 298,200.0 thousand m<sup>3</sup> p. a., 816,987.0 m<sup>3</sup> p. d., 9,456.0 l/sec
9. Description of discharge: no qualitative or quantitative changes in water due to operation of HPP
10. Allowed concentrations of hazardous substances in waste water: no qualitative changes in water due to operation of HPP
11. Water standards and/or related publications: publication of results of qualitative and quantitative monitoring (if any) of water resources in local mass media
12. Special measures for efficient use of water resources, improvement of water quality, protection of vital super-moist adjacent ecosystems and biodiversity: deploying fish passageways at intake and allowing minimum water flow adequate for wildlife and water quality at intake
13. Requirements for registration, monitoring and adjustment of water use: (i) deploy a water gauge at intake and seal/lock it in accordance with the established procedure; (ii) maintain a water use register and report to the Ministry of Nature Protection on annual basis according to the 2-unu form
14. Guarantees against harm to water resources: compensation pursuant to the legislation of RA for damages caused through violation of the RA Water Code
15. Water permit-related charges and payment schedule: government duty receipt # U/2
16. The water permit is subject to registration in the state water cadastre within \_\_\_ days.

The water permit is registered with the state water cadaster. Registration book N 6, note N272

This water permit is prepared in two copies.

\*In cases provided for by the Law of the Republic of Armenia “On Earth Subsurface”, an agreement on use of earth subsurface is required for the use of ground waters.

# 000260, August 21, 2015

## ADDITIONAL TERMS FORMING INDISPENSABLE PART OF WATER PERMIT

These terms have been developed pursuant to article 32 of the Water Code of the Republic of Armenia and are binding upon the holder of the permit.

1. ContourGlobal Hydro Cascade CJSC (Spandaryan HPP) shall:
  - a. Ensure compliance with the requirements of the RA legislation in relation to receipt of water permit # 000260 and use of water resources
  - b. In emergency situations and in the event of drought ensure compliance with the requirements of the Water Resources Management Agency of the Ministry of Nature Protection of RA aimed at protection of environment and public interest
  - c. Not restrict water use rights of traditional users using water resources before issuance of the permit # 000260
  - d. Ensure the required conditions for the appropriate employee of the Water Resources Management Agency of the Ministry of Nature Protection of RA to check compliance with the terms of water permit
  - e. In case of request for use of water for drinking and irrigation purposes the company shall upon request provide the water permit to the Water Resources Management Agency to have the water use volumes reviewed.
  - f. cancellation of water permit # 000055 ՁԹ as of April 22, 2014.
2. Ensure compliance with the RA Government decree # 118-Ն as of January 14, 2010 “On Application of Modern Technologies, Improvement of Monitoring of Water Resources and Reduction and Prevention of Pollution”.
3. Upon request of the Water Resources Management Agency the terms of this water permit are subject to review during development of the plan for management of the given basin.
4. Coordinates of intake and discharge points:

X = 45°50'52.3"    Y = 39°38'53.3"    H = 2072.0 m

X = 45°54'49.0"    Y = 39°34'23.1"    H = 1715.0 m

Minister of Nature Protection of the  
Republic of Armenia

A. Grigoryan

August 21, 2015

General Director of ContourGlobal  
Hydro Cascade CJSC

Garry Levesley

August 21, 2015

### 9.3 Appendix III: Records of Meetings and Site Visits

Date	Agency/ Institution/ Company	Place	Name of Person consulted Position	Reason for Visit
28 Sep 2015	ContourGlobal Hydro Cascade CJSC	Spandaryan Reservoir Spandaryan HPP Angeghakot Reservoir	Aram Arushanyan Engineer of ContourGlobal Electric Department, Sergey Pogosyan Chief of Spandaryan HPP	Inspection of facilities
29 Sep 2015	ContourGlobal Hydro Cascade CJSC	Tolors Reservoir Shamb HPP Shamb/Tatev Reservoir	Smbat Mkrtchyan Chief of Investment Programs Department, Anush Gharagyozyan Chief of Health and Safety Department, Syoma Avanesyan Chief of Shamb HPP	Inspection of facilities
29 Sep 2015	Sisian Municipality	Sisian	Karen Hovhannisyan Deputy Mayor	Possible concerns about Vorotan Cascade
29 Sep 2015	Uyts Community	Uyts	Avetyan Artak Community Head	Possible concerns about Vorotan Cascade
30 Sep 2015	ContourGlobal Hydro Cascade CJSC	Daily Regulation Reservoir Tatev HPP	Smbat Mkrtchyan Chief of Investment Programs Department, Mamikon Gharagyozyan Hydroworkshop Superintendent, Aram Yolyan Chief of Tatev HPP	Inspection of facilities
30 Sep 2015	Goris Municipality	Goris	Vachagan Adunts Mayor	Possible concerns about Vorotan Cascade
30 Sep 2015	Landfill	Goris		Waste dumping situation
30 Sep 2015	Vorotan Water Users Company	Shinuhayr	Sevada Adamyan	Vorotan River water use for irrigation purposes between HPP Shamb and HPP Tatev

Date	Agency/ Institution/ Company	Place	Name of Person consulted Position	Reason for Visit
01 Oct 2015	ContourGlobal Hydro Cascade CJSC	Spandaryan Reservoir Spandaryan HPP Angeghakot Reservoir	Smbat Mkrtchyan Chief of Investment Programs Department, Sergey Pogosyan Chief of Spandaryan HPP	Inspection of facilities
01 Oct 2015	'Sisian' Water Users Association (WUA)	Sisian	Azazat Tangyan Head of WUA, Tsangtzyan Hamlet Chief Engineer	Vorotan River water use for irrigation purposes between HPP Spandaryan and HPP Shamb
01 Oct 2015	Municipality of Shaghat	Shaghat	Noza Stepanya, Hoyk Ohanyan	Vorotan River water use for irrigation purposes upstream HPP Spandaryan; visit of the water extraction site upstream Spandaryan HPP
02 Oct 2015	Aarhus Centers of Armenia	Yerevan	Silva Ayvazyan Coordinator of Yerevan Aarhus Center, Mary Chakryan PR Manager of Yerevan Aarhus Center	Concerns received from local population and other NGOs about Vorotan Cascade
12 Oct 2015	Regional Environmental Inspectorate, Kapan	Telephone call	Levon Petrosyan Head of the Environmental Inspection, Syunik Region	Possible concerns about Vorotan Cascade

#### 9.4 Appendix IV: Maps Based on High Resolution Satellite Pictures



**Map 2:** Overview map of Spandaryan Reservoir





**Map 3:** Detailed map of Spandaryan Dam Site (red line: proposed location of swimming barrier)





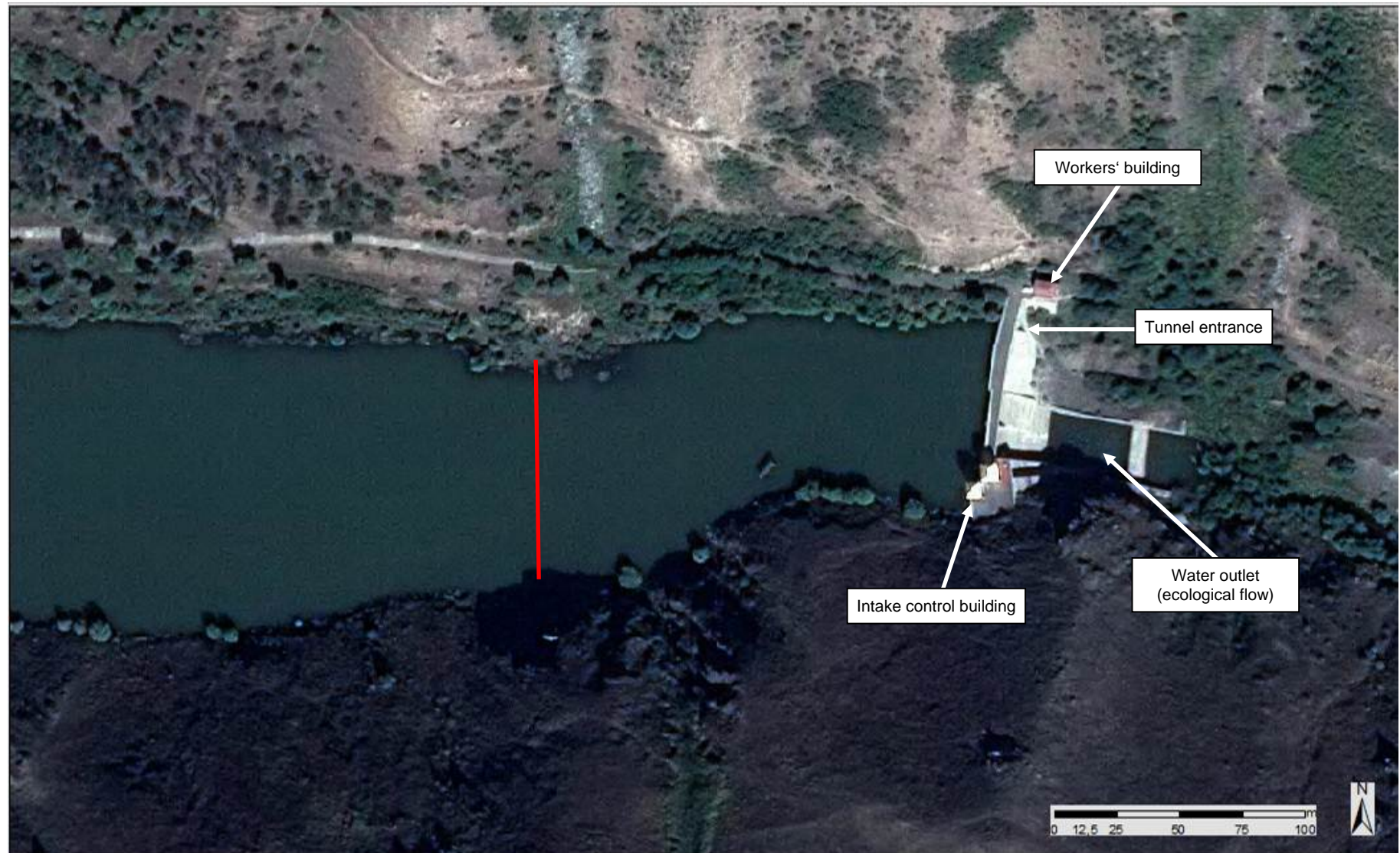
**Map 4:** Overview map of Spandaryan HPP and Angeghakot Reservoir





**Map 5:** Detailed map of Spandaryan HPP





**Map 6:** Detailed map of Angeghakot Dam Site (red line: proposed location of swimming barrier)





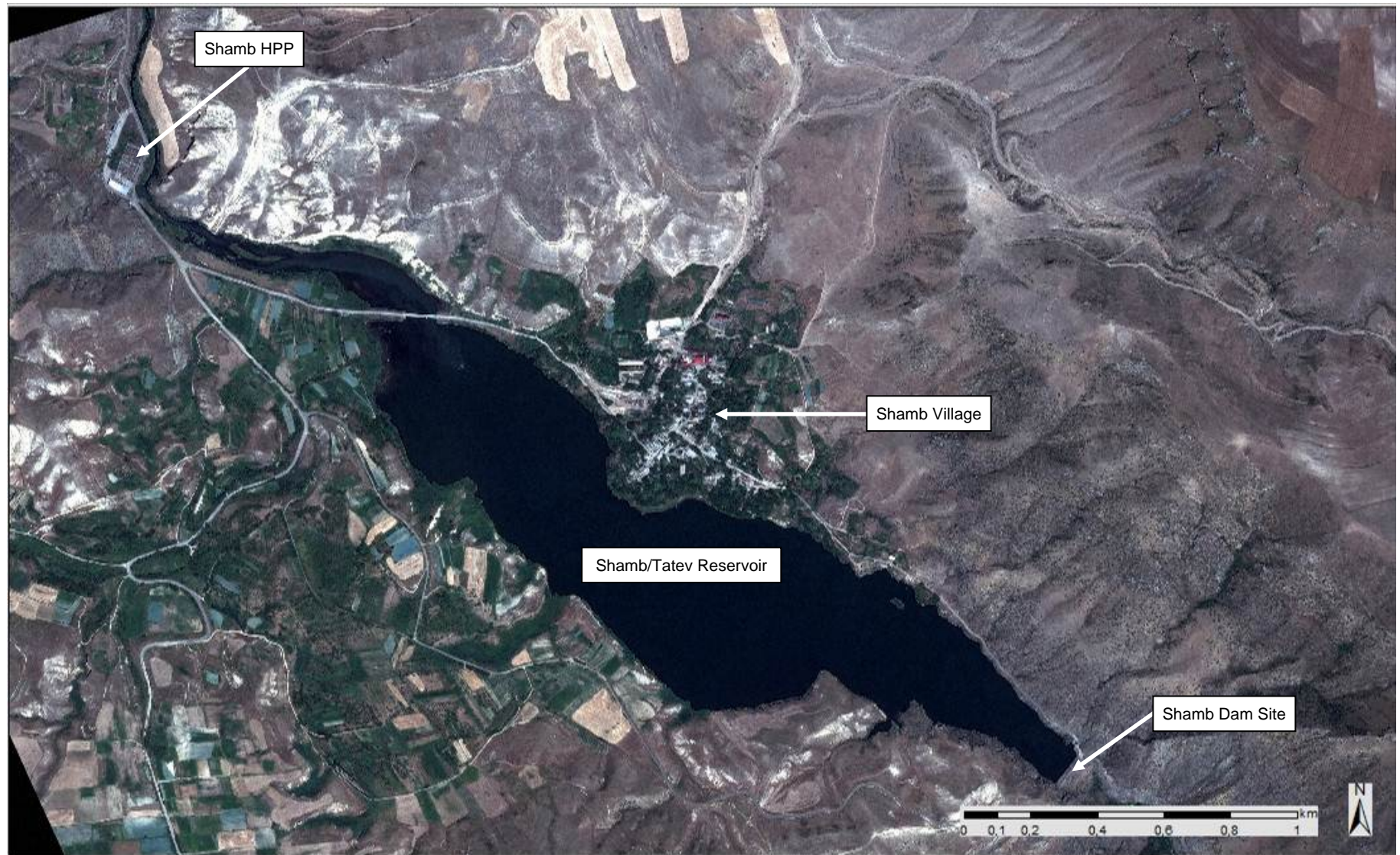
**Map 7:** Overview map of Tolors Reservoir





**Map 8:** Detailed map of Tolors Dam Site (red line: proposed location of swimming barrier)





**Map 9:** Overview map of Shamb HPP and Shamb/Tatev Reservoir





**Map 10:** Detailed map of Shamb HPP





**Map 11:** Detailed map of Shamb/Tatev Dam Site (red line: proposed location of swimming barrier)





**Map 12:** Overview map of Tatev Daily Regulation Reservoir and Tatev HPP





**Map 13:** Detailed map of Tatev Daily Regulation Reservoir





**Map 14:** Detailed map of Tatev HPP