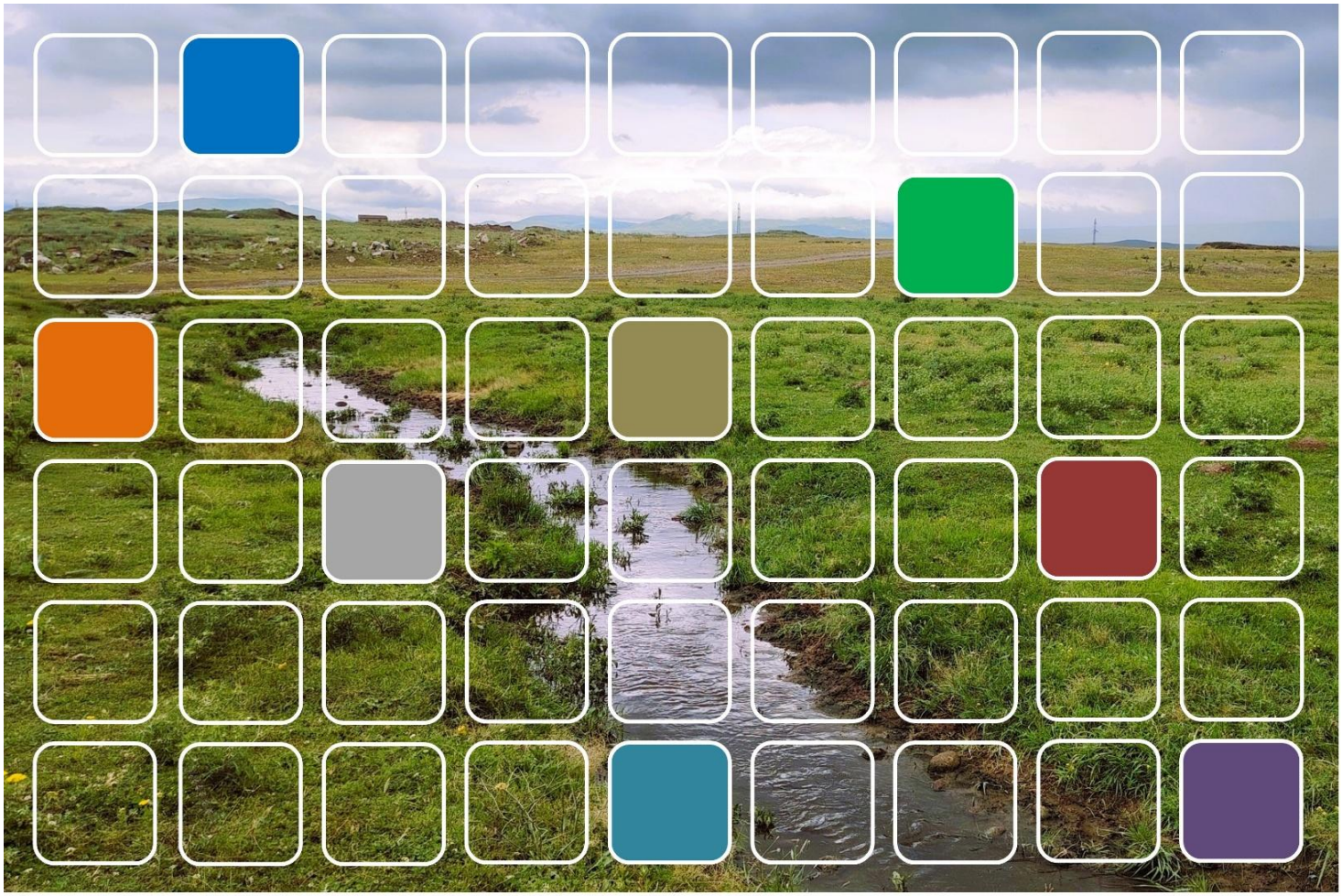

Source: Photo taken by the Consultant during the site visit

# WATER RESERVOIRS PROJECT - ARMENIA

## Environmental and Social Impact Assessment for the Artik Reservoir Construction Project

# ESIA REPORT

**Rev02**

**December 2025**

**Prepared for:**

**European Bank for Reconstruction and Development**

***and***

**Water Committee under the Ministry of Territorial Administration and Infrastructure of the Republic of Armenia**

ATMS Solutions

www.atms.am

# WATER RESERVOIRS PROJECT - ARMENIA

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# ESIA REPORT

**Rev02**

**Consultancy Services Contract № 2023.009567**

**Prepared for:**

- **European Bank for Reconstruction and Development**
- **Water Committee under the Ministry of Territorial Administration and Infrastructure of the Republic of Armenia**

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| | | | | | |

# Disclaimer

This Environmental and Social Impact Assessment (ESIA) Report has been prepared at the request of the Client in accordance with applicable national legislation, the European Bank for Reconstruction and Development (EBRD) Environmental and Social Policy (ESP, 2019) and Performance Requirements (PRs) as well as Good International Practices (GIP).

The ESIA is based on information, data, and documentation provided by the Client, third parties, and publicly available sources, as well as site visits and stakeholder engagement activities undertaken at the time of assessment. Reasonable efforts have been made to verify the accuracy and completeness of the information used; however, the consultants do not warrant that such information is complete or free from error. Any reliance placed on this Report by third parties is at their own risk.

This Report reflects the professional judgment of the consultants, taking into account the scope of work agreed with the Client, the conditions prevailing at the time of preparation, and the information reasonably available. Environmental and social conditions, regulatory frameworks, project design, and stakeholder concerns may change over time. Accordingly, the findings, conclusions, and recommendations presented herein may require revision should new information become available or should material changes to the Project occur.

This ESIA Report has been prepared solely for the purposes described above and should not be relied upon for any other purpose, including but not limited to detailed engineering design, legal interpretation, or financial decision-making. The consultants accept no responsibility or liability for the use of this Report, in whole or in part, by any party other than the Client or EBRD, or for any purpose other than that for which it was prepared

# List of Abbreviations

ACL - Admissible Concentration Limits
BAP - Biodiversity Action Plan
BMP - Biodiversity Management Plan
BSMP - Blasting Safety Management Plan
CCSM - Community Climate System Model
CESMP - Construction Environmental and Social Management Plan
CH - Critical Habitat
CJSC - Close Joint Stock Company
CIA - Cumulative Impact Assessment
CN - Construction Norms
CN&R - Construction Norms and Rules
NDC - Nationally Determined Contribution
DSL - Dead Storage Level
EBRD - European Bank for Reconstruction and Development
EIA - Environmental Impact Assessment
EIEC - Environmental Impact Examination Centre
EPRP - Emergency Preparedness and Response Plan
ESAP - Environmental and Social Action Plan
ESIA - Environmental and Social Impact Assessment
ESMP - Environmental and Social Management Plan
ESMS - Environmental and Social Management System
ESP - Environmental and Social Policy
EU - European Union
E&S - Environmental and Social
FSL - Full Supply Level
GBVH - Gender-Based Violence and Harassment
GHG - Greenhouse Gas
GPN - Good Practise Note
GRP - Glass-Reinforced Plastic
HMMP - Hazardous Materials Management Plan
ICH - Intangible Cultural Heritage
IFI - International Financial Institution
LLC - Limited Liability Company
LT-LEDS - Long Term - Low Emission Development Strategy
ME - Ministry of Environment

MSDS - Material Safety Data Sheets
MWL - Maximum Water Level
OHS - Occupational Health and Safety
OHSMP - Occupational Health and Safety Management Plan
GA - Government of Armenia
PAP - Project Affected Person
PBF - Priority Biodiversity Features
PE - Polyethylene
PPE - Personal Protective Equipment
PR - Performance Requirement
PSHA - Probabilistic Seismic Hazard Assessment
RA - Republic of Armenia
SDA - Spoil Disposal Area
SDMP - Spoil Disposal Management Plan
SPA - Spoil Disposal Area
SPMP - Spill Prevention and Management Plan
SEP - Stakeholder Engagement Plan
SNCO - State None Commercial Organization
SSESMP - Site-Specific Environmental and Social Management and Monitoring Plan
STD - Sexually Transmitted Disease
TLV - Threshold Limit Value
TMP - Tree Management Plan
TsMP - Topsoil Management Plan
ToR - Terms of Reference
VEC - Valued Environmental and Social Component
WB - World Bank
WMP - Waste Management Plan
WUA - Water Users Association

# Content

# 1. Introduction

## 1.1 Background

The Government of the Republic of Armenia ('RA') plans to construct 17 reservoirs within the EU support initiative 'Recovery, resilience and reform: post 2020 Eastern Partnership priorities' to the Government of Armenia ('GA') to enhance the water and food security level in the country. The European Bank for Reconstruction and Development ('EBRD' or the 'Bank') is considering provision of a loan to the GA to finance the construction of five water reservoirs in different regions (marzes) of Armenia (the 'Project'):

- Kassakh reservoir in Aragatsotn Marz[1],
- Lichk reservoir in Syunik Marz,
- Yelpin reservoir in Vayots Dzor Marz,
- Artik reservoir in Shirak Marz,
- Astghadzor reservoir in Gegharkunik Marz.

The EBRD has categorized this greenfield project as 'A' in line with its Environmental and Social Policy ('ESP') (2019) because it may cause significant environmental and social impacts. This means that a comprehensive Environmental and Social Impact Assessment ('ESIA') report and associated documents must be elaborated, followed by their public disclosure for a minimum period of 120 days.

The Project's implementing agency is the Water Committee under the RA Ministry of Territorial Administration and Infrastructure ('Client' or 'Water Committee' or 'WCRA'). The Water Committee hired a national consultants to carry out Environmental and Social ('E&S') studies, develop Environmental Impact Assessment ('EIA') reports for the Project's five reservoirs in accordance with the relevant national legislation, and obtain environmental expert examination conclusions (permits) from the State Authorized Body (that is, the Environmental Impact Examination Centre (EIEC) under the RA Ministry of Environment (ME)).

The national EIA reports for the five reservoirs have passed the national expert examination process and received positive environmental expert examination conclusions. Although the national EIA reports comply with national requirements, they need to be further upgraded to align with the EBRD Environmental and Social Policy (ESP), including the implementation of a series of supplementary E&S studies:

- Spring season field biodiversity surveys and Critical Habitat Assessment,
- Appropriate Assessments and Biodiversity Action Plans (if required),
- Analysis of Project alternatives,
- Cumulative impact assessment,
- Assessment of impacts of the associated facilities,
- Assessment of greenhouse gas emissions and climate change mitigation measures,
- Water infiltration and loss study, water and soil quality surveys, etc.

One of the five reservoirs listed above is planned for construction within the administrative boundaries of Artik community, located in the Shirak Marz of the Republic of Armenia (RA). The Artik Reservoir is to be constructed on the Artikjur River, a tributary of the Karkachun River, and is

[1]Marz - Region in Armenian

intended to supply irrigation water to 300 hectares of agricultural land in the rural settlements of the Artik community, including the villages of Nor Kyanq, Vardaqar, Panik, Meghrashen, and Anushavan.

This ESIA report presents the key findings of the national EIA report for the Artik reservoir, which has been significantly upgraded to incorporate the outcomes of the supplementary studies outlined above as well as restructured and refined to ensure alignment with the EBRD ESP.

The positive environmental expert examination conclusion №278-24 for the Artik reservoir EIA report was issued by the EIEC under the ME on 13.12.2024 (**Annex 1**).

## 1.2 Objective and Scope of Works

The objective of the Assignment is to identify and assess any potentially significant future adverse environmental and social impacts associated with the proposed Project, assess compliance with applicable national E&S legislation and the EBRD ESP (2019) and Performance Requirements ('PR'), determine the measures needed to prevent or minimize and mitigate the adverse impacts, and identify potential environmental and social benefits / opportunities, including those that would improve the environmental and social sustainability of the Project.

The scope of work under the Assignment included the following tasks:

1) Reviewing and identifying applicable national E&S legislative requirements, as well as EU substantive environmental standards, Good International Practices ('GIP'), and EBRD Performance Requirements ('PR').
2) Outlining the Project components and associated facilities.
3) Updating the existing E&S baseline data developed during the national EIA studies by incorporating the results of the supplementary studies.
4) Analysing the outputs of the stakeholder consultation process conducted during the national EIA studies, and identifying key stakeholder concerns and recommendations.
5) Analysing project alternatives and justifying the selected option.
6) Identifying the Project's footprint and assessing its impacts on the physical, biological, socio-economic, and cultural environments, including potential benefits and opportunities from Project implementation.
7) Cumulative impact assessment and transboundary impact.
8) Proposing E&S management and mitigation measures, and assessing residual impacts.
9) Developing an environmental monitoring plan and site-specific E&S management plans.

## 1.3 Content of the ESIA Report

This report has been prepared as part of the Project's ESIA study. It is structured in a manner to address the following sections requested by the Project 'ToR':

Chapter 1 - Introduction,
Chapter 2 - Project Description,
Chapter 3 - Project Alternatives,
Chapter 4 - Legal and Regulatory Framework,
Chapter 5 - ESIA Methodology and Approach,

Chapter 6 - E&S baseline,
Chapter 7 - Stakeholder Consultation,
Chapter 8 - E&S Impacts Assessment, Benefits and Opportunities, Mitigation Measures,
Chapter 9 - E&S Management and Monitoring.

## 1.4 Sources of Information

The key information and data sources used to prepare this ESIA report include:

- Project ToR (issued by the EBRD),
- ToR for the local EIA consultant,
- National EIA report for the Artik reservoir (in Armenian) (minenv.am),
- Project design document for Artik reservoir,
- Information about the Water Committee from its website (scws.am),
- Armenia Water Reservoirs - Technical, Economic and Green Due Diligence Gap Analysis, Draft Final Report, 2023-2024, Ove Arup & Partners,
- Technical, Economic and Green Due Diligence of Water Reservoirs in Armenia Inception Report, March 2024, Ove Arup & Partners,
- Documents/information provided by the Water Committee,
- E&S reports and documents related to the ongoing water sector projects (Vedi and Kaps reservoirs),
- Meetings/consultations with the national EIA Consultant,
- Result of field studies and meetings with the project stakeholders,
- Key findings of supplementary studies,
- Available maps, layouts, reports, etc. related to the project area.

# 2. Project Description

## 2.1 Agricultural Problems specific to the Project Region

According to the data provided by Artik municipality, the areas of irrigable lands in rural settlements by crop composition are as follows:

**Table 2-1. Actual area of irrigated lands by crops**

| № | Rural settlements | | Wheat | Vegetables | Potato | Orchards | Total |
|---|---|---|---|---|---|---|---|
| 1 | Nor Kyanq, ha | | 5 | 75 | 85 | 2 | 167 |
| 2 | Vardaqar, ha | | 5 | 40 | 60 | 5 | 110 |
| 3 | Panik, ha | | 3 | 24 | 27 | - | 54 |
| 4 | Meghrashen, ha | | 5 | 20 | 29 | - | 54 |
| 5 | Anushavan, ha | | 3 | 14 | 18 | - | 35 |
| **Total** | | **ha** | **21** | **173** | **219** | **7** | **420** |
| | | **%** | **5** | **41.2** | **52.1** | **1.7** | **100** |

Taking into account the 50% probability flow, it is justified that to irrigate 420 ha of agricultural lands, the useful capacity of the reservoir shall be 1.687 mln. $m^3$.

However, based on climate change considerations and the outputs of hydrological surveys (see **Section 2.3**), the data in **Table 2-1** were revised during the design phase by the project designer. As a result, the actual area planned for irrigation under the reservoir has been reduced to 300 ha.

## 2.2 Water Demand and Command Area

The justification for determining the reservoir volume was based on the following: monthly 50% and 75% probability flows entering the reservoir from the left-bank floodplains of the Artikjur and Karkachun Rivers; the monthly irrigation water demand for 300 ha; reservoir losses due to evaporation and infiltration; and required environmental monthly flows.

To meet 50% probability irrigation water demand for 300 ha, a reservoir with a useful volume of 1.152 mln. $m^3$ is required. However, under 75% probability conditions, it is not possible to fully meet the irrigation demand for the same area.

The agricultural lands under the reservoir command area according to crop composition and settlements are presented in **Table 2-2**.

**Table 2-2. Actual area of irrigated lands by crops**

| № | Rural settlements | | Wheat | Vegetables | Potato | Orchards | Total |
|---|---|---|---|---|---|---|---|
| 1 | Nor Kyanq, ha | | 4 | 51 | 62 | 1 | 118 |
| 2 | Vardaqar, ha | | 4 | 28 | 44 | 4 | 80 |
| 3 | Panik, ha | | 2 | 17 | 20 | - | 39 |
| 4 | Meghrashen, ha | | 3 | 14 | 21 | - | 38 |
| 5 | Anushavan, ha | | 2 | 10 | 13 | - | 25 |
| **Total** | | **ha** | **15** | **120** | **160** | **5** | **300** |
| | | **%** | **5** | **40** | **53.3** | **1.7** | **100** |

In the Project area, the irrigation water requirements for agricultural croplands are estimated based on the bulletin 'Norms and Regimes of Crop Irrigation for Irrigated Lands in the Republic of Armenia', approved by a joint decree of the RA Minister of Territorial Administration and the RA Minister of Agriculture in 2007[2].

## 2.3 Key Outputs of the Hydrological Study

The water regime of the Artik (also Artikjur) River has not been directly studied; therefore, all hydrological parameters were determined by analogy. The Gharibjanyan hydrological station on the Karkachun River was selected for this purpose.

Regular observations of the Karkachun River's water regime began in 1942, when a monitoring station was established near the village of Gharibjanyan. This station has been operating continuously to the present day.

The hydrological study of the Artikjur River was conducted by the Project Designer, a consortium comprising the "Institute of Water Problems and Hydro-Engineering named after I.V. Yeghiazarov" CJSC and the "Shushi Technological University" Foundation[3]. According to the study, to estimate the annual flow rate at the estimated cross-sections of the Artikjur River, transition coefficients were applied. These coefficients are equal to the ratio of the catchment areas of the calculated and reference cross-sections. Average monthly and annual flow data are presented based on an 80-year observation series.

The average annual water flows for the two left-bank ravines of the Karkachun River basin (cross-sections №2 and №3), as well as for the calculated cross-section of the Artik River under different flow probabilities, are presented in **Table 2-3**.

**Table 2-3. Average annual water discharges for various probabilities in the Karkachun River basin**

| River, section | Q, m³/s | Probability, % | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 3 | 5 | 10 | 25 | 50 | 75 | 90 | 95 | 97 | 99 |
| Karkachun River - Gharibjanyan station | 0.96 | 2.34 | 1.97 | 1.79 | 1.54 | 1.19 | 0.88 | 0.64 | 0.48 | 0.39 | 0.35 | 0.27 |
| Artik cross-section | 0.062 | 0.15 | 0.13 | 0.11 | 0.10 | 0.08 | 0.06 | 0.04 | 0.03 | 0.03 | 0.02 | 0.02 |
| №2 cross-section | 0.008 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| №3 cross-section | 0.016 | 0.04 | 0.03 | 0.03 | 0.03 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 |

The annual distribution of water flow in the Karkachun River basin has a pronounced seasonal character. From April to August, approximately 80% of the annual flow passes through the river. Based on water availability characteristics, the year 2003 was selected as an average-flow year, while 1962 as a low-flow year for the calculated cross-sections of the Karkachun River. These data are provided in **Table 2-4**, **2-5** and **2-6**.

[2]Ibid
[3]Consulting Services for the Preparation of Design and Estimate Documentation for the Reconstruction of the Artik Reservoir, Shirak Region, Republic of Armenia, Book №3-1 - Hydrological and seismic surveys, 2024

**Table 2-4. Distribution of monthly flows of years with 50% and 75% probabilities in the Artikjur River cross-section**

| Unit | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2003 - average flow year with 50% probability** | | | | | | | | | | | | | |
| % | 4.9 | 5.6 | 8.8 | 31.2 | 16.8 | 3.7 | 2.1 | 3.5 | 7.3 | 5.0 | 6.6 | 4.5 | 100 |
| $m^3/s$ | 0.035 | 0.040 | 0.063 | 0.224 | 0.121 | 0.026 | 0.015 | 0.025 | 0.053 | 0.036 | 0.047 | 0.033 | 0.060 |
| $mln.m^3$ | 0.09 | 0.10 | 0.17 | 0.58 | 0.32 | 0.07 | 0.04 | 0.07 | 0.14 | 0.10 | 0.12 | 0.09 | 1.89 |
| **1962 - low flow year with 75% probability** | | | | | | | | | | | | | |
| % | 5.8 | 6.1 | 13.4 | 13.5 | 13.4 | 3.8 | 6.0 | 4.7 | 9.8 | 10.8 | 6.7 | 6.0 | 100 |
| $m^3/s$ | 0.026 | 0.028 | 0.060 | 0.061 | 0.060 | 0.017 | 0.027 | 0.021 | 0.044 | 0.049 | 0.030 | 0.027 | 0.04 |
| $mln.m^3$ | 0.07 | 0.07 | 0.16 | 0.16 | 0.16 | 0.04 | 0.07 | 0.06 | 0.11 | 0.13 | 0.08 | 0.07 | 1.19 |

**Table 2-5. Distribution of monthly flows of years with 50% and 75% probabilities in №2 cross-section of the Karkachun River cross-section**

| Unit | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2003 - average flow year with 50% probability** | | | | | | | | | | | | | |
| % | 4.9 | 5.6 | 8.8 | 31.2 | 16.8 | 3.7 | 2.1 | 3.5 | 7.3 | 5.0 | 6.6 | 4.5 | 100.0 |
| $m^3/s$ | 0.005 | 0.006 | 0.009 | 0.031 | 0.017 | 0.004 | 0.002 | 0.003 | 0.007 | 0.005 | 0.007 | 0.004 | 0.008 |
| $mln.m^3$ | 0.01 | 0.01 | 0.02 | 0.08 | 0.04 | 0.01 | 0.01 | 0.01 | 0.02 | 0.01 | 0.02 | 0.01 | 0.26 |
| **1962 - low flow year with 75% probability** | | | | | | | | | | | | | |
| % | 5.8 | 6.1 | 13.4 | 13.5 | 13.4 | 3.8 | 6.0 | 4.7 | 9.8 | 10.8 | 6.7 | 6.0 | 100 |
| $m^3/s$ | 0.004 | 0.004 | 0.008 | 0.008 | 0.008 | 0.002 | 0.004 | 0.003 | 0.006 | 0.007 | 0.004 | 0.004 | 0.005 |
| $mln.m^3$ | 0.01 | 0.01 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 | 0.01 | 0.01 | 0.16 |

**Table 2-6. Distribution of monthly flows of years with 50% and 75% probabilities in №3 cross-section of the Karkachun River cross-section**

| Unit | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2003 - average flow year with 50% probability** | | | | | | | | | | | | | |
| % | 4.9 | 5.6 | 8.8 | 31.2 | 16.8 | 3.7 | 2.1 | 3.5 | 7.3 | 5.0 | 6.6 | 4.5 | 100 |
| $m^3/s$ | 0.009 | 0.010 | 0.016 | 0.057 | 0.031 | 0.007 | 0.004 | 0.006 | 0.013 | 0.009 | 0.012 | 0.008 | 0.015 |
| $mln.m^3$ | 0.02 | 0.02 | 0.04 | 0.15 | 0.08 | 0.02 | 0.01 | 0.02 | 0.03 | 0.02 | 0.03 | 0.02 | 0.48 |
| **1962 - low flow year with 75% probability** | | | | | | | | | | | | | |
| % | 5.8 | 6.1 | 13.4 | 13.5 | 13.4 | 3.8 | 6.0 | 4.7 | 9.8 | 10.8 | 6.7 | 6.0 | 100 |
| $m^3/s$ | 0.007 | 0.007 | 0.015 | 0.015 | 0.015 | 0.004 | 0.007 | 0.005 | 0.011 | 0.012 | 0.008 | 0.007 | 0.010 |
| $mln.m^3$ | 0.02 | 0.02 | 0.04 | 0.04 | 0.04 | 0.01 | 0.02 | 0.01 | 0.03 | 0.03 | 0.02 | 0.02 | 0.30 |

The findings of the hydrological studies are used to estimate the planned capacity of the Artik Reservoir's capacity, define its command area, and determine the environmental flow.

## 2.4 Environmental Flow

The environmental flow for the reservoir area was calculated in line with the RA Government Decree №57-N, dated 25.01.2018 based on data from the data of Gharibjanyan hydrometric station located on the Karkachun River. According to the noted Government Decree, the environmental flow for each month is calculated by adding the average value of minimum 10 consecutive days discharges

from the winter low-flow period to 33% of the minimum monthly discharge. If the monthly calculated environmental flow exceeds the natural minimum discharge for a given month, then the natural minimum discharge is used as the environmental flow for that month.

Monthly environmental discharge values are used to determine the environmental flow for the hydrological seasons (December-February, March-June, July-November). Multi-year data on the average values of minimum ten-day discharges and multi-year natural minimum discharge values at the Gharibjanyan hydrometric station on the Karkachun River were obtained from the annual bulletin of the Hydrometeorology and Monitoring Centre[4] under the Ministry of Environment.

The average value of the minimum ten-day discharges, based on data from the Gharibjanyan station on the Karkachun River (1942: first, second, and third ten-day periods in January; first, second, and third ten-day periods in February), is equal to 0.16 $m^3/s$. The environmental flow for the Artikjur River cross-section was calculated in accordance with RA Government Decree №57-N, using a transition coefficient of k = 0.064. The results of the environmental flow calculations for the Artikjur River are summarised in **Table 2-7**.

**Table 2-7. Environmental flow at Artik reservoir cross section**

| Months | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII |
| 0.013 | 0.013 | 0.013 | 0.022 | 0.033 | 0.028 | 0.029 | 0.025 | 0.019 | 0.015 | 0.015 | 0.017 |

Hence, the minimum environmental flow in the Artik Reservoir study area will be 13 l/s during January-March, and the maximum flow will be 33 l/s in May.

## 2.5 Sediment Load from the Artikjur River

No studies on sediment load and its transport have been conducted for the Artikjur River. The sediment load in the Karkachun River was studied between 1976 and 1980; however, bottom sediments were not observed at all[5], which is insufficient to use as an analogue for estimating sediment load. Therefore, the Aragats hydrometric station on the Gegharot River is used as an analogue for calculating the sediment load, since the Gegharot River, like the Artik River, originates from Mount Aragats.

Bottom sediments have never been studied in Armenia. Annual values are roughly estimated based on sediment load data. Sediment load at the Aragats hydrometric station on the Gegharot River was recorded between 1979 and 1990, based on which the multi-year average sediment load was calculated to be 0.023 kg/s. At the dam head unit cross-section, the corresponding value is estimated to be 0.038 kg/s. This value was used as a reference for determining the annual sediment load, calculated to be approximately 1,200 t/year, or, considering the specific weight of sediment (1.2 $t/m^3$), about 1,000 $m^3$/year.

Since bottom sediments have not been studied directly but typically constitute about 40% of the total sediment load in mountain rivers, the amount of bottom sediment at the dam head unit cross-section of the Artik Reservoir is estimated at 800 tons, or approximately 300 $m^3$. Therefore, the total annual sediment load, including both suspended and bottom fractions, is estimated at 2,000 tons/year or 1,300 $m^3$/year.

[4] https://armmonitoring.am/#home
[5] Consulting Services for the Preparation of Design and Estimate Documentation for the Reconstruction of the Artik Reservoir, Shirak Region, Republic of Armenia, Book №3-1 - Hydrological and seismic surveys, 2024

For the Artik Reservoir Project, the maximum flood discharge has been assumed to be 23.4 $m^3/s$, corresponding to a 0.1% probability event. The irrigation water discharge capacity, including environmental flows, is assumed to be 320 l/s. The dead storage volume, based on the estimated sediment accumulation over 100 years, is calculated to be 0.13 mln. $m^3$.

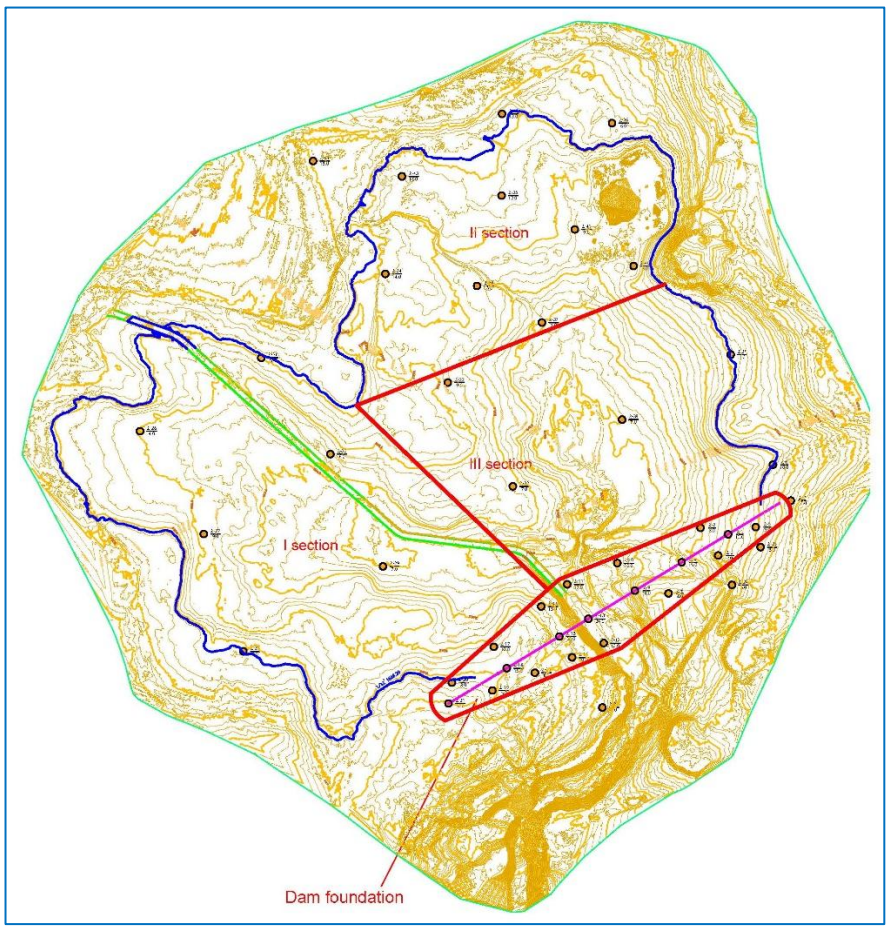
## 2.6 Water Infiltration from the Reservoir Body

Water infiltration from the reservoir dam and body was estimated during the engineering-geological surveys conducted as part of the Project design study[6]. As part of this study, water losses from the dam foundation and reservoir body due to infiltration through the ground layer were calculated.

Through experimental water filling tests conducted in 21 wells drilled within the boundaries of the reservoir and dam body, the permeability coefficients of layers 2, 4, 5, and 11 were determined. These layers account for nearly the entire volume of infiltration losses from both the reservoir basin and beneath the dam. The infiltration properties of the natural soils and rocks within the reservoir site are characterized by significant variability, both between individual layers and within different intervals of the same layer.

According to calculations conducted by the Project designer, water infiltration losses from the reservoir dam are estimated at 9,504 $m^3$/day. To estimate infiltration losses from the reservoir body, it was divided into three sections based on the permeability characteristics of the natural soils and rocks in the ground layers (**Figure 2-1**).

**Figure 2-1. Map of the reservoir body divided into three sections with different infiltration properties**




[6]Reconstruction of the Artik Reservoir in Shirak Marz of the RA, Engineering-geological conditions, 2024

**Section I** occupies the right-bank slopes of the reservoir basin and the longitudinal zone adjacent to the concrete channel. In this area, predominantly gravel-sandy soils lie above the eroded and wind-blown upper layer of tuffs (to a depth of *h* = 8 m), where clay deposits also appear as isolated, small pockets.

**Section II** occupies the eastern part of the reservoir basin, where highly permeable gravel-sandy soils overlie a silty-sandy-clay layer.

**Section III** occupies part of the southwestern slope of the reservoir basin, which gradually merges with the dam. Here as well, gravelly loamy soils with high permeability coefficients are deposited over tuffs of varying composition.

The water infiltration losses calculated for all three sections of the reservoir body are summarized in **Table 2-8**.

**Table 2-8. Water infiltration from reservoir body**

| Parameter | Unit | I section | II section | III section |
|---|---|---|---|---|
| Water infiltration | $m^3$/year | 1,367,300 | 1,267,000 | 996,000 |
| | | **2,263,000** | | |

The water infiltration losses from reservoir dam and body are 2,263,000+9,504=2,272,504 $m^3$/year.

The analysis of the above calculations shows that, without the implementation of anti-filtration measures, the entire volume of water stored in the reservoir would be completely lost within a single day. Therefore, constructing the reservoir without such measures is not feasible or justifiable.

Two anti-infiltration options are considered by the Project designer:

**Option I** - Calculation of infiltration losses assuming that the gravel-pebble soils of the 2nd layer in the reservoir basin, with an average thickness of 4.5 m, have not been removed and that losses occur primarily through this layer.

*The calculated water infiltration losses will be 1,007,180 $m^3$/year.*

**Option II** - Calculation of infiltration losses assuming that the gravel-pebble sediments of the 2nd layer in the reservoir basin have been excavated and removed, exposing the pulverized sandy clays of the 4th layer.

*The calculated water infiltration losses will be 7,197 $m^3$/year.*

Comparison of the infiltration losses for the both above-described anti-infiltration options shows that, after the removal of the gravel-pebble soil (2nd layer) from the reservoir basin, allowing the sandy-clay sediments (4th layer) to serve as the natural basin soils, the infiltration losses are reduced by approximately 140 times, amounting to 7,197 $m^3$/year.

## 2.7 Project Overview

### 2.7.1 Background and Current Design Study

The consultancy services for the development of design and estimate documentation for the reconstruction of the Artik Reservoir in Shirak Marz, Republic of Armenia, are being implemented by a consortium consisting of "Institute of Water Problems and Hydro-Engineering named after I.V.

Yeghiazarov" CJSC and the "Shushi Technological University" Foundation, under Contract JK-BMKhTsDB-23/1-N and Agreement №1 dated 20.07.2023.

The Artik Reservoir is situated in the Artik community of Shirak Marz, within the Karkachun River basin, northwest of Artik town, on the Artikjur River. The region features a well-developed road network, with both the Yerevan-Gyumri highway and the railway passing through its territory. Commissioned in 1992, the Artik Reservoir was constructed to provide irrigation for 420 ha of agricultural land across five rural settlements in the region.

The Artik Reservoir was constructed between 1988 and 1992 by the "Glkhhayjrshin" construction company, based on design documents developed by the "Volgogradshin" Design Institute. However, on May 31, 1994, during extensive flooding in the Karkachun River basin, the reservoir's dam failed, resulting in the loss of its water regulation capabilities.

To achieve the planned capacity of the Artik Reservoir, it is necessary to channel the water flowing through two ravines near the Pemzashen settlement into the reservoir. To this end, the terrain of the Project area has been thoroughly studied, and the most optimal alignment for the feeding channel has been selected. The channel will extend approximately 5.7 km from the headwaters to the Artikjur River, passing through the settlements of Tufashen, Pemzashen, and Artik. Subsequently, water from the Artikjur River will be conveyed to the reservoir over a distance of about 2.4 km (**Figure 2-2**).

To deliver the irrigation water from the reservoir to the Project command area (see **Section 2.7.1**) a 6.7 km long feeding channel (pipeline) will be constructed. The irrigation channel will be passed through Nor Kyanq, Panik, Meghrashen and Anushavan villages (**Figure 2-2**).

**Figure 2-2. Layout of Project reservoir, feeding and irrigation channels**

### 2.7.2 Project Location

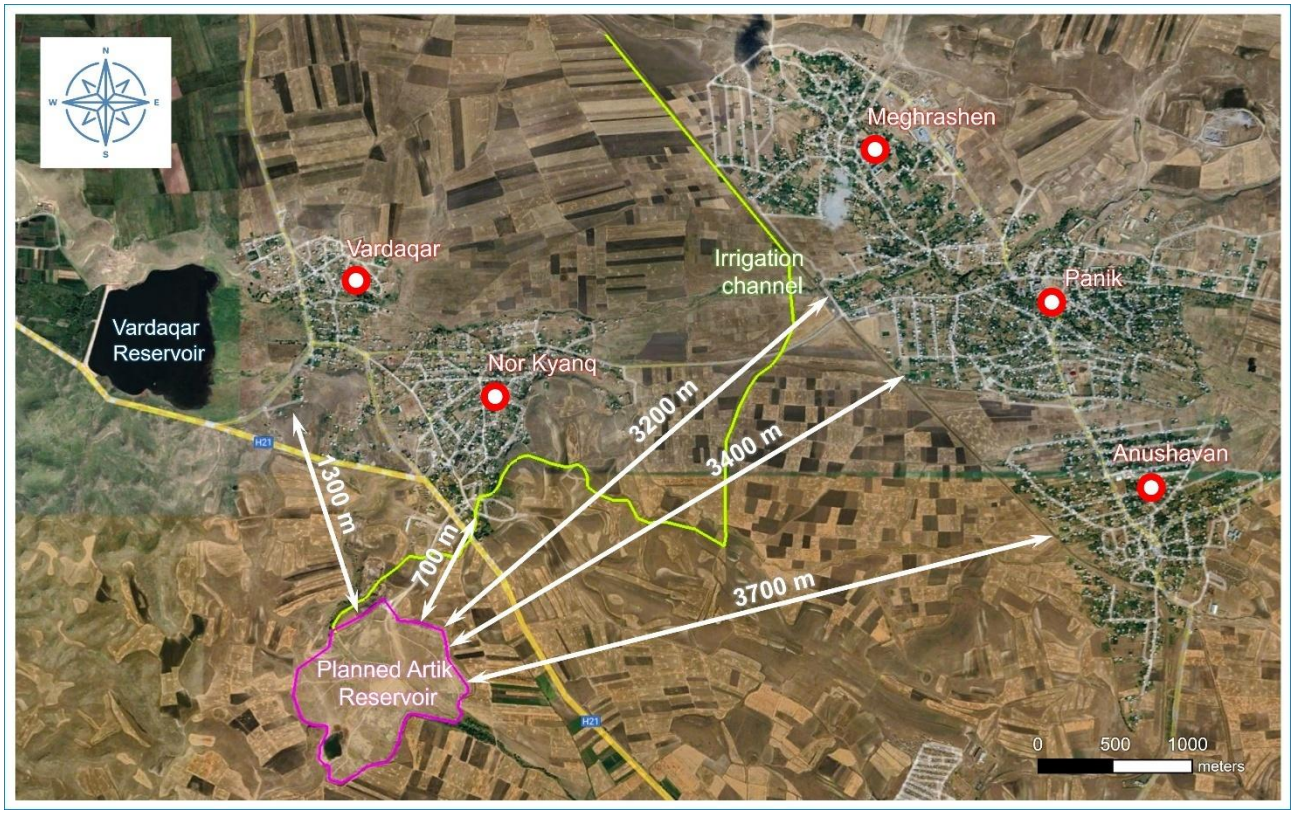
The planned area of the Artik Reservoir construction is located within the administrative boundaries of Artik multi-settlement community at the elevation of 1,700 meters above sea level (masl) and:

- Approximately 115 km from Yerevan City, the capital of Armenia,
- Approximately 15 km from the Gyumri City, the regional center of the Shirak Marz,
- Around 3 km from the Artik town,
- About 700 m from the nearest residential house in Nor Kyanq settlement.

The reservoir will provide irrigation water to 300 ha of agricultural land across five rural settlements in the Artik community, specifically the command area, which includes the villages of Nor Kyanq, Vardaqar, Panik, Meghrashen and Anushavan.

The H21 'Horom-Artik-Alagyaz' road runs 500 m to the northeast and 800 m to the north of the reservoir site. The irrigation channel from the reservoir will intersect the H21 road near the Nor Kyanq settlement (**Figure 2-3**). The direct distance between the western boundary of the reservoir area and the M1 'Yerevan-Gyumri-Armenian Border (Bavra)' highway is 5.5 km.

**Figure 2-3. Location of the Artik reservoir site and the command area**




### 2.7.3 Project Components

The hydraulic unit of the Artik Reservoir will consists of:

1. Dam,
2. Reservoir body,
3. Construction (diversion) channel,
4. Feeding channel,

5. Main irrigation channel,
6. Outlet,
7. Emergency spillway,
8. Electricity supply.

The layout of the Artik reservoir and its components is presented in **Figure 2-4**. The Master Plan of the Project area, indicating Artik reservoir, its components and infrastructure, locations of borrow-pits, surrounding settlements, is provided in **Annex 2** of this ESIA report.

**Figure 2-4. Layout of the Artik reservoir and its components**


### 2.7.4 Technical Solutions

Dam structure

The dam body is planned to be constructed using local construction materials, including cobble-pebble aggregates. As an anti-filtration measure, the Project envisions the use of a clay loam screen.

The upstream slope of the dam is planned to be reinforced with a stone layer. The dam's reverse filter will be constructed with a slope of 3 m, as will the screen. The transition layer, composed of gravel-pebble ground is planned to have a slope of 2 m. Stone drainage is also planned along the inner slope of the dam. A bentomat liner will be installed on the dam's screen, with a double-layer covering, designed in accordance with the dam's seismic stability requirements.

A concrete curb is planned along the edges of the upstream and downstream slopes of the dam crest. The entire width of the dam crest, including the 0.6-meter-wide curb, is planned to be covered with an 8 cm thick asphalt layer, consisting of 5 cm of coarse-grained and 3 cm of fine-grained asphalt. The dam crest will have a slope of $i = 0.015$ toward the upstream edge. To manage rainwater runoff, metal pipes with a diameter of Ø102×4 mm and a length of 2.5 m are planned to be installed every 26 m. Additionally, a semi-circular metal pipe system with a diameter of Ø325×6 mm will be installed along the crest to collect and discharge rainwater.

Reservoir body

To prevent water infiltration from the 20.0 ha reservoir, the Project design provides for anti-seepage measures by lining the reservoir bottom with bentomat.

Construction (diversion) channel

During the construction phase, the existing channel (**Figure 2-5**) built for the old reservoir using G-20 type concrete blocks and a concrete bottom will be used to divert river flows. The channel is in good condition, and to prepare it for operation, the following works are planned:

- Removal of vegetation and debris from the channel bottom,
- Replacement of approximately 60 m of damaged blocks with new ones,
- Filling of cavities in the channel floor,
- Plastering of the G-20 type wind-exposed blocks,
- Construction of a new bridge over the channel.

**Figure 2-5. Existing G-20 type concrete channel**

Feeding channel

To ensure the calculated volume of the Artik reservoir, it is necessary to direct the waters coming from two ravines passing through the Pemzashen settlement to the reservoir.

Feeding Channel №1 will begin with the construction of a head structure of the Feeding Channel №3 located just beyond the existing twin-barrel tunnel beneath the Maralik-Artik highway (**Figure 2-6**). The head structure will include a Yartsev-type water intake with a design flow rate of Q=100 l/s.

From there, the channel will run parallel to the Pemzashen-Tufashen road, cross it at marker 5+10, collect runoff from the right-hand storm drain (located after the ponds), pass beneath the road leading to the tuff mines, and make a sharp turn eastward at marker 15+10.

It will then follow the path of an abandoned and partially demolished asphalt road up to marker 20+95, where it turns approximately 90° north and connects with the existing, older water pipeline (Feeding Channel №2) near the tuff mine at marker 23+28. Beyond this point, the new pipeline will follow the alignment of the old, partially destroyed trench until it discharges into the Artikjur riverbed.

**Figure 2-6. The existing twin-barrel tunnel under the Maralik-Artik highway**

The total length of the channel from the head structure to the Artikjur River will be 5,623 m. The distance between the Artikjur River and the reservoir is approximately 2,400 m.

Main irrigation channel

The main irrigation channel will originate from a well installed at the end of the Ø720×10 mm irrigation pipeline that starts at the dam. The channel is planned to be constructed using prefabricated LR-8 concrete culverts, designed to handle a flow rate of 200-250 l/s.

In this section, the channel will pass over the abandoned quarry, currently the site of the Artik landfill, and continue along the previously excavated trench. Beyond this trench, the channel will follow the alignment of the LR-8 concrete culverts. The system will then connect to the existing Ø1000 mm concrete well located beneath the Artik-Horom asphalt highway at marker 9+73.5, using a concrete culvert.

Beyond the highway, a concrete well will be constructed at marker PK9+96, followed by the installation of two prefabricated LR-8 reinforced concrete (r/c) wells, terminating at a dividing corner well. From this dividing well, water will be supplied to the existing LR-4 r/c wells, while the main irrigation channel will continue parallel to the canal through Ø720×10 mm steel pipes. In front of the channel, a debris collection screen is planned as specified in the Project. The main irrigation channel, constructed with Ø720×8 mm steel pipes, will extend along the marker 10+10.5 - marker 50+30 section, passing near the residential areas of Nor Kyanq settlement, continuing through the territories of Nor Kyanq, Anushavan, and Panik settlements, and terminating near the border of Meghrashen settlement.

Along section 50+30 - 55+08 of the main irrigation channel, water will be conveyed through an existing table-shaped concrete channel with a depth of 70 cm and a width of 50 cm. The channel

bottom will be concreted with a 10 cm layer, and the sidewalls will be coated with a 3 cm cement-polymer plaster. In section 52+34 - 52+40, the existing stonework will be demolished and replaced with a concrete channel, with both the floor and walls lined with 10 cm of concrete.

The planned 6,703 m long channel will provide gravity irrigation for 300 ha of agricultural land in the settlements of Nor Kyanq, Vardakar, Panik, Meghrashen and Anushavan.

Emergency spillway

The emergency spillway is located on the right side of the dam and consists of the following components:

- **Water intake section**: a concrete well 20.0 m wide and 7.0 m long,
- **Dam junction**,
- **Concrete discharge junction**: a concrete well 20.0 m wide and 10.0 m long, followed by a narrowing section 10.0 m wide and 5.0 m long,
- **Rapid section**: a 112.0 m long and 10.0 m wide rectangular channel downstream of the concrete discharge junction, equipped with G-20 type concrete blocks and a concrete floor, connecting to the existing construction outlet drainage channel.

Electricity supply

The electricity supply for the Artik Reservoir will be provided via the overhead transmission line of the "Ghars" branch of the national power operator, “Electric Networks of Armenia” CJSC, located approximately 600 m from the planned reservoir guardhouse. The following electricity supply works will be carried out to support the operation of the reservoir:

- Lay an overhead line from the existing electrical network to the guardhouse (approximately 600 m),
- Install a complete transformer substation with a capacity of 25 kVA and a voltage of 10/0.4 kV,
- Provide electricity supply to the guardhouse,
- Supply power to the reservoir irrigation and feeding pipelines and install control panels.
- Install lighting along the reservoir dam crest.

Spillway

The spillway will consist of:

1. Water intake tower with a height of 3.3 m and external dimensions of 2.9×4.4 m,
2. Reinforced concrete outlet, 85 m long, including Ø300 mm discharge and Ø700 mm irrigation pipes,
3. Water discharge valve chamber,
4. Irrigation outlet steel pipeline, 500 m long with Ø700 mm diameter,
5. Emptying valve chamber,
6. Outlet valve chamber: a steel well with external dimensions of 6.4×5.5 m, connecting the Ø700 mm irrigation outlet pipeline to the LR-80 type steel prefabricated culvert of the irrigation channel

Construction spillway

A construction spillway is a temporary structure used during the construction phase of the hydraulic unit to safely divert or release water from the river or catchment area before the permanent spillway is completed. According to the design, river diversion will be carried out through a square-section gallery (2.0m×2.0m) with a length of 165.2 m and a bottom slope of i=0.05. Calculations were performed for a flow with a 10% probability ($Q_{10\%}$=14.07 m³/s).

To divert the river flow during construction and channel it into the gallery, a diversion spillway is planned. From this spillway, an access earthen canal with a depth of 2.0 m will be constructed. To prevent backflow from the gallery to the construction site, a cofferdam is planned downstream in the form of a rock toe, which will later be integrated into the main dam body.

The main technical characteristics of the reservoir and dam are presented in **Table 2-9**.

**Table 2-9. Main technical characteristics of the Artik reservoir**

| № | Key technical data | Measurement unit | Details |
|---|---|---|---|
| **1. General data** | | | |
| 1.1 | Location of the reservoir | | Administrative boundaries of Artik community (RA Shirak Marz) |
| 1.2 | Location of main irrigation pipeline | | Administrative boundaries of Nor Kyanq, Anushavan, Panik and Meghrashen rural settlements of Artik community |
| 1.3 | Location of feeding pipeline | | Administrative boundaries of pemzashen, Tufashen and Artik settlements of Artik community |
| 1.4 | Capacity of the Artik reservoir | mln. m³ | Total: 1.479 |
| | | mln. m³ | Active: 1.152 |
| | | mln. m³ | Dead: 0.327 |
| 1.5 | Reservoir surface area (at top water level) | ha | 22.0 |
| 1.6 | Area occupied by the feeding and irrigation pipelines / channels | ha | 9.607 |
| 1.7 | Anti-infiltration measure of the reservoir | | bentonite blanket |
| **2. Dam** | | | |
| 2.1 | Material of the body | | Pebble-gravel |
| 2.2 | Dam type | | Embankment dam with a sandy loam screen |
| 2.3 | Anti-infiltration measure of the dam | | Sandy loam screen |
| 2.4 | Dam slopes (v:h) | | Upstream slope: 1:3.5 |
| | | | Downstream slope: 1:2.5 |
| 2.5 | Strengthening the upper slope | | Rockfill |

| № | Key technical data | Measurement unit | Details |
|---|---|---|---|
| 2.6 | Strengthening the lower slope | | Grass cover |
| 2.7 | Dam class (Armenian Standards) | | II |
| 2.8 | Crest parapet wall | | Concrete with metal base |
| 2.9 | ICOLD - Dam class | | - |
| 2.10 | ICOLD - Dam hazard | | - |
| 2.11 | Dam crest level | masl | 1670.0 |
| 2.12 | Dam height | m | 10 |
| 2.13 | Length of the dam with the crest | m | 610.0 |
| 2.14 | Width of the crest | m | 6.0 |
| **3. Reservoir** | | | |
| 3.1 | Type | | On-stream |
| 3.2 | Dead Storage Level (DSL) | masl | 1662.0 m |
| 3.3 | Full Supply Level (FSL) | masl | 1668.1 |
| 3.4 | Maximum Water Level (MWL) | masl | 1668.8 |
| **4. Construction (diversion) channel** | | | |
| 4.1 | Name | | Available concrete channel |
| 4.2 | Type | | Reinforced concrete and reinforced concrete blocks of G-20 type |
| 4.3 | Length of channel | m | 850.0 |
| 4.4 | Width of channel | m | 10.0 |
| 4.5 | Water conveying capacity of the channel | $m^3$/sec | 30.0 |
| **5. Feeding channel** | | | |
| 5.1 | Outflow | $m^3$/s | 0.1-0.15 |
| 5.2 | Length of pipeline | m | 5623 |
| 5.3 | Type of pipeline<br>a) a steel pipe with a ∅400mm<br>b) a steel pipe with a ∅500mm<br>c) reinforced concrete culverts LR-60 | <br>m<br>m<br>m | <br>900<br>2300<br>2423 |
| **6. Main irrigation pipeline** | | | |
| 6.1 | Outflow | $m^3$/s | 0.2-0.25 |
| 6.2 | Length of pipeline | m | 6703 |
| 6.3 | Type of pipeline<br>a) a steel pipe with a ∅700mm<br>b) reinforced concrete culverts LR-80<br>c) a trapezoidal-section channel<br>d) reinforced concrete culverts LR-60 | <br>m<br>m<br>m<br>m | <br>4035<br>995<br>478<br>1195 |
| **7. Irrigation spillway** | | | |
| 7.1 | Reinforced concrete outlet | m | 85 |

| № | Key technical data | Measurement unit | Details |
|---|---|---|---|
| 7.2 | Irrigation outlet steel pipeline | m | 500 |
| 7.3 | Water discharge valve chamber and emptying valve chamber | | 1 |
| **8. Emergency spillway** | | | |
| 8.1 | Type | | trench |
| 8.2 | Outflow | $m^3/s$ | 24.0 (0.01%) |
| 8.3 | Outflow after transformation | $m^3/s$ | 21.75 |
| 8.4 | Actual conveying capacity | $m^3/s$ | 24.0 |
| 8.5 | Type of spillway | | high velocity |
| 8.6 | Length of spillway | m | 112.0 |
| 8.7 | Height of the discharging water layer | m | 0.7 |
| **9. Electricity supply** | | | |
| 9.1 | Transformer station | | with a capacity of 25 kVA and a voltage of 10/0.4 kV |
| 9.2 | Supply source | | transmission line of the "Ghars" branch located 600 m far from the reservoir guardhouse |

### 2.7.5 Land Resources Required for the Project

The Artik reservoir and its components will cover 22.0 ha, while the feeding and irrigation pipelines/ channels will occupy 9.607 ha:

1) Feeding channel - 53831 $m^2$ or 5.3831 ha, including:
   - Community land - 46933 $m^2$,
   - State land - 6340 $m^2$,
   - Private land - 558 $m^2$.
2) Main irrigation channel - 42234 $m^2$ or 4.2234 ha, including:
   - Community land - 24238 $m^2$,
   - State land - 12464 $m^2$,
   - Private land - 5532 $m^2$.

Temporary land use

The construction site is planned to cover an area of approximately 76 ha, allocated as follows:

- 4.2 ha for the main irrigation channel,
- 5.4 ha for the feeding channel,
- 30 ha for the reservoir body and dam,
- 1 ha for the cobble-pebble borrow pit, consisting of 2 sections, №1 and №2,
- 5.3 ha for the spoil disposal area (SDA),
- 0.6 ha for access roads,
- 29.7 ha for the construction camp and installation of other construction equipment.

Of the total 76 hectares, only 31.607 hectares will be permanently acquired for the Project. The remaining land plots will be rehabilitated as needed and returned to their respective owners (community, state, or private).

The construction site can be conditionally divided into the following sections:

1. Dam and its structures,
2. Reservoir body, that is also a borrow-pits of cobble-pebble, clay loam and sand,
3. Cobble-pebble borrow-pit,
4. Stone borrow-pit (operating),
5. Feeding channel,
6. Main irrigation channel.

Temporary use of private land will be carried out in accordance with applicable laws, regulations and practices. If, for any construction-related reason, it becomes necessary to intervene on privately owned land, the construction contractor must first consult with the community head and the landowner, and obtain their consent. This will not result in involuntary resettlement but entail temporary restriction of access and loss of income and thus will require a written agreement between the construction contractor and the landowner, and signed by the head of the affected community. The agreement shall clearly document the total loss of income, compensation for any damage to crops and structures, as well as the rental period and price. Restoration of the rented land plot to its original condition shall be carried out by the construction contractor, or alternatively, appropriate financial compensation shall be provided to the landowner. Where required, financial or technical measures, including the restoration of any disturbed land, shall be discussed and agreed upon with the landowner.

### 2.7.6 Description of the Construction Activities

Construction materials and equipment will be delivered to the construction site primarily by road transport. Deliveries will originate from relevant sources, including:

- Concrete and prefabricated reinforced concrete manufacturing plants,
- Steel pipe and fitting manufacturers or importers,
- Suppliers of other materials such as sand, gravel, and similar aggregates.

Transportation will primarily be carried out via national highways and communal roads. The main routes include the M1 highway (Yerevan - Gyumri - Georgian border) and the H21 communal road (H75 - Horom - Artik - Alagyaz). The final access to the construction site will require traveling an additional 2 km on an earthen road.

A cobble-pebble borrow pit, consisting of two sections located up to 3 km apart within the administrative boundaries of the Nor Kyanq settlement, was studied for dam construction purposes (see **Annex 2**). Stone material will be supplied from an existing operating mine located approximately 33 km from the site. The reservoir area itself will also serve as a source of cobble-pebble, clay loam, and sand materials.

Cobble-pebble aggregates extracted from the reservoir area will be used for the dam's filter and transition layers, as well as for the preparatory layers of the structures. These materials will be washed and sorted in accordance with the previously specified grain size distribution curve.

Two construction camps with necessary auxiliary facilities will be established within the construction wite. These camps will be located in designated areas on unused land during the construction period.

The first construction camp will serve the dam, its structures, the reservoir body and the irrigation and feeding channels, while the second camp will serve the borrow-pits.

The number and locations of the SDAs are not specified in the Project design document. Their placement will be proposed by the construction contractor and agreed upon with the heads of the affected communities and, in the case of private land, with the respective landowners. The temporary land use mechanism for the SDAs will be the same as proposed above. Considering that the Project area was used as a reservoir until 1994 (see **Sub-section 2.7.1**), the Project designer has assumed that no topsoil layer is present at the site; therefore, no topsoil storage areas are foreseen in the Project design document.

No blasting operations are envisioned by the Project design document.

The types of construction machinery and equipment are provided in **Table 2-10** for reference and may be adjusted depending on the availability of existing equipment or the possibility of procurement. However, any substitutions must have equivalent technical specifications.

**Table 2-10. Construction machinery and equipment to be used for the construction of the reservoir**

| № | Type of machinery / equipment | Specifications / capacity | Quantity, pcs. |
|---|---|---|---|
| 1 | Heavy truck | 20-36 t | 6 |
| 2 | Heavy truck | 16 t | 2 |
| 3 | Side-loading truck | 10 t | 2 |
| 4 | Concrete mixer truck | 4 $m^3$ | 3 |
| 5 | Truck-mounted crane | 16 t | 2 |
| 6 | Semi-trailer truck | 20 t | 2 |
| 7 | Bulldozer | 59 kW | 2 |
| 8 | Bulldozer | 96 kW | 6 |
| 9 | Rubber-tired roller | 25 t | 2 |
| 10 | Vibration roller | 10 t | 2 |
| 11 | Compressor | 10 $m^3$/min | 2 |
| 12 | Jackhammer | MO-10 | 4 |
| 13 | Excavator | bucket - 0.65$m^3$ | 2 |
| 14 | Excavator | bucket - 1.25$m^3$ | 2 |
| 15 | Excavator | bucket - 2.5$m^3$ | 4 |
| 16 | Needle vibrator | IV | 8 |
| 17 | Pneumatic hammer | - | 4 |
| 18 | Welding machine | - | 2 |
| 19 | Pump | 40 $m^3$/hour | 1 |
| 20 | Autograder | 79 kW | 1 |
| 21 | Loader mechanism equipped with a traversing system | Excavator, bulldozer or other mechanism | 2 |
| 22 | Asphalt paving machine | - | 1 |

Duration of the construction works was determined based on the volume and labour intensity of the main earth/excavation and concrete works, the rational sequencing of tasks, and a consolidated assessment of operational constraints in line with CN&R №1.04.03-85 "Norms for the duration of construction of facilities, buildings, and structures". The construction period will be 33 months[7].

There is currently no available information regarding the workforce requirements for the Artik reservoir construction project. However, based on its experience conducting E&S assessments for similar projects, the Consultant estimates that approximately 100 workers will be engaged during the construction phase. This workforce is expected to include 65 workers and technicians, 15 managers and engineers, and 20 administrative officers.

The construction workforce will primarily comprise highly skilled professionals, such as welders, concreters and construction machinery operators, alongside unskilled labour recruited mainly from the project-affected settlements. Overall construction management will be overseen by the site manager and supported by foremen in line with construction phase management plans..

## 2.8 Associated Facilities

According to the EBRD ESP (2019), facilities or activities that are not financed under the Bank's loan agreement but are, in the EBRD's view, significant for the success of the project or for achieving agreed project outcomes are considered **Associated Facilities**[8].

All components required for the reservoir's operation, including access roads, power supply lines, and borrow pits, one of which (a stone borrow pit) will be located approximately 33 km from the construction site, are included in the Project design document. Therefore, no components can be classified as associated facilities for the Project.

## 2.9 Project Justification

The GA has prioritised the management of water resources for agricultural use and plans to construct 17 reservoirs within the EU support initiative 'Recovery, resilience and reform: post 2020 Eastern Partnership priorities' to the Government of Armenia to enhance the water and food security level in the country. The Program for the 17 reservoirs construction was developed by the Ministry of Territorial Development an Infrastructure (MTAI) on 2022 and approved by the GA.

The objective of the Program is to implement large-scale reservoir construction in Armenia to regulate surface water flow, manage water resources effectively, and increase both the availability of usable water and the area of agricultural land to be irrigated. The construction of the planned reservoirs will support the conversion of the existing irrigation system to gravity-based operation, which will help reduce power consumption and, consequently, lower the cost of agricultural production.

[7]Consulting Services for the Preparation of Design and Estimate Documentation for the Reconstruction of the Artik Reservoir, Shirak Region, Republic of Armenia, Book №1 - Explanatory Note, 2024
[8]These are new facilities or activities: (i) without which the project would not be viable, and (ii) would not be constructed, expanded, carried out or planned to be constructed or carried out if the project did not exist

# 3. Project Alternatives

## 3.1 Zero Option

Under the Zero Option scenario, where the reconstruction of the Artik Reservoir does not take place, the current situation of unirrigated agricultural land would remain unchanged across the Nor Kyanq, Vardaqar, Panik, Meghrashen, and Anushavan rural settlements. Approximately 300 ha of land that previously benefited from irrigation would continue to rely solely on natural precipitation, which is insufficient for stable crop production in the area's semi-arid climatic conditions.

Historically, the original Artik Reservoir, constructed between 1988 and 1992 and commissioned in 1992, provided irrigation for around 420 ha of agricultural land. However, following the 1994 flooding event in the Karangu River basin, the dam structure failed, eliminating the reservoir's water storage and regulation function. Since then, agricultural production in the affected communities has been significantly constrained by the lack of reliable irrigation water.

Without the reconstruction of the reservoir, agricultural productivity would remain low, and the potential for economic revitalization of Artik enlarged community would be lost. The dominant livelihood activity in the region is agriculture, which serves as the main source of both income and subsistence for local households. The absence of reliable irrigation water limits opportunities to diversify crops, increase yields, and improve food security. Under the Zero Option, households would continue to depend on rainfed cultivation, primarily producing potatoes, vegetables, and wheat in small quantities, with limited potential for market-oriented production.

Socially, the continuation of current conditions may exacerbate economic vulnerability, underemployment, and seasonal migration, particularly among younger population groups. The limited viability of agricultural livelihoods could further contribute to outmigration from rural settlements, leading to demographic decline and a reduction in the local labour force. This, in turn, would negatively affect community cohesion and the sustainability of local services.

From a gender and social inclusion perspective, the Zero Option would also limit opportunities for women and vulnerable groups, who often engage in small-scale agricultural activities, to benefit from improved income generation or enhanced food self-sufficiency that would otherwise be supported by the Project.

In summary, the Zero Option would maintain the current socio-economic challenges in the Artik region, including low agricultural productivity, limited income opportunities, and continued rural depopulation. Therefore, from a socio-economic perspective, the no-project alternative is undesirable, as it fails to address key development and livelihood needs of the affected communities.

## 3.2 Analysis of Alternative Capacities of the Reservoir

The required storage volume for the proposed Artik Reservoir was based on an assessment of the monthly inflow probabilities and irrigation water demand within the Project command area. The analysis considered the following parameters:

- Monthly inflows with 50% and 75% probability levels from the left-bank floodplains of the Artikjur River and Karkachun River,
- Irrigation water demand for approximately 300 ha of agricultural land within the identified beneficiary settlements,
- Reservoir water losses due to evaporation and filtration,
- Environmental flow to maintain the ecological integrity of downstream watercourses.

**Tables 3-1** and **3-2** present the results of the feasibility calculations for the reservoir capacities under the 50% and 75% probability scenarios.

**Table 3-1. Artik River annual flow regulation balance at 50% probability, mln. m³**

| Months | Artik River flow | Feeding channels №2 and №3 | | Flow to the reservoir | Required for the irrigation of 300 ha | Losses from the reservoir | | | Environ-mental flow | Total water demand | Consumption | | | Stored in the reservoir | Capacity of the reservoir |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Flow | K=0.9 | | | infiltration | evapo-ration | total | | | transit | from reservoir | shortage | | |
| IX | 0.098 | 0.035 | 0.032 | 0.130 | 0.039 | 0.002 | 0.001 | 0.003 | 0.039 | 0.081 | 0.081 | | | 0.049 | 0.049 |
| X | 0.070 | 0.021 | 0.019 | 0.089 | 0.000 | 0.000 | 0.001 | 0.001 | 0.040 | 0.041 | 0.041 | | | 0.048 | 0.096 |
| XI | 0.084 | 0.035 | 0.032 | 0.116 | 0.000 | 0.000 | 0.001 | 0.001 | 0.039 | 0.040 | 0.040 | | | 0.076 | 0.172 |
| XII | 0.063 | 0.021 | 0.019 | 0.082 | 0.000 | 0.000 | 0.001 | 0.001 | 0.035 | 0.036 | 0.036 | | | 0.046 | 0.218 |
| I | 0.063 | 0.021 | 0.019 | 0.082 | 0.000 | 0.000 | 0.001 | 0.001 | 0.025 | 0.026 | 0.026 | | | 0.056 | 0.274 |
| II | 0.070 | 0.021 | 0.019 | 0.089 | 0.000 | 0.000 | 0.001 | 0.001 | 0.022 | 0.023 | 0.023 | | | 0.066 | 0.340 |
| III | 0.119 | 0.042 | 0.038 | 0.157 | 0.000 | 0.000 | 0.001 | 0.001 | 0.035 | 0.036 | 0.036 | | | 0.121 | 0.460 |
| IV | 0.406 | 0.161 | 0.145 | 0.551 | 0.000 | 0.002 | 0.002 | 0.004 | 0.057 | 0.061 | 0.061 | | | 0.490 | 0.950 |
| V | 0.224 | 0.084 | 0.076 | 0.300 | 0.018 | 0.002 | 0.003 | 0.005 | 0.075 | 0.098 | 0.098 | | | 0.202 | 1.152 |
| VI | 0.049 | 0.021 | 0.019 | 0.068 | 0.312 | 0.002 | 0.003 | 0.005 | 0.073 | 0.390 | 0.068 | 0.322 | | | 0.830 |
| VII | 0.028 | 0.014 | 0.013 | 0.041 | 0.394 | 0.002 | 0.002 | 0.004 | 0.073 | 0.471 | 0.041 | 0.430 | | | 0.400 |
| VIII | 0.049 | 0.021 | 0.019 | 0.068 | 0.356 | 0.002 | 0.001 | 0.003 | 0.067 | 0.426 | 0.068 | 0.358 | | | 0.042 |
| Total | 1.323 | 0.497 | 0.447 | 1.770 | 1.119 | 0.012 | 0.018 | 0.030 | 0.580 | 1.729 | 0.619 | 1.110 | 0.000 | **1.152** | |

**Table 3-2. Artik River annual flow regulation balance at 75% probability, mln. m³**

| Months | Artik River flow | Feeding channels №2 and №3 | | Flow to the reservoir | Required for the irrigation of 300 ha | Losses from the reservoir | | | Environ-mental flow | Total water demand | Consumption | | | Stored in the reservoir | Capacity of the reservoir |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Flow | K=0.9 | | | infiltration | evapo-ration | total | | | transit | from reservoir | shortage | | |
| IX | 0.077 | 0.035 | 0.032 | 0.109 | 0.036 | 0.002 | 0.001 | 0.003 | 0.049 | 0.088 | 0.088 | | | 0.021 | 0.021 |
| X | 0.091 | 0.035 | 0.032 | 0.123 | 0.000 | 0.000 | 0.001 | 0.001 | 0.040 | 0.041 | 0.041 | | | 0.082 | 0.102 |
| XI | 0.056 | 0.021 | 0.019 | 0.075 | 0.000 | 0.000 | 0.001 | 0.001 | 0.039 | 0.040 | 0.040 | | | 0.035 | 0.137 |
| XII | 0.049 | 0.021 | 0.019 | 0.068 | 0.000 | 0.000 | 0.001 | 0.001 | 0.045 | 0.046 | 0.046 | | | 0.022 | 0.159 |
| I | 0.049 | 0.021 | 0.019 | 0.068 | 0.000 | 0.000 | 0.001 | 0.001 | 0.035 | 0.036 | 0.036 | | | 0.032 | 0.191 |
| II | 0.049 | 0.021 | 0.019 | 0.068 | 0.000 | 0.000 | 0.001 | 0.001 | 0.032 | 0.033 | 0.033 | | | 0.035 | 0.226 |
| III | 0.112 | 0.042 | 0.038 | 0.150 | 0.000 | 0.000 | 0.001 | 0.001 | 0.035 | 0.036 | 0.036 | | | 0.114 | 0.339 |

| Months | Artik River flow | Feeding channels №2 and №3 | | Flow to the reservoir | Required for the irrigation of 300 ha | Losses from the reservoir | | | Environ-mental flow | Total water demand | Consumption | | | Stored in the reservoir | Capacity of the reservoir |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Flow | K=0.9 | | | infiltration | evapo-ration | total | | | transit | from reservoir | shortage | | |
| IV | 0.112 | 0.042 | 0.038 | 0.150 | 0.000 | 0.002 | 0.002 | 0.004 | 0.057 | 0.061 | 0.061 | | | 0.089 | 0.428 |
| V | 0.112 | 0.042 | 0.038 | 0.150 | 0.070 | 0.002 | 0.003 | 0.005 | 0.088 | 0.163 | 0.150 | 0.013 | | | 0.415 |
| VI | 0.028 | 0.014 | 0.013 | 0.041 | 0.450 | 0.002 | 0.003 | 0.005 | 0.073 | 0.528 | 0.041 | 0.415 | 0.072 | | |
| VII | 0.049 | 0.021 | 0.019 | 0.068 | 0.685 | 0.002 | 0.002 | 0.004 | 0.078 | 0.767 | 0.068 | | 0.699 | | |
| VIII | 0.042 | 0.014 | 0.013 | 0.055 | 0.574 | 0.002 | 0.001 | 0.003 | 0.067 | 0.644 | 0.055 | | 0.589 | | |
| Total | 0.826 | 0.329 | 0.296 | 1.122 | 1.815 | 0.012 | 0.018 | 0.030 | 0.638 | 2.483 | 0.695 | 0.428 | 1.360 | **0.428** | |

The hydrological analysis indicates that, to reliably meet 50% of the irrigation water demand for the 300 ha of agricultural land, a reservoir with a useful storage volume of 1.152 mln. $m^3$ is required.

However, under the 75% probability supply scenario, representing lower and more conservative inflow conditions, the available water resources would not be sufficient to fully satisfy the irrigation water demand for the same area. Consequently, construction of a reservoir designed for 75% inflow probability would not enable full provision of irrigation water to the 300 ha of land within the project command zone.

The Project designer also estimated the availability of water required for the irrigation of 420 ha of agricultural land that considering the 50% probability level will require the reservoir with the capacity of 1.687 mln. $m^3$. This scenario seems to be unrealistic due to the climate change issues and taking into account the hydrological calculations showing that during the last 10 years the water decreases for up to 30%.

The Project designer also requested the professional conclusion regarding the options for the capacity of the reservoir from the Hydrometeorology and Monitoring Centre under the Ministry of Environment. As per the conclusion issued on 19.12.2023: *under the pessimistic RCP6.0 emissions scenario, the vulnerability of Armenia's river flow is projected to reach -8.3% by 2040, -13.2% by 2070, and -19.8% by 2100. The flow volume of the Artikjur River is expected to decrease from 1.19 mln. $m^3$ in 2010 to 0.95 mln. $m^3$. In the №2 feeding stream, the flow will decline from 0.005 mln. $m^3$ to 0.004 mln. $m^3$ and in the №3 feeding stream from 0.01 mln. $m^3$ to 0.008 mln. $m^3$. As a result, the river inflow volume to the Artik Reservoir in 2100 is projected to be 0.96 mln. $m^3$. Under an optimistic scenario, the construction of a 1.2 mln. $m^3$ reservoir would be fully justified, whereas a reservoir with a volume of 1.7 mln. $m^3$ would pose significant water supply risks*.

## 3.3 Alternative Locations of the Reservoir

As discussed in **Section 3.1**, the original Artik Reservoir was constructed between 1988 and 1992 and became operational in 1992, providing irrigation to approximately 420 ha of agricultural land. However, its operation was halted following the destruction of the dam. Although the stated objective of the Project is the construction of a reservoir, it is, in essence, a reconstruction of the facility that was in use roughly 33 years ago. At present, only partially destroyed channel and remnants of concrete structures remain on site (**Figure 3-1**).

**Figure 3-1. Current view of the reservoir site**

The selected project area has been identified as the most suitable and environmentally favourable location for the proposed reservoir construction. The selection is supported by the following considerations:

1. **Land Tenure:** The land designated for the reservoir construction is communal property. Consequently, no private land acquisition will be required for the reservoir footprint, thereby avoiding potential social displacement or compensation issues.
2. **Previous Land Use and Human Impact:** The proposed reservoir site has been subjected to long-term human activities, initially utilized as a reservoir site and subsequently as a cattle grazing area. As a result, the site has already been significantly altered, reducing the likelihood of additional ecological disturbance.
3. **Topsoil Condition:** According to the Artik Reservoir construction national EIA report, the topsoil within the proposed reservoir area was removed between 1988 and 1992. Therefore, the Project will not result in the destruction of undisturbed or agriculturally valuable land[9].
4. **Availability of Construction Materials:** A portion of the required gravel–pebble aggregate can be sourced directly from within the reservoir basin. This approach minimizes the need for operating external borrow pits, thereby reducing off-site environmental impacts and transportation requirements.
5. **Irrigation System Efficiency:** The topography of the selected site allows for the efficient delivery of irrigation water to the command area through a gravity-fed system. This design eliminates the need for additional energy consumption for water pumping, contributing to operational sustainability and cost efficiency.

## 3.4 Locations of the Reservoir Components

### 3.4.1 Dam Locations

*Alternative Option 1*

Under this option, the dam axis is located approximately 55-60 m upstream (east) from the remnants of the dam body that failed in the 1990s. This relocation was intended to ensure that the foundation and lower toe of the new dam structure would remain completely independent, avoiding any physical intersection or structural influence from the remains of the former dam.

The dam abutment area under this alternative was investigated through 21 boreholes drilled using the mechanical-core method, to depths ranging between 5.0 and 24.0 m. The boreholes were positioned along the dam axis, as well as along the upstream and downstream boundaries, to provide a comprehensive geotechnical characterization of the foundation conditions.

Field investigations included permeability (filtration) tests and laboratory analyses to determine the bulk density and moisture content of the natural soils and rock materials encountered at various depths.

Based on the design parameters for this option, the proposed dam would have a total length of approximately 610 m and a maximum height of 15.5 m at its deepest section.

*Project Option*

In the Project option, the dam axis is proposed to be relocated approximately 280 m to the southeast (upstream). This adjustment is designed to maintain the same reservoir storage capacity while enabling the construction of a dam with nearly half the original height and a reservoir basin approximately four times smaller in surface area.

[9]However, the Consultant assumes that limited topsoil layer may have re-formed over time that is likely attributable to natural soil formation process driven by the interaction of physical, chemical, and biological factors (see Section 8.2.6)

The dam junction area for this revised alignment has been investigated through 15 boreholes drilled to depths ranging from 6.0 to 12.0 m. These boreholes were located along the dam axis and within the upper abutment zone, providing detailed information on the geological and geotechnical conditions of the foundation materials.

In this final configuration, the dam length remains approximately 610 m, while the maximum height is reduced to about 10.0 m at its deepest section.

Compared to Alternative Option 1, the Project option presents several technical and environmental advantages, including:

- A reduction in dam height and reservoir surface area, leading to less extensive land use and lower environmental impact,
- Optimized geological conditions at the revised site, confirmed through additional borehole investigations,
- Improved design efficiency, allowing the same storage volume to be achieved with a smaller structural footprint and reduced construction materials,
- Lower overall safety risks, as the new alignment is located farther from the remains of the failed 1990s dam, eliminating potential geotechnical interference.

In conclusion, the Project option is considered the most technically feasible and environmentally preferable alternative for the dam location, offering enhanced stability, reduced impacts, and improved design efficiency.

### 3.4.2 Locations of Emergency Spillway

*Alternative Option 1*

Under this option, the emergency spillway alignment originates on the left bank of the reservoir basin at an elevation of approximately 1668 m. From this point, it crosses the dam axis, makes a sharp right turn, and then transitions into a steep, high-velocity channel that ultimately discharges into the Artikjur River.

Throughout its entire length, the spillway passes through horizontally fractured, microporous, and porous multi-coloured Artikian-type tuffs. These tuffs appear in natural outcrops and are locally overlain by loose clay deposits of the upper layer, reaching a maximum thickness of about 4.0 m.

The loose clayey soils in the upper layer exhibit low shear strength and weak bearing capacity, requiring complete removal prior to construction. Once these materials are excavated, the spillway structure would rest directly on the underlying Artikian tuffs, which, due to their favourable geological conditions and physical-mechanical characteristics, are considered a stable and reliable foundation for the proposed structure.

*Project Option*

In the Project option, the length of the emergency spillway has been considerably reduced compared to the alternative design and now does not exceed 120 meters. The alignment begins at the dam abutment and extends gently north-eastward, discharging into a channel constructed with existing reinforced concrete structures.

Along this alignment, the natural soils consist predominantly of fine-grained gravel–pebble deposits derived from various volcanic rock types. These deposits, owing to their favourable depositional

conditions and adequate physical–mechanical properties, are deemed to provide a stable and reliable foundation for the proposed spillway.

Compared with Alternative Option 1, the Project option offers several advantages:

- The spillway is significantly shorter, minimizing land disturbance and construction footprint,
- The use of existing reinforced concrete infrastructure reduces the need for new construction and associated environmental impacts,
- The foundation conditions under the Project option are favourable, consisting of stable gravel-pebble materials that require minimal excavation and preparation compared to the weak clay soils encountered in Alternative Option 1.

Overall, the Project option represents a more technically efficient and environmentally sound solution for the emergency spillway location and design.

# 4. Legal, Regulatory and Institutional Framework

## 4.1 Applicable Legal and Regulatory Framework

According to the ***Law on Environmental Impact Assessment and Expert Examination (2014, revised in 2023)***[10], there are two types of documents, which are subject to environmental impact assessment and expert examination. These documents are:

(i) Framework Document - a policy, strategy, concept, scheme of utilization of natural resources, program, master plan, urban development document, which are likely to affect the environment; and

(ii) (ii) Design Document - technical report, feasibility study and construction-engineering design of intended activity.

The Law establishes the general legal and organizational principles for conducting mandatory EIA of various types of activities and concept documents of sectoral development. According to the Article 12 of the Law, the types of activities, which should undergo EIA are divided into "A" and "B" categories depending on their expected environmental impact.

As per the Article 12 the Law, the reservoirs or artificial lakes with 500,000 $m^3$ and more capacities are subject of national EIA and State expert examination. The roles and authorities of parties engaged in EIA and expert examination processes are set in Chapter 2 of the Law. The procedure for public notification and public discussions is outlined in the ***RA Government Decree №1325-N*** dated 19.11.2014[11].

The ***Water Code (2002)***[12] provides the legal basis for protection of water resources, the provision of water for people and economic sectors through effective management of water resources and ensuring the protection of water resources for future generations. The Water Code includes the following: responsibilities of state/local authorities and public, development of the national water policy and national water program, water cadastre and monitoring system, public access to relevant information, water use and water system use permitting systems, trans-boundary water resources use, water quality standards, safe operation of hydraulic facilities, protection of water resources and state supervision. The quality of surface water in Armenia is monitored as per the principles of EU Water Framework Directive adopted by the ***RA Government Decree №75-N*** dated 27.01.2011[13].

Article 1 of the Water Code among others defines:

- 'Water protection zone' as an area designated to prevent the pollution and depletion of water resources, and to maintain a favourable water regime; such areas are not subject to privatization or confiscation.
- 'Sanitary protection areas of water ecosystems' as an area designated to protect water resources used for drinking, healthcare, domestic services, medical facilities, resorts, and other health-related purposes.

The Criteria for the definition of areas for sanitary protection of water ecosystems, flow formation, groundwater protection, water protection, ecotone and unalienable zones are approved by the ***RA Government Decree №64-N*** dated 20.01.2005[14].

[10] https://www.arlis.am/documentview.aspx?docid=178468
[11] https://www.arlis.am/documentview.aspx?docid=188071
[12] https://www.arlis.am/DocumentView.aspx?docid=148955
[13] https://www.arlis.am/documentview.aspx?docid=200962
[14] https://www.arlis.am/DocumentView.aspx?DocID=13388

The criteria for defining sanitary protection areas of water ecosystems are:

a) areas that are protected for the conservation of biological, hydrological and recreational values of water resources,
b) areas where the quality and quantity of surface and groundwater may be required for human health and well-being, including drinking water and water used for therapeutic and ecological integrity purposes,
c) sanitary protection areas of water ecosystems may include river or lake sections, humid areas, ponds and lakes, as well as adjacent areas that are subject to conservation taking into account their natural conditions as acting healthy environmental systems and areas where a restoration need (in the context of supervision over the contamination, erosion and other adverse impacts caused by floods effect on water quality and quantity) of human activity or natural environment will be raised,
d) sanitary protection areas of water ecosystems are defined with a radius of up to 90 m.

The criteria for defining areas of water protection zones are:

a) areas where the prevention of littering, pollution, suffocation and depletion of water resources, as well as favourable conditions for the water regime, are ensured,
b) the areas of water protection zones include all areas intended for the conservation of water resources,
c) the areas of water protection zones are defined in the form of a strip up to 32 m long.

The Regulation for reservoirs water protection zones (strips) in the Armenian Soviet Socialist Republic (SSR) approved by the Decision №648 of the Council of Ministers of the Armenian SSR[15] applies to all reservoirs located within the borders of the Armenia, regardless their ownership.

The boundaries of the Water Protection Zone (WPZ) are defined for each reservoir by a **water protection design document,** taking into account the local conditions and methodological recommendations set for the determination of water protection zones (strips) of reservoirs. For new reservoirs the water protection design documents are drafted during the project design stage and included into the environmental measurements section. The commissioning of the newly constructed reservoirs shall be done within the water protection boundaries after implementation of all designed water protection measures.

Design document for the water protection zone of operating reservoirs is drawn up separately. Before drawing up the design of the water protection zone, it is determined by the minimum allowable sizes as follows:

- for the water protection zone - 500 m above the normal elevated water level[16],
- for the riparian water protection strip - 50-100 m above the normal elevated level.

The Riparian Water Protection Strips (RWPS) include islands, peninsulas, islets, etc., regardless of their size.

To prevent the pollution and depletion of the water object and to appropriately use its adjacent areas, the regime of economic activity and land use within the water protection zone of the reservoir is defined by the relevant design document.

[15] https://www.arlis.am/DocumentView.aspx?docid=4965
[16] The term 'normal elevated water level' is not defined in the legal act; however, the Consultant assumes that it corresponds to the 'full supply level'

Before the establishment of the WPZs, the national economic facilities[17] constructed within their boundaries continue to operate provided that the requirements and conditions set by this regulation as well as water protection measures envisioned by the design document are followed. The sizes of water protection zones, the procedure of land use within the WPZ, water protection and other measures are determined by specialized design companies in accordance with this regulation and agreed with water use and protection authorities and involved ministries and State bodies.

The objective of the ***Law on RA water national program (2006)***[18] is to meet the needs of the population and the economy through the effective management of usable water resources, ensure ecological stability, establish and use strategic water reserves, protect national water resources, and define measures aimed at addressing the issues outlined in the RA Water Code and the RA Law on the fundamentals of national water policy.

The objective of the ***Law on the fundamentals of national water policy (2005)***[19] is to ensure the availability of water resources in the quantity, regime, and quality necessary to meet human well-being, support the development of the republic's socio-economic system, and address both current and future economic and ecological needs.

The ***Law on Lake Sevan (2001)***[20] regulates the relations related to the preservation, restoration, reproduction, natural development and use of the ecosystems of Lake Sevan, its catchment area and economic activity zone.

The ***Land Code (2001)***[21] defines the key provisions for land-use in Armenia. Land is classified as per designated purposes (categories) into: 1) agricultural land, 2) settlement land, 3) industrial, mining and other production designation land, 4) land for energy, transport, communication, utility infrastructure facilities, 5) land for specially protected areas, (6) special designation land, 7) forest land, 8) water land[22], and 9) reserve land. The Land Code also specifies soil preservation principles, objectives and regulations via the following RA Government decrees:

- The procedure for topsoil use, approved by the RA Government Decree №1396-N dated 08.09.2011[23],
- The requirements for determination of topsoil stripping norms and for stripped topsoil preservation and use, approved by the RA Government Decree №1404-N dated 02.11.2017[24],
- The procedure for soil excavation, approved by the RA Government Decree №572-N dated 10.05.2019[25].

The ***Law on surveillance over the land use and land conservation (2008)***[26] provides objectives and types of effective use and conservation of RA lands, inspection related to enforcement of land legislation and institutions, procedures of control, rights and responsibilities of entities controlling land use and protection. The Law applies to all lands of the RA Land Fund, irrespective of purpose, ownership and/or right to use.

[17] national economic facility is a term used in the former Soviet Union time, now it means commercial units
[18] https://www.arlis.am/documentview.aspx?docid=166250
[19] https://www.arlis.am/DocumentView.aspx?docid=166244
[20] https://www.arlis.am/documentview.aspx?docid=200928
[21] https://www.arlis.am/documentview.aspx?docid=150513
[22] Water lands - areas occupied by water bodies such as rivers, natural and artificial reservoirs, and lakes, as well as areas designated for hydraulic, water management, and other facilities necessary for the use and protection of these water bodies.
[23] https://www.arlis.am/documentview.aspx?docID=71439
[24] https://www.arlis.am/DocumentView.aspx?docID=117360
[25] https://www.arlis.am/documentview.aspx?docid=130889
[26] https://www.arlis.am/DocumentView.aspx?docid=144520

The ***Law on waste (2004)***[27] provides the legal and economic basis for collection, transportation, disposal, treatment, re-use of wastes as well as prevention of negative impacts of waste on natural resources, human life and health. It defines the roles and responsibilities of state authorities as well as of waste generator organizations in waste management activities.

The ***Law on alienation of property for overriding interests of the public (2006)***[28] defines procedures for determining the overriding public interest, for alienating property in order to ensure public interest and for compensation for the alienated property. This law applies to all land ownership (real or movable estate, property rights, equities, etc.) located and registered in Armenia and belonging to physical persons, legal entities and communities. The constitutional conditions for the alienation of property in order to ensure overriding interests of the public are: (i) the alienation must be carried out in exceptional cases defined by the law and in accordance with the procedure established by the law; and (ii) adequate compensation must be paid for the alienated property.

The ***Law on atmospheric air protection (1994, revised in 2022)***[29] regulates air quality as well as public relations in the field of prevention and reduction of adverse chemical, physical and biological impacts on air. The Law also regulates emission permits and provides permissible limits/concentrations for atmospheric air emissions. The RA Government Decree №160-N dated 02.02.2006 defines maximum permissible concentrations of ambient air pollution in residential areas.

The ***Law on flora (1999)***[30] and ***Law on fauna (2000)***[31] outline Armenia's policies for the conservation, protection, use, regeneration and management of natural populations of plants and animals as well as the impact of human activities on biodiversity. These laws are aimed at the sustainable preservation and use of flora/fauna and the conservation of biodiversity. The laws also contain provisions for assessing and monitoring flora and fauna, especially rare and threatened species. The RA Government Decree №71-N and №72-N on approval of the ***RA Red Book of animals***[32] and ***RA Red Book of plants***[33] respectively define the biology of threatened (rare, threatened, endangered, vulnerable) species of flora and fauna as well as their quantity, habitats and variety.

The ***Law on special protected areas of nature (2006)***[34] regulates special protected areas of the RA and eco-systems that have environmental, economic, social, scientific, educational, historical, cultural, healthcare and recreation value. It also outlines the legal basis for state policies regarding sustainable development, restoration, protection, reproduction and use of natural objects and complexes. The Law defines four categories of protected areas in Armenia: (i) State Reserves; (ii) National Parks; (iii) Sanctuaries; and (iv) Nature Monuments. The list of the nature monuments is approved by the RA Government Decree №967-N dated 14.08.2008[35].

The ***Law on protection and use of immovable cultural and historic monuments and historic environment (1998)***[36] provides the legal and policy basis for the protection and use of such monuments in Armenia. Article 15 of the Law describes procedures for discovering and registering monuments, establishing protection zones around them and creating historical and cultural reserves. Article 22 stipulates that the land plots located in historically sensitive areas can be allocated for

[27] https://www.arlis.am/documentview.aspx?docid=140521
[28] https://www.arlis.am/documentview.aspx?docid=153844
[29] https://www.arlis.am/documentview.aspx?docid=146626
[30] https://www.arlis.am/documentview.aspx?docid=120784
[31] https://www.arlis.am/documentview.aspx?docid=120790
[32] https://www.arlis.am/DocumentView.aspx?DocID=56347
[33] https://www.arlis.am/DocumentView.aspx?DocID=56348
[34] https://www.arlis.am/documentview.aspx?docid=140513
[35] https://www.arlis.am/documentview.aspx?docid=157090
[36] https://www.arlis.am/DocumentView.aspx?docid=107521

construction, agricultural and other activities only upon approval of the authorized state body (Department of Historic and Cultural Monuments Preservation). The Law also sets the roles and responsibilities of State bodies engaged in management of cultural and historic monuments through the Procedure for State registration, study, conservation, strengthen, repair, reconstruction and use of immovable historic and cultural monuments, approved by the RA Government Decree №438 dated 20.04.2002[37]. The RA Government Decree №2322-N[38], №754-N[39], №80-N[40], №628[41] and №1270-N[42] define the State lists of immovable historical and cultural monuments in the RA Syunik, Gegharkunik, Vayots Dzor, Aragatsotn and Shirak regions respectively, while the Government Decree №385-N approves the list of State owned immovable historical and cultural monuments that are not subject of alienation/acquisition[43].

The ***Law on intangible cultural heritage (2009)[44]*** regulates the legal relations arising from the processes of preservation, safeguarding, and development of intangible cultural heritage, including identification, documentation, research, application, recreation, teaching, and dissemination of intangible cultural values, protection of the property rights over such values, maintenance of intangible cultural heritage of Armenia, international cultural cooperation, cultural communication between peoples of foreign countries and those of the RA. Several legal acts have been adopted by the RA to promote the administration of the legal framework of the sector which enables to regulate relations pertaining to preservation, safeguarding, and development of intangible cultural heritage; the activities of communities that create, preserve and transmit intangible cultural values; international cultural cooperation, including: (i) Government Decree №310-A "On Defining the Criteria for Preparing the Lists of Intangible Cultural Values and Approving the List of Intangible Cultural Heritage Values"[45], (ii) Government Decree №36-N "On the Criteria for Preparing the Lists of Intangible Cultural Heritage in Need of Urgent Safeguarding, and the List of Intangible Cultural Heritage Values Based thereon"[46], (iii) Government Decree №241-N "On approving the criteria for defining cultural spaces and published the list of cultural spaces"[47], etc.

The ***Code on subsoil resources (2011)[48]*** contains the main provisions in the area of use and protection of mineral resources and underground water, including sanitary protection zones for underground water resources.

The ***Forest Code (2005)[49]*** regulates sustainable management of forests: guarding, preserving, rehabilitation, afforestation and rational use of forests and forest lands in Armenia as well as with forest stock-taking, monitoring and control.

The ***Law on environmental oversight (2005)[50]*** regulates the organization and enforcement of oversight of national environmental legislation and defines the legal and economic basis underlying the specifics of oversight over the fulfilment of environmental requirements and relations between the parties. The existing legal framework relating to natural resources and environmental includes a

[37] https://www.arlis.am/documentview.aspx?docid=137204
[38] https://www.arlis.am/DocumentView.aspx?DocID=36406
[39] https://www.arlis.am/DocumentView.aspx?DocID=38081
[40] https://www.arlis.am/DocumentView.aspx?DocID=37837
[41] https://www.arlis.am/DocumentView.aspx?DocID=36898
[42] https://www.arlis.am/DocumentView.aspx?docid=12877
[43] https://www.arlis.am/DocumentView.aspx?docid=55737
[44] https://www.arlis.am/DocumentView.aspx?docid=121003
[45] https://www.arlis.am/DocumentView.aspx?docid=151791
[46] https://www.arlis.am/DocumentView.aspx?docID=157499
[47] https://www.arlis.am/DocumentView.aspx?docID=134827
[48] https://www.arlis.am/documentview.aspx?docid=146898
[49] https://www.arlis.am/DocumentView.aspx?docid=121312
[50] https://www.arlis.am/documentview.aspx?docid=146636

range of legal tools. Government decrees are the key legal instruments for implementing environmental laws. The other tools are Presidential orders, Prime-Minister's resolutions, and ministerial decrees.

The RA ***Law on public health (2024)***[51] regulates the organization and implementation of preventive and anti-epidemic measures, immunoprophylaxis of diseases, prevention of the impact of harmful and dangerous environmental factors on the human body (environmental hygiene), epidemiological surveillance, production control, public awareness, dissemination of medical and public health knowledge and promotion of a healthy lifestyle, teaching public health knowledge, sanitary-epidemiological control in the Republic of Armenia and registration of products (goods) subject to state registration (except for those regulated by the technical regulations of the Eurasian Economic Union), occupational hygiene services and public health expertise, as well as public relations related to the powers of the Government, state administration bodies in the field of public health, the rights and obligations of individuals and legal entities, individual entrepreneurs, the features of population protection in the event of establishing quarantine due to an epidemic that is the basis for a state of emergency, the mechanisms and procedure for exercising the right to health protection.

In addition, there are sanitary-hygienic norms and standards approved by the RA Minister of Health and regulating the sanitary hygienic conditions in public and residential areas viz.:

- Sanitary Norms ("SN") №2-III-11.3. Noise in workplace, residential and public buildings and in the residential construction areas,
- Hygienic Norms ("HN") №2.2.4-009-06. The hygienic norms of the vibration in the workplace, residential and public buildings.

The ***Labour Code (2004)***[52] regulates collective and individual employment relationship; defines the basis and procedure of implementation for the establishment, revision and cessation of that relationship; assigns duties, authorities and responsibilities of the parties of employment relationship, as well as defines conditions for OHS. The Labour Code also recognizes workers' rights to form and to join workers' organizations of their choice, contains provisions for enabling collective bargaining, and prohibits any type of forced labour. Key principles related to ensuring the equal rights and opportunities for men and women are set out in the ***Law №HO-57-N (2013) On ensuring of equal rights and equal opportunities for men and women***[53]. As per Article 6 of this Law, gender discrimination is prohibited, *inter alia*, via setting different levels of wages, changing wages as well as worsening working conditions conditioned by gender. Armenia has ratified 29 Conventions of the International Labor Organization, including eight fundamental ones.

The ***Law on fire safety (2001)***[54] regulates the relations of the state bodies and local self-governing bodies of Armenia, organizations/companies and people in fire safety-ensuring sphere. It defines the basic ways of shaping the state fire safety policies, as well as legal mechanisms of their implementation, such as provision of the populations with effective and reliable fire protection systems. The Law is supplemented by the Fire Safety Rules (Order №595-N of the RA Minister of Territorial Administration and Emergency Situations (2015)[55]).

[51] https://www.arlis.am/hy/acts/191172
[52] https://www.arlis.am/documentview.aspx?docid=152137
[53] https://www.arlis.am/DocumentView.aspx?docid=138982
[54] https://www.arlis.am/documentview.aspx?docid=144513
[55] https://www.arlis.am/documentview.aspx?docID=99397

## 4.2 Ratified International Agreements

Armenia is a signatory/party to a number of **international agreements and conventions** related to the protection and management of the natural environment, communities, cultural heritage and labour issues.

**Table 4.1. List of ratified by the RA international agreements applicable for the project**

| International agreements (convention or protocol) | Description |
|---|---|
| Convention on Wetlands of International Importance - (Ramsar 1971) | The Ramsar Convention is an intergovernmental treaty to maintain the ecological character and plan the sustainable use of Wetlands of International Importance.<br>The Convention entered into force in Armenia in 1993. |
| Paris Convention for the Protection of the World Cultural and Natural Heritage (1972) | The Convention establishes the need to preserve natural and cultural heritage and the balance between the two.<br>Armenia became a State party in 1993. |
| The Convention on the Conservation of Migratory Species of Wild Animals (1979) (Bonn Convention) | The objective of the Bonn Convention, which was adopted in 1979, is to ensure the conservation of land, marine and air migratory species over the whole of their area of distribution.<br>Armenia is a State party since 2011 |
| Convention on the Conservation of European Wildlife and Natural Habitats, Bern (1979) | The Bern Convention is a binding international legal instrument in the field of nature conservation, covering most of the natural heritage of the European continent and extending to some States of Africa.<br>Ratified by Armenia in 2008. |
| The Convention on Biological Diversity (1992) | The three main objectives of the Convention are: the conservation of biological diversity; the sustainable use of the components of biological diversity; and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.<br>Signed by Armenia in 1993. |
| European Landscape Convention, Florence (2000) | The European Landscape Convention of the Council of Europe promotes the protection, management and planning of the landscapes and organises international co-operation on landscape issues. |
| United Nation Framework Convention on Climate Change (UNFCCC) (1992) | The UNFCCC is one of the «Rio Conventions» adopted at the Rio Earth Summit in 1992. The principal objective is to prevent «dangerous» human interference with the climate system. The UNFCCC entered into force in March 1994 and the first Conference of the Parties of the Convention took place in Berlin, 1995.<br>Armenia became a state party in 2002. |
| Paris Agreement under the United Nations Framework Convention on Climate Change | The aim of the agreement is to decrease global warming through:<br>(a) Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;<br>(b) Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas |

| International agreements (convention or protocol) | Description |
|---|---|
| | emissions development, in a manner that does not threaten food production;<br>(c) Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.<br>Ratified by Armenia in 2017. |
| UN Convention to Combat Desertification, Paris (1994) | This Convention is the sole legally binding international agreement linking environment and development to sustainable land management. The Convention addresses specifically the arid, semi-arid and dry sub-humid areas, known as the drylands, where some of the most vulnerable ecosystems and peoples can be found.<br>Ratified by Armenia in 1997. |
| UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage (2003) | The purposes of this Convention are: (a) to safeguard the intangible cultural heritage; (b) to ensure respect for the intangible cultural heritage of the communities, groups and individuals concerned; (c) to raise awareness at the local, national and international levels of the importance of the intangible cultural heritage, and of ensuring mutual appreciation thereof; (d) to provide for international cooperation and assistance.<br>Ratified by Armenia in 2006. |
| Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, Aurhus Convention (1998) | The Aarhus Convention is a multilateral environmental agreement through which the opportunities for citizens to access environmental information are increased and transparent and reliable regulation procedure is secured.<br>Armenia became a State-party in 2001. |
| Convention on Environmental Impact Assessment in a Transboundary Context, Espoo Convention (1991) | The Convention sets out the obligations of the Parties to carry out an environmental impact assessment of certain activities at an early stage of planning. Before permitting an industrial project, the country to decide on the project («country of origin») must notify any countries which could be affected by the transboundary impacts of a project located in another country («affected parties»).<br>The affected party and the public in the affected area must be able to express their views and comments about the proposed project. This is a separate procedure which is additional to any relevant national permitting process.<br>The permitting state must take these comments into account in its final decision and communicate it to the affected country and the public.<br>The projects subject to consultations under the Convention are those listed in Appendix I including 'large dams and reservoirs'.<br>Ratified by Armenia in 1997. |
| International Labour Organization (ILO) Conventions | Armenia has ratified 29 ILO conventions including the following fundamental ones:<br>- Forced Labour Convention, 1930 (Ratified 17.12.2004),<br>- Freedom of Association and Protection of the Right to Organize Convention, 1948 (Ratified 02.01.2006), |

| International agreements (convention or protocol) | Description |
|---|---|
| | - Right to Organize and Collective Bargaining Convention, 1949 (Ratified 12.11.2003),<br>- Equal Remuneration Convention, 1951 (Ratified 29.07.1994),<br>- Abolition of Forced Labour Convention, 1957 (Ratified 17.12.2004)<br>- Discrimination (Employment and Occupation) Convention, 1958 (Ratified 29.07.1994),<br>- Minimum Age Convention, 1973 (Ratified 27.01.2006),<br>- Worst Forms of Child Labour Convention, 1999 (Ratified 02.01.2006). |

## 4.3 EBRD Requirements

The main requirements of the EBRD for its own activities are formulated in the Bank's ESP (2019), and the requirements for the E&S aspects of the Client-borrower's activities are set out in the PRs[56]. The ESP sets E&S requirements for the EBRD clients' activities to achieve sustainable results. The PRs applicable to this Project are listed below:

**PR1: Assessment and Management of Environmental and Social Risks and Impacts** requires the EBRD client (borrower) to conduct an E&S assessment and / or audit. Assessment is carried out for all stages of the project (construction, operation, decommissioning). Based on the assessment and audit, an ESAP, an Environmental and Social Management Plan (ESMP), and other plans are developed. An important feature of the EBRD's requirements is the concept of associated facilities that are not financed by the Bank, and therefore are not part of the project, but which are significant in determining the success of the project[57]. These associated facilities may be carried out by both the client of the Bank and other parties. However, they should be part of the E&S assessment. PR1 is also applicable to contractors involved in project implementation. EBRD also requires borrowers to implement an E&S Management System (ESMS) appropriate to the nature of the project, as well as reporting to EBRD on the project's E&S performance, including compliance with the relevant PRs and the approved ESMP, ESAP, SEP and other documents or commitments.

**PR2: Labour and Working Conditions** establishes requirements in terms of labour and working conditions, including the prohibition of forced and child labour in the project. The PR2 requirements are based on the conventions of the ILO.

**PR3: Resource Efficiency and Pollution Prevention and Control** requires efficient use of energy, water and resources, and minimisation of waste, as well as compliance with good international practice (GIP), and application of a mitigation hierarchy. This PR is based on the principles of the EU Industrial Emissions Directive (Integrated Pollution Prevention and Control)[58] and calls for the implementation of EU requirements on the use of BATs and related standards for emissions and discharges.

[56]EBRD. 2019. ESP. https://www.ebrd.com/news/publications/policies/environmental-and-social-policy-esp.html.
[57]'These are new facilities or activities: i) without which the project would not be viable, and ii) would not be constructed, expanded, carried out or planned to be constructed or carried out' (EBRD ESP. 2019. Section II. Definitions).
[58]Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on Industrial Emissions (Integrated Pollution Prevention and Control). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32010L0075.

**PR4: Health, Safety and Security** requires the client (borrower) to identify and assess community and occupational health and safety risks and implement preventive measures. The focus is on preventing and eliminating risks rather than reducing and minimising them.

**PR5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement** defines requirements related to project-induced land acquisition, including restrictions on land use and access to assets and natural resources, which may cause physical displacement (relocation, loss of land or shelter), and/or economic displacement (loss of land, assets or restrictions on land use, assets and natural resources leading to loss of income sources or other means of livelihood). The key requirement of PR5 is to avoid or, when unavoidable, minimise, involuntary resettlement via feasible alternative project designs/sites. A resettlement framework (RF), including livelihood restoration where needed, is developed in an early stage of the project to detail resettlement principles and organisational arrangements.

**PR6: Biodiversity Conservation and Sustainable Management of Living Natural Resources** determines the requirements for the conservation of biological and landscape diversity in the development area. PR6 requires the borrower to characterise the state of biodiversity, identifying sensitive species and habitats, and developing measures to avoid / reduce impacts. PR6 defines criteria for critical habitat screening and requires developing a Biodiversity Action Plan (BAP) where significant adverse impacts on biodiversity are expected.

**PR8: Cultural Heritage** defines the requirements for the preservation of both tangible and intangible cultural heritage. PR 8 requires exploring the presence / possibility of the presence of objects of cultural heritage in the project's area of influence. Where the assessment identifies that the project may have material risks and impacts on cultural heritage, the client is required to develop a cultural heritage management plan.

**PR10: Information Disclosure and Stakeholder Engagement.** The EBRD requires careful and systematic stakeholder identification, including communities that may be affected by project impacts (affected groups) and groups whose vital interests may be affected by projects (vulnerable groups). The EBRD requirements for organising stakeholder engagement are also set out in its Access to Information Directive59. Meaningful stakeholder consultations are viewed by the EBRD as an ongoing process throughout the project lifecycle. The EBRD's stakeholder engagement requirements are detailed in the draft SEP for the Project.

## 4.4 Applicable EU Directives

The EBRD PRs require projects to comply with the relevant European Union (EU) environmental requirements in addition to the applicable national laws and regulations. The list of EU Directives that are relevant to the Project is given below.

**Directive 2011/92/EU, as amended by Directive 2014/52/EU, on assessment of the effects of certain public and private projects on the environment (the EIA Directive)[60]**

The Directive defines the environmental impact assessment (EIA process for certain public and private projects in the Member States to integrate environmental considerations into project

[59]EBRD. 2019. Access to Information Directive. www.ebrd.com/documents/strategy-and-policy-coordination/access-to-information-policy-directive.pdf?blobnocache=true
[60]Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment. https://eur-lex.europa.eu/eli/dir/2014/52/oj. Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification). https://eur-lex.europa.eu/eli/dir/2011/92/oj

preparation and authorisation. It applies to a wide range of projects listed in Annexes I and II. The projects listed in Annex I are considered to have a significant environmental impact (incl. inter alia 'dams and other installations designed for the holding back or permanent storage of water, where a new or additional amount of water held back or stored exceeds 10 million $m^3$'). For projects listed in Annex II, national authorities should determine the need for an EIA using a 'screening procedure'.

The key features of the EIA process are as follows:

- the project developer may request the competent authority to specify what should be covered by the EIA information to be provided (scoping stage);
- the developer must provide information on the environmental impact (in the form of an EIA report drafted in accordance with Annex IV of the Directive);
- the environmental authorities and the public, as well as local and regional authorities (as well as any EU countries that are affected) must be informed and consulted;
- the competent authority decides taking into consideration the results of consultations; this decision also includes a reasoned conclusion on the significant effects of the project;
- the authority informs the public of its decision.

**Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control) (the Industrial Emissions Directive)[61]**

The Directive is the main EU instrument regulating the emission of pollutants from industrial facilities. It aims to protect human health and the environment in general by reducing harmful industrial emissions in the EU, in particular through the use of Best Available Techniques (BAT). It is noted that production facilities carrying out the activities listed in Annex I to the Directive *(including inter alia cement production for dam construction)* require a special permit (issued by the authorities in the EU Member States).

**Directive 2009/147/EC on the conservation of wild birds (the Birds Directive)[62]**

The Directive requires the Member States to protect wild bird species and protect and restore their habitats. Annex I lists wild bird species that shall be the subject to special conservation measures concerning their habitats. It is required to designate special 'protection areas' to avoid significant pollution or deterioration of habitats or any disturbances affecting the birds including birds associated with floodplain habitats to be affected by the Project. Outside these protection areas, it is also required avoid pollution or deterioration of habitats.

**Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive)[63]**

The Directive requires the Member States to specify areas that are expected to ensure the conservation of flora and fauna species. It is stipulated the need for designating 'special areas of conservation' which, together with the existing special 'protection areas' established per the Birds Directive, to form a became a coherent European ecological network for protecting species and habitats (Natura 2000).

[61]Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (recast). https://eur-lex.europa.eu/eli/dir/2010/75/oj
[62]Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (Codified version). https://eur-lex.europa.eu/eli/dir/2009/147/oj
[63]Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. https://eur-lex.europa.eu/eli/dir/1992/43/oj

**Directive 2000/60/EC establishing a framework for Community action in the field of water policy (the Water Framework Directive)[64]**

The Directive aims to ensure an integrated approach to water management by establishing a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater. It envisions water management by river basin approach.

**Directive 2008/98/EC on waste (Waste Framework Directive[65])**

The Directive defines the priorities and principles of waste management and the basic concepts and requirements for waste recycling, reuse and disposal in a way that does not have a negative impact on the environment or human health. The principle of waste management hierarchy integrated in the Directive envisions the following sequence of priority in selection of waste management methods:

- waste prevention (prevention at the of waste generation at source);
- waste reduction;
- waste reuse;
- application of other methods of waste recovery, e.g. energy recovery;
- final disposal at landfills.

**Directive 2003/10/EC on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise)[66]**

The Directive defines the physical parameters that serve as risk predictors, such as peak sound pressure, daily noise exposure level and weekly noise exposure level. It sets exposure limit values and exposure action values in respect to the daily and weekly noise exposure level as well as peak sound pressure. These exposure limits are to be available for Project construction workers.

**Directive 2002/44/EC on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (vibration)[67]**

The Directive aims at ensuring health and safety of each worker and at creating a minimum basis of protection for all Community workers by timely detection of adverse health effects arising or likely to arise from exposure to mechanical vibration, especially muscle-skeletal disorders. These exposure limits are to be available for Project construction workers.

## 4.5 Good Industry Practice (GIP) Guidance

Specific E&S requirements applicable to the Project are set out in the EBRD's Sub-sectoral Environmental and Social Guidelines: Building and Construction Activities (2010)[68]. They elaborate on typical E&S risks related to construction, operation, maintenance and decommissioning of facilities. Other relevant EBRD guiding documents used in the ESIA relate to resettlement; forced

[64]Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. https://eur-lex.europa.eu/eli/dir/2000/60/oj
[65]Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives. https://eur-lex.europa.eu/eli/dir/2008/98/oj
[66]Directive 2003/10/EC of the European Parliament and of the Council of 6 February 2003 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise). https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:042:0038:0044:EN:PDF
[67]Directive 2002/44/EC of the European Parliament and of the Council of 25 June 2002 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (vibration). https://eur-lex.europa.eu/resource.html?uri=cellar:546a09c0-3ad1-4c07-bcd5-9c3dae6b1668.0004.02/DOC_1&format=PDF%20
[68]https://www.ebrd.com/downloads/about/sustainability/Building_Construction_Activities.pdf

labour; gender issues, non-discrimination and equal opportunity; workers' accommodation; and other E&S topics.

The International Finance Corporation (IFC) ***General Environmental, Health and Safety Guidelines (2007)***[69] (General EHS Guidelines) are technical reference documents with general and industry-specific examples of GIIP. The General EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in facilities by existing technology at reasonable costs.

**ICOLD Bulletin 173** (2021) - Integrated Operation of Hydropower Stations and Reservoirs. *This bulletin gives an overview of the main functional and operational aspects relating to cascade hydropower stations and reservoirs, it was formed by reviewing of all the related aspects proposed and case studies provided by committee members.*

**ICOLD Bulletin 96** (1994) - Dams and environment - Water quality and climate. *This Bulletin gives an overview of effects of reservoirs on water quality and climate.*

**ICOLD Bulletin 86** (1992) - Dams and Environment - Socio-economic impacts. *The present bulletin gives an overview of social and economic problems which may arise before, during or after the construction of a large dam.*

*The International Commission on Large Dams (ICOLD) is the leading international professional and academic organization in the field of hydraulic engineering. Its mission is to develop the art and science of dam engineering, and to promote the sustainable development and management of the world's water and hydropower resources. ICOLD has 100 member countries.*

## 4.6 Institutional framework

Several state bodies and their subordinate structures or units are involved in water management in Armenia. The main roles and responsibilities of these bodies in the field of irrigation water management are outlined below:

- **The Ministry of Environment (ME)** is the authorized body responsible for water resources management and protection in Armenia. It is tasked with developing and implementing the National Water Policy, National Water Program, and river basin management plans; protecting natural water bodies; preparing annual water balances; and overseeing their implementation.
- **The Environmental Impact Expert Examination Center (EIEEC)**, acting on behalf of the Ministry of Environment (ME), is responsible for organizing and implementing the expert examination and related processes for framework and design documents (projects) initiated by state and private entities, as well as individuals. Among other functions, the EIEEC ensures stakeholder participation in public discussions, facilitates the notification and involvement of interested parties in the expert examination process, and issues environmental impact expert examination conclusions.
- **The Water Resources Management Department**, under the ME, is responsible for regulating water resources management issues, including approving surface and groundwater extraction volumes, issuing water use permits, maintaining the State Water Cadastre, and managing water use related data. It also prepares documents for the suspension, amendment, or cancellation of water use permits.

[69] https://www.ifc.org/content/dam/ifc/doc/2000/2007-general-ehs-guidelines-en.pdf

- **The Hydrometeorology and Monitoring Centre** State Non-Commercial Organization (SNCO), under the ME, monitors meteorological, hydrological, and geophysical conditions in Armenia and provides disaster warnings. The Centre also supports the implementation of Armenia's international obligations in these areas.
- **The Ministry of Territorial Administration and Infrastructure (MTAI)**, along with its affiliated authorities and organizations, develops policy and regulations for the overall management of water infrastructure systems.
- **The Water Committee**, under the MTAI, is designated by the Water Code as the Water System Management Body. It is responsible for developing and implementing investment programs and submitting proposals to the Regulatory Commission concerning regulated tariffs and water system use permits.
- Irrigation in Armenia is managed by **"JRAR" Closed Joint-Stock Company (CJSC)** and 15 **Water Users Associations (WUAs)**. JRAR CJSC, a 100% state-owned enterprise, handles water abstraction and delivery, and is responsible for the maintenance and operation of first- and second-category irrigation systems. The WUAs operate reservoirs and distribute irrigation water to end users.
- **The Environmental Protection and Mining Inspection Body** is responsible for supervising and inspecting compliance with regulations related to the use and protection of water resources.

# 5. ESIA Methodology and Approach

## 5.1 Introduction

The ESIA is an iterative process that involves the prediction and assessment of potential impacts of the Project on the physical, biological, and cultural components (indicators) of the environment, as well as on social and socio-economic resources/receptors. During the ESIA study, recommendations were developed to eliminate, minimize, reduce, mitigate, or compensate for adverse impacts, while also enhancing expected benefits and opportunities. Appropriate management and monitoring measures have also been proposed.

The main stages of the ESIA study are as follows:

- Screening,
- Scoping,
- Baseline Study,
- Impact Assessment and Mitigation,
- Management and Monitoring,
- Stakeholder Engagement and Public Consultations.

## 5.2 Screening

Screening is the initial stage of the ESIA that is carried out to determine the level of the impact assessment as well as what legal and other requirements will be applied for the Project.

The construction of the Artik Reservoir, with a capacity of 1.152 mln. m³, is a greenfield project that may trigger significant adverse environmental and/or social impacts. The EBRD has classified this project as Category 'A' under its 2019 Environmental and Social Policy (ESP), which means that a comprehensive ESIA report and associated documents must be prepared and publicly disclosed for a minimum of 120 days.

## 5.3 Scoping

The key task of the E&S scoping process is to determine the content and extent of the matters that should be addressed in the ESIA and its associated documentation. The Scoping process is not intended to provide detailed information about the Project. Rather, it serves as a preliminary overview, aimed at facilitating early engagement with relevant stakeholders and helping to identify potential Project impacts. Scoping is designed to ensure that the ESIA focuses on the most significant impacts, project alternatives, and other key issues.

The scoping process involves a comprehensive analysis of the activities and features associated with each stage of the Project lifecycle, and their potential to positively or negatively interact with environmental (including physical and biological receptors), social, and socio-economic resources and receptors.

## 5.4 Baseline Study

To provide a context within which the impacts of the Project can be assessed, a description of the physical, biological, and socio-economic (including social, economic, and health and safety) environment expected to prevail in the absence of the Project must be presented. In this regard, it is

essential to collect comprehensive baseline data on environmental, social, and socio-economic conditions through the collection of both primary and secondary information.

Secondary baseline data were gathered from documents prepared during the Project design phase and the national EIA study provided by the Water Committee and the National EIA Consultant, as well as from the gap analysis study conducted by the ESIA Consultant. In addition, baseline information related to the Project region, components, and associated facilities was collected by the Consultant from publicly available sources, reports, online databases, and interactions with Project stakeholders. The list of documents and information used during the secondary baseline data collection process is provided in **Section 1.4** of this ESIA report.

Where necessary, or where information is lacking, secondary baseline data should be supplemented with primary data collected during field surveys and investigations. The following field surveys were initially conducted by the National EIA Consultant and subsequently enhanced by the ESIA Consultant to describe the baseline conditions within the Project's footprint and to supplement the baseline chapter (**Chapter 6**) of this ESIA report:

| **Surveys conducted by the National EIA Consultant** |
|---|
| • Biodiversity (flora and fauna) field investigation<br>• Background air quality survey (determination of $SO_2$, $NO_2$, CO and dust actual concentration in the atmospheric air within the area of Project influence)<br>• Water and soil quality survey<br>• Ambient noise study (determination of actual noise levels within the Project's area of influence)<br>• Socio-economic data collection and interviews<br>• Archaeological field surveys |
| **Supplementary studies conducted by the ESIA Consultant** |
| • Cumulative impact assessment,<br>• Assessment of impacts of the associated facilities,<br>• Water infiltration and loss study, water and soil quality survey,<br>• Assessment of Greenhouse Gas (GHG) emissions and climate change mitigation measures,<br>• Spring season field biodiversity surveys and Critical Habitat Assessment,<br>• Appropriate Assessment procedure,<br>• Cultural Heritage studies and intangible Cultural Heritage survey |

The results of the field surveys are provided in the annexes and summarised in the relevant sections of **Chapter 6**, and are further discussed in **Chapter 8** of this ESIA report.

The baseline outlines the existing E&S conditions and provides the context against which potential impacts will be identified and assessed. Specifically, the baseline aims to provide information to support the following:

1. Identify the key conditions and sensitivities within the zone potentially affected by the Project,
2. Provide baseline data for subsequent prediction and assessment of potential impacts to be generated in the course of Project implementation,
3. Understand stakeholders' concerns and analysis of their perceptions and expectations,
4. Ensure a benchmark to assess future changes resulting from the Project implementation and monitor the effectiveness of mitigation measures.

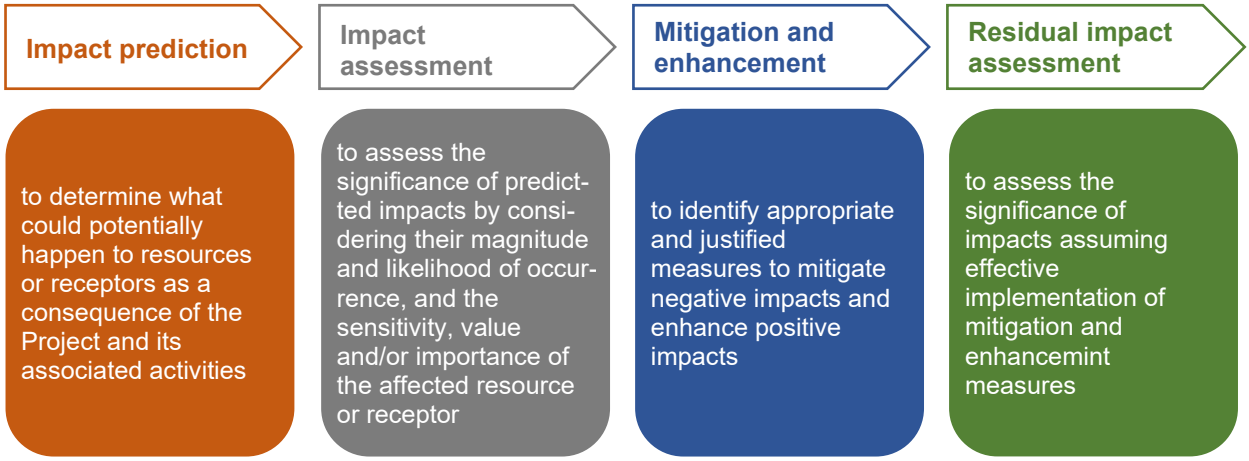
## 5.5 Impact Assessment and Mitigation

The potentially significant impacts identified during the scoping stage are subject to a full-scale appraisal during the ESIA study. The impact assessment follows a consistent process for the consideration of the following four aspects:

- Impact prediction,
- Impact evaluation,
- Mitigation and enhancement,
- Residual impact evaluation.

The scheme of impact assessment and evaluation process is presented in **Figure 5-1**.

**Figure 5-1. Schematic view of impact assessment process**




*Impact Prediction*

Impact prediction is an expert-driven process used to determine the likely consequences of the Project and its associated activities or features on the environment. Impacts on various resources and receptors are identified and assessed based on the potentially significant interactions determined during the scoping phase. Given the diverse range of potential impacts considered in the assessment process, a variety of prediction methods are typically employed, including quantitative, semi-quantitative, and qualitative techniques.

*Impact Assessment*

E&S impacts arise as a result of Project activities or features interacting directly with receptors, or causing indirect changes to the existing environment. Impacts can be described and quantified in various ways. In the course of this study, impacts on different components of the physical, biological, human, and social environment are assessed throughout the Project's lifecycle in terms of:

- Nature: positive or negative,
- Type: direct, indirect, residual,
- Magnitude: high, medium, low, negligible,
- Likelihood: high, medium, low,
- Duration of the Impact: temporary, short-term, long-term, permanent,
- Reversibility,
- Significance degree: significant, moderate, low, negligible.

The key characteristics of the impacts are defined in Table 5-1.

**Table 5-1. Impact Characteristics**

| Impact Characteristics | Description |
|---|---|
| **Type** | **Direct impact** resulting from the direct interaction between a project activity and the resource / receptor.<br>**Indirect impact** between the proposed activity and the environment/ receptor as a result of subsequent interactions within it.<br>**Residual impacts** are defined as those impacts that remain following the implementation of the mitigation measures proposed. |
| **Duration of impact** | **Temporary (very low duration)** impacts would last for a short duration of six months of less and are reversible and intermittent or occasional in nature. The resource or receptor would return to the previous state when the effect ceases or after a short period of recovery.<br>**Short-term (low duration)**, when impact is likely to be restricted for a duration of up to three years.<br>**Long-term (medium duration**), when impacts would continue for an extended period of time; this is based on the understanding that there will be recovery of the effected environmental component to its best achievable pre-project state over time.<br>**Permanent (high duration)**, when impacts would occur during the lifetime of the Project and cause a permanent change in the affected receptor or resource. |
| **Magnitude** | **Negligible**, when the impact having almost no influence on baseline conditions.<br>**Low**, when resulting in slight changes of prevailing baseline conditions.<br>**Medium**, when resulting in changes which are within the benchmark norms or shows some signs of stress on any of the components of environment.<br>**High**, when resulting in changes which affects larger extent or shows signs of stress on receptors in larger extent. |
| **Likelihood** | **Low**, when event is unlikely, but may occur at some time during normal operating conditions.<br>**Medium**, when event is likely to occur at some time during normal operating conditions.<br>**High**, when event will occur during normal operating conditions. |

Once the magnitude and likelihood of the impact has been characterized, the impact significance degree is assigned using the matrix in Figure 5-2.

**Figure 5-2. Impact Significance Matrix**

| | | ***Likelihood / Duration*** | | |
|---|---|---|---|---|
| | | Low | Medium | High |
| ***Magnitude*** | Negligible | Negligible | Negligible | Negligible |
| | Low | Negligible | Low | Moderate |
| | Medium | Low | Moderate | Significant |
| | High | Moderate | Significant | Significant |

If the duration of an impact is long-term or permanent, but the likelihood is low or medium, the significance of the impact is evaluated one level higher.

In the case of a positive impact, no magnitude designation, other than 'positive', is assigned. For the purposes of this impact assessment, it is considered sufficient to indicate that the Project is expected to result in a positive impact, without quantifying the exact degree of positive change.

Context of impact significance for E&S resources is provided in **Table 5-2**.

**Table 5-2. Context of impact significance**

| Significance of impacts | Description | |
|---|---|---|
| | Environmental resources | Socio-economic resources |
| Negligible | Impacts practically do not change the environmental baseline conditions, local in extent and temporary or short-term in duration | No significant changes in baseline conditions are expected, in-site in extent and temporary or short-term in duration impact. No significant inconveniences are caused |
| Low | Site, local and regional impacts which are not accompanied by long-term degradation of sensitive resources; effects are usually reversible and minor (do not require special mitigation measures); usually do not exceed the applicable standards (criteria, i.e. noise, vibration, etc.) in relation to the less sensitive resources | Short-term inconveniences caused by Project implementation to individuals and communities, but with no consequences to long-term change of livelihood or quality of life. Receptors either easily in part adapt to changes brought by the Project or proceed with previous livelihood |
| Moderate | Site and local environmental impacts, mostly long-term; impacts which do not affect critical resources but result in reversible loss of biodiversity and habitats; impacts with regional effects persisting from 1 to 3 years; require development of cost reasonable impact mitigation measures | Direct and indirect impacts on livelihood and quality of life of the local communities or individuals. Receptors may undergo some difficulties to adapt to changes and they will be able to return to their former livelihood under condition of some support (for instance, compensation) |
| Significant | Significant impacts of regional and of the larger scale; medium-term, long-term and permanent impacts resulting in irreversible changes and degradation of baseline conditions; usually having adverse effects exceeding national environmental standards or associated with transnational environmental issues; involving effects of toxic substances and associated with potential emergencies affecting critical resources and sensitive receptors | Widely spread adverse direct and indirect impacts on both individuals and local communities which are practically cannot be mitigated or compensated. Affected receptors are not able to adapt to changes or proceed with previous livelihood |
| Positive | There will be a beneficial impact to a resource/receptor | There will be a beneficial impact to a resource/receptor |

*Mitigation and Enhancement*

A key component of the ESIA process is to identify practical ways to avoid, reduce, or mitigate the potentially significant impacts identified during the study. These are referred to as mitigation measures and are incorporated into the Project as commitments. The objective of mitigation is to prevent, minimize, or manage significant negative impacts to as low as reasonably practicable, and to optimize and maximize any potential benefits or opportunities of the Project, where applicable.

A hierarchy of mitigation options is considered, with the preferred approach being to avoid the impact at source. The least desirable option is to provide compensation or an offset for residual impacts that cannot be reasonably avoided.

Embedded controls (i.e., physical or procedural controls that are planned as part of the Project design) were considered as part of the Project (i.e., prior to the impact assessment stage of the ESIA process) as avoidance measures.

All mitigation measures outlined in the ESIA are summarized in an Environmental and Social Management Plan (ESMP) for the Project, which provides an overview of how these measures will be implemented during the construction and operation stages.

*Residual Impact Assessment*

Following the identification of potential E&S impacts, their significance is assessed, taking into account the proposed mitigation measures already incorporated into the Project design and, where appropriate, any additional mitigation measures that are considered feasible and justified.

Mitigation measures are applied to reduce impacts to as low as reasonably practicable; however, some impacts may not be eliminated entirely. These remaining impacts are referred to as residual impacts. One objective of the ESIA is to assess the significance of these residual impacts, which will remain after mitigation measures have been incorporated into the Project, and to determine the appropriate monitoring and measurement actions.

## 5.6 Management and Monitoring

At the final stage of the impact assessment process, basic management and monitoring measures are defined to determine whether: a) residual impacts or their associated Project components remain in conformance with applicable standards; and b) mitigation measures are effectively addressing impacts, and compensatory measures and offsets are reducing effects to the extent predicted.

## 5.7 Stakeholder Engagement and Public Consultations

International best practices for the implementation of an ESIA, along with the requirements of the EBRD, provide the basis for conducting active consultations with competent supervisory agencies, experts, affected local communities, and other stakeholders. These consultations aim to understand their views on the Project and its impacts, and to incorporate these perspectives into the prediction and evaluation of impacts, as well as the corresponding mitigation measures. Consultation is also valuable for identifying data and information within the studied area.

As part of this ESIA package, a Stakeholder Engagement Plan (SEP) has been developed, including a grievance mechanism, to serve as a structured and systematic approach for stakeholder engagement throughout all stages of Project implementation.

# 6. Environmental and Social Baseline

## 6.1 Physical Environment

### 6.1.1 Geography

The Artik Reservoir is located in the administrative boundaries of Artik enlarged community of Shirak marz, within the Karkachun River basin, northwest of Artik town, at the elevation of 1700 masl.

The area has a well-developed, multi-branch transportation network. The M1 "Yerevan-Gyumri-Georgia border" highway, the H21 "H75-Horom-Alagyaz" road, and a railway line all pass through its territory. The road distance between the Project site and Yerevan, the capital of the Republic of Armenia, is approximately 110 km. The city of Gyumri, the administrative centre of Shirak Marz, is located about 20 km north from the Project site. The H21 asphalt road connecting Artik and Gyumri runs about 700 m from the planned reservoir site, while the nearest railway station is located in the southeastern part of Artik, approximately 5 km away.

The Artik Reservoir is designed to irrigate agricultural lands in five rural settlements within Artik enlarged community, situated roughly 6-8 km from the planned reservoir. The administrative map of Shirak Marz is shown in **Figure 6-1**.

**Figure 6-1. Administrative map of Shirak Marz**

### 6.1.2 Relief, Landscape and Visual Amenity

The Project region (Artik community) is situated in the southwest Shirak marz and lies on the elevated Armenian volcanic highlands. The regional relief is characterized by a combination of volcanic plateaus, gentle hills, and isolated ridges, shaped primarily by extensive volcanic activity during the Quaternary period.

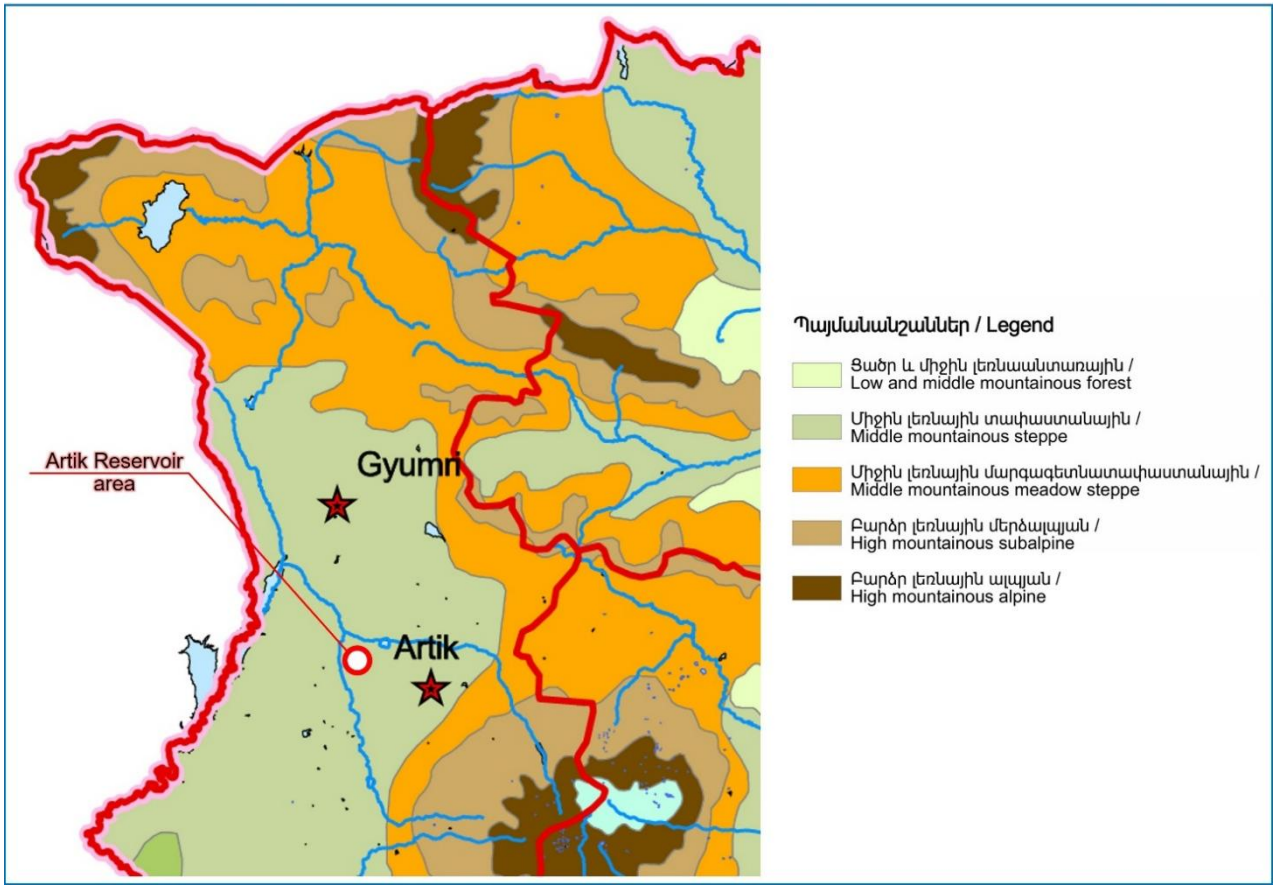
The area's elevation ranges between 1,500 and 2,000 masl, with predominantly gently undulating to moderately sloped terrain. The area is formed by basaltic lava flows and tuffaceous deposits, contributing to the development of flat plateau surfaces interspersed with eroded volcanic cones and shallow depressions. The plateau is bordered by the Aragats Massif to the southeast and the Pambak Range to the northeast, providing a broader orographic context.

Due to the volcanic origin of the terrain, the soils are rich in minerals, and the region supports agricultural activity in the more level areas. The presence of extensive tuff quarries around Artik is also a notable geomorphological and economic feature of the area.

Overall, the morphology of the Artik region presents a relatively stable geological environment, though localized erosion and land disturbance from quarrying activities are observed and should be taken into account in environmental planning.

According to the map of landscape zones the Project site (**Figure 6-2**) is characterised by the middle mountainous steppe.

**Figure 6-2. Map of landscape zones of the Project region**



### 6.1.3 Geology and Hydrogeology

The area of the works is distinguished by its complex geological structure, which is due to the combination of heterogeneous rock complexes of different origins and variegated lithological composition, which determines the highly multifaceted physical, mechanical and filtration properties of the latter.

a) Modern Alluvial-Proluvial Deposits - *ap.QIV*

These soils have developed along watercourses and are primarily composed of silty deposits derived from volcanic rocks, with occasional gravel and debris inclusions and clayey aggregates. The thickness of the silty soils ranges from 0.8 to over 10.0 m, increasing significantly in the valleys of more water-rich rivers.

The sandy loams in this group are typically medium to heavy in texture, displaying mixed shades of brown to brick-brown. Their thickness ranges from 1.0 to 11.0 m, and they may contain 10-45% coarse debris.

b) Modern Diluvial-Proluvial Deposits - *dp.QIV*

These deposits form a cover over Middle Quaternary volcanic formations and consist mainly of sandy clays, clayey loams, and siltstone.

The sandy clays vary from light to heavy in composition, are yellowish to ash-brown in colour, and have a dry to semi-dry structure. They are microporous, carbonate-rich, and contain 20–25% debris. The thickness of these soils typically ranges from 0.5 to 6.0 m.

c) Modern Proluvial Deposits - *P.QIV*

These deposits are found exclusively along the slopes of the Artikjur River. In the area of the proposed reservoir's dam junction, the formation is primarily composed of large-scale volcanic rock debris, with localized occurrences of sandy-clay fill.

d) Middle Quaternary Volcanic Formations - *t.QII*

These formations are widely distributed and are represented by tuffs and volcanic emissions, typically overlain by Quaternary sediments. In many areas, the rocks appear as natural outcrops. In the upper layers, the tuffs are pink, transitioning with depth to brick-lilac, gray, and occasionally black. These tuffs range from soft to very hard, are highly porous and cavernous, and are interbedded with volcanic emissions such as slags, tuff fragments, and occasionally basalts. The thickness of the tuff layers varies between 3.0 and 11.0 m, while slag-tuff layers may reach up to 15.0 m, with the total thickness of the volcanic sequence estimated at 25-30 m.

e) Middle Quaternary Diluvial-Proluvial Deposits - *dp.QII*

These deposits have limited distribution within the reservoir basin and along the dam axis. They are found as lenticular layers of sandy clays and sands, located at the contact zone between tuffaceous lavas and slag formations. The thickness of these layers varies from 0.4 to 4.0 m, and they are believed to have formed during periods of intermittent volcanic activity.

f) Upper Pliocene - Middle Interglacial Formations - *α+βN2´-QIV*

These formations are represented by basalts and andesitic basalts and are extensively distributed at depth within the area of the planned reservoir, as confirmed by borehole data. They are typically overlain by tuff and slag layers.

The andesitic basalts are black to dark gray or purple, fissured, very strong, and frequently slag-stained. They are interbedded with volcanic emissions, forming stratified sequences. The total thickness of the basalt-andesitic sequence exceeds 20 m.

Engineering-geological investigations in the Project area and surrounding vicinity were conducted in April 2024[70]. The scope of work included the following activities:

- Engineering-geological survey of the reservoir site and construction material deposits at a scale of 1:1000, covering an area of approximately 62 hectares.
- Engineering-geological investigations along the proposed access roads, and feeding and irrigation channels, with a total length of approximately 13.0 km.
- Drilling of 67 boreholes, with depths ranging from 4 to 24 meters, using the mechanical core drilling method, totaling 611 linear meters.
- Execution of 26 experimental filtration tests in selected borehole intervals using the free water jet method.
- Field determination of volumetric weight and natural moisture content of clayey soils - 21 tests.
- Field determination of bulk density, grain-size distribution, and natural moisture content of non-cohesive (crumbly) soils - 24 tests.
- Field determination of bulk density and natural moisture content of tuff samples - 12 tests.
- Collection of 7 samples of clayey soils of various structures for subsequent laboratory testing.

Hydrogeological conditions

The area of the planned reservoir is characterized by unfavourable hydrogeological conditions, primarily due to its complex geological structure and the widespread presence of natural soils and rocks with high permeability.

The region is composed of a substantial thickness of volcanic lava formations, overlain by a tuffaceous cover, which in turn is capped by deluvial-proluvial deposits. The volcanic formations are notable for their intensive fracturing, high porosity, and cavernous nature. These characteristics result in the rapid infiltration of atmospheric precipitation and surface runoff into deeper geological horizons, leading to an almost complete absence of surface water flow in the area.

An exception to the generally poor surface water conditions is the Artikjur River, a minor left tributary of the Karkachan River, which ultimately flows into the Akhuryan River. The Artikjur River originates from several small springs located approximately 3-4 km southeast of the city of Artik, with a combined natural flow of 5-10 l/sec. These waters, supplemented by snowmelt from the surrounding catchment area, converge and flow through the Moghrovidzor and Bmbalidzor gorges, passing along the outskirts of Artik.

The Moghrovidzor ravine, which cuts through the urban boundary of Artik, discharges into the municipal sewage overflow channel, which is approximately 2-3 m wide and 1.0-1.5 m deep. At the point where clean water from the Moghrovidzor ravine enters this channel, the flow rate is around 15-20 l/sec. Within the city limits, the channel collects all municipal sewage flows, increasing the total discharge at the city's outskirts to approximately 40-50 l/sec.

[70]Consulting Services for the Preparation of Design and Estimate Documentation for the Reconstruction of the Artik Reservoir, Shirak Region, Republic of Armenia, Book №3-1 - Hydrological and seismic surveys, 2024

The flow of the stream passing through the Bmbalidzor ravine near the outskirts of Artik is approximately 15-20 l/sec. As it passes through the city, collecting sewage and other runoff, its discharge increases to 100-150 l/sec.

Thus, clean spring water and snowmelt approach the city of Artik in the form of two separate streams, with a combined natural flow of 30-40 l/sec. As these streams flow through the urban area and absorb nearly all surrounding sewage discharges, they merge on the outskirts of the city into a single stream with a final flow rate of approximately 120-150 l/sec, which continues into the plain along the Artikjur riverbed.

During investigations in the reservoir area, no continuous groundwater horizons were encountered down to depths of 25.0 m. However, in borehole №13, located in the central part of the dam axis, and borehole №10, situated on the upper slope, localized groundwater was recorded at depths of 10.5 m and 4.5 m, respectively. These water occurrences are associated with a buried riverbed and are local in nature, appearing as isolated, lens-shaped pockets.

Mechanical pumping of water from these boreholes revealed a very low discharge capacity, with the water quickly drying up, further confirming the limited and discontinuous nature of these aquifers.

According to data from the former Geological Department of the Republic of Armenia, the regional groundwater table in this area is typically found at depths of 50-60 m.

Conclusions

1) The most widespread rocks in the Artik reservoir area are Artik-type tuffs, formed from gas-rich magmatic melts during ignimbrite volcanic eruptions. After the release of gases, the remaining melt underwent condensation and thermal fusion, forming the characteristic tuff layers.
2) The dam foundation, along its entire length, is composed of multi-coloured tuffs derived from foamed lava, overlain by sandy clay-limestone deposits with a thickness not exceeding 6.0 m.
3) Filtration losses from the reservoir basin are estimated at approximately 7,200 $m^3$/day. Without the implementation of anti-filtration measures, the reservoir could be fully drained within 170 days.
4) Given that the water sources feeding the reservoir have very low flow rates and are seasonal in nature (lasting a maximum of two months), the implementation of anti-filtration measures in the reservoir basin is an urgent necessity to ensure adequate irrigation water reserves. The required construction materials for such measures are available within the boundaries of the reservoir basin.
5) There is no evidence of landslides, ground displacement, or other geological or geotechnical hazards within the reservoir area, the footprint of associated structures or along the alignment of the feeding and irrigation water channels.
6) Stable groundwater horizons were not identified within either the reservoir basin or dam site down to the investigated depth of 24.0 m. The only exceptions are borehole №10 and borehole №13, where localized groundwater was encountered at depths of 4.5 m and 10.5 m, respectively. These were found to be small, isolated pockets, with extremely limited reserves that dried up quickly during test pumping.
7) All natural soils and rock types within the reservoir area and associated structure locations are considered favourable for construction, based on their physical and mechanical properties and site conditions with the exception of layer composed of ochre-brick-brown,

light, powdery sandy clays. Due to their high natural moisture content, low dry unit weight, and low deformation modulus, these clays are unsuitable as dam foundation material. Accordingly, both this layer and the overlying fine-grained gravel and loamy soils must be fully removed.

### 6.1.4 Tectonics, Seismic Stability and Landslides

The area of the planned reservoir lies within a tectonic zone characterized by superimposed orogenic folding. From a geotectonic perspective, the study area includes the following structural subdivisions: the Bazum-Zangezur Intensive, the Peri-Araksian Moderately and the Superimposed Orogenic folded zones.

The Bazum-Zangezur Intensive Folded Zone is further subdivided into:

- the Hankavan-Zangezur Subzone,
- the Sevan-Amasia Ophiolite Zone,
- the Tsaghkunyats Anticlinorium.

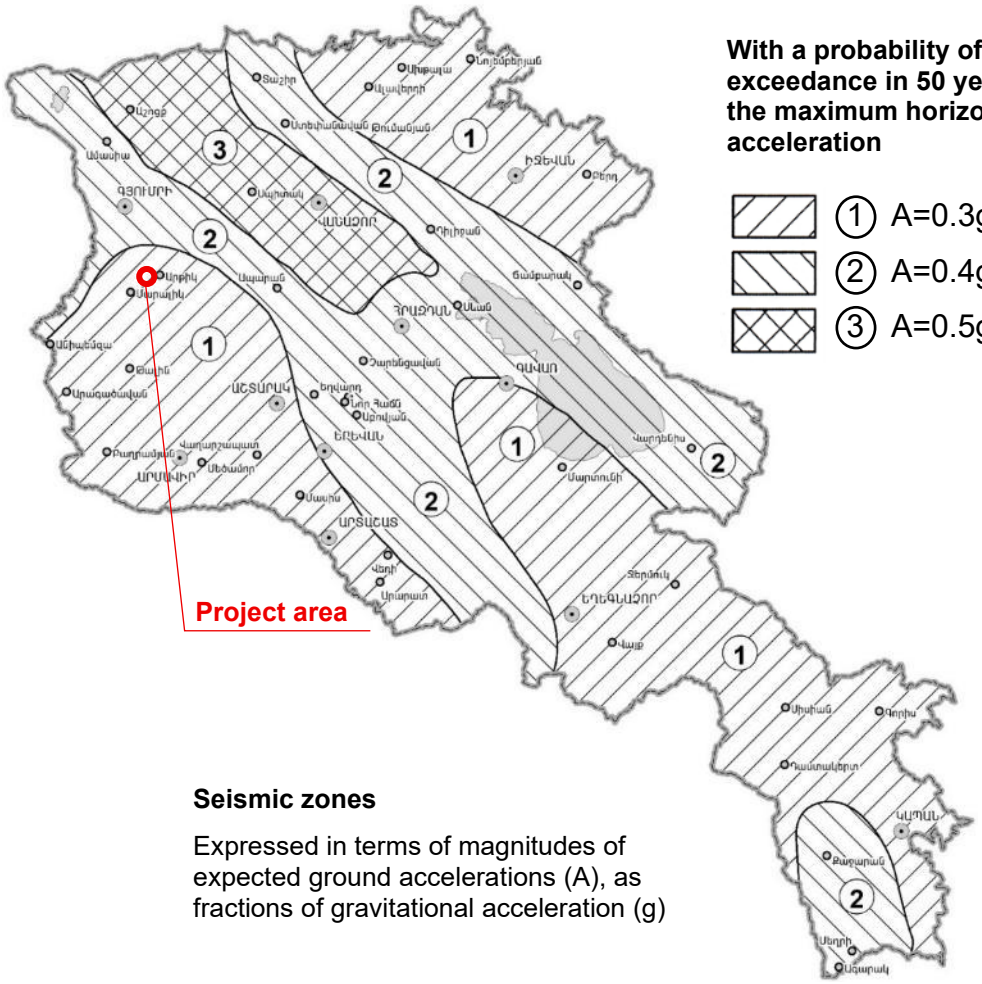
As per the RA CN 20.04 "Earthquake-resistant construction, Design norms"[71], Armenia is divided into 1st, 2nd and 3rd seismic zones, with the last the most seismically hazardous. The magnitudes of expected ground horizontal accelerations per seismic zones are:

| Seismic zones | 1st | 2nd | 3rd |
|---|---|---|---|
| Ground horizontal accelerations magnitudes a, cm/sec$^2$ | 300 | 400 | 500 |

The project site (Artik community) is located in Seismic Zone 1 (**Figure 6-3**), where the expected seismic hazard is estimated at Amax = 0.3g. Thus, the Project is not situated within the low seismic hazard zones of Armenia.

[71] https://www.arlis.am/documentview.aspx?docid=172012

**Figure 6-3. Map of zoning of probable seismic risks in the RA territory**




The results of geophysical surveys conducted using the Multichannel Analysis of Surface Waves (MASW) method indicate that the ground in the studied area falls under Category II, in accordance with RA CN 20.04 “Earthquake-Resistant Construction, Design Norms” and as shown in **Table 6-1**.

**Table 6-1. Map of zoning of probable seismic risks in the RA territory**

| № | Seismic classification of ground based on its seismic properties | Ground Condition Coefficient Values | | |
|---|---|---|---|---|
| | | Seismic zones | | |
| | | 1 | 2 | 3 |
| 1 | I | 0.8 | 0.8 | 0.8 |
| 2 | II | 1.0 | 1.0 | 1.0 |
| 3 | III | 1.1 | 1.0 | 1.0 |
| 4 | IV | 1.2 | 1.1 | 1.0 |

According to the engineering geological survey conducted in April 2024 (see **Sub-section 6.1.3**), there is no evidence of landslides, ground displacement, or other geological or geotechnical hazards within the reservoir area, the footprint of associated structures, or along the alignment of the feeder and irrigation channels. Therefore, in terms of landslide risk, the Project area is considered favourable for reservoir construction.

### 6.1.5 Hydrology (surface and groundwater resources)

Surface water

The Artikjur River is a left-bank tributary of the Karkachun (Karangu) River, joining it 19 km upstream from its mouth. The Artikjur River is 26 km long and originates from the northwestern slope of Mount Aragats. Its catchment area covers 77.0 km$^2$, with an average elevation of 2,350 masl. The river has an average gradient of 99‰, indicating a steep mountain flow regime.

The Artikjur River rises from a lake situated at an altitude of 3,079.2 masl on the northwestern slope of Aragats mountain. The source region includes a small catchment area that is permanently covered with snow. In its upper reaches, the river flows primarily through a gorge, receiving additional input from snow-fed streams descending along the gorge slopes.

The river basin follows a general north-westerly direction. Administratively, the catchment area lies within the Shirak Marz of the Republic of Armenia. It is bordered on all sides by the Karkachun and Kasakh River basins and their respective tributaries.

The Artikjur River is a mountain watercourse fed by a combination of sources, predominantly snowmelt, with significant contributions from groundwater and precipitation. Its flow regime is marked by several distinct phases:

- Spring floods, often extending into early summer;
- Rain-induced flash floods; and
- Low-flow periods during the summer-autumn and winter seasons.

The peak flooding period, which almost always represents the annual maximum discharge, typically occurs in May-June. This general flood wave is often superimposed by short, sharp peaks caused by intense rainfall, resulting in a hydrograph with a pronounced, towering appearance.

Unlike other rivers in the region, the Artikjur River is characterized by smooth and prolonged flood events from April to August, primarily driven by snow and glacier melt. While rainfall does influence the hydrograph, its role in the overall flow formation is relatively minor.

Throughout the observation period, the Artikjur River's flow has been primarily sustained by snowmelt and glacial meltwater. Each year, the river develops a stable ice cover that persists for an average of 120-140 days. During winter, the ice thickness reaches 20-25 cm, and the maximum perennial water level is 171 cm.

Irrigation-related water withdrawal begins intensively in June. In some years, ice banks start forming as early as September, with ice caps developing during colder winters. Ice formation generally begins in mid-November and persists until mid-March, after which the ice melts in place. Snow accumulation occurs in both the upper and middle reaches of the river valley.

The elevations of the headwaters in the left-bank gorges N2 and N3 of the Artikjur and Karkachun Rivers are as follows:

- Karkachun River: 1,660 masl, with a catchment area of 65.4 km$^2$,
- Gorge N2: 1,740 masl, catchment area 8.99 km$^2$,
- Gorge N3: 1,740 masl, catchment area 16.6 km$^2$.

A feeding channel is planned to be constructed to supply water to the Artik Reservoir by diverting flow from gorges N2 and N3 (**Figure 6-4**).

**Figure 6-4. The Karkachun River basin**

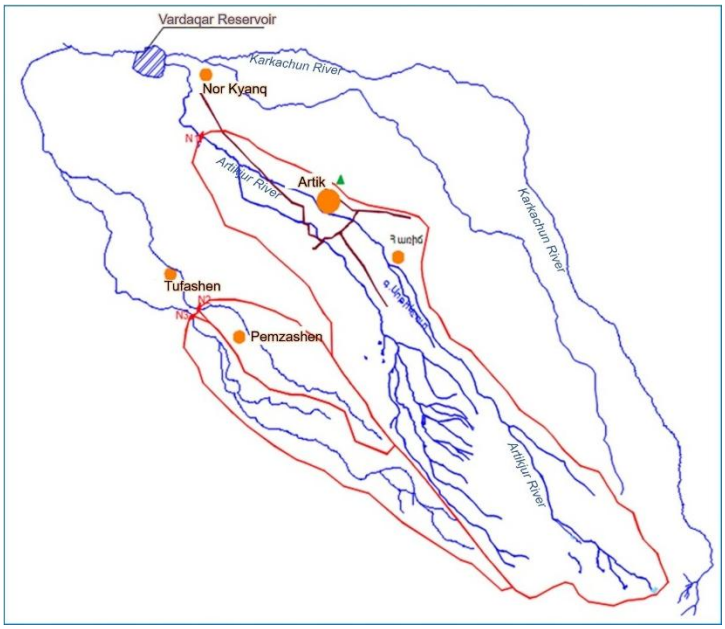
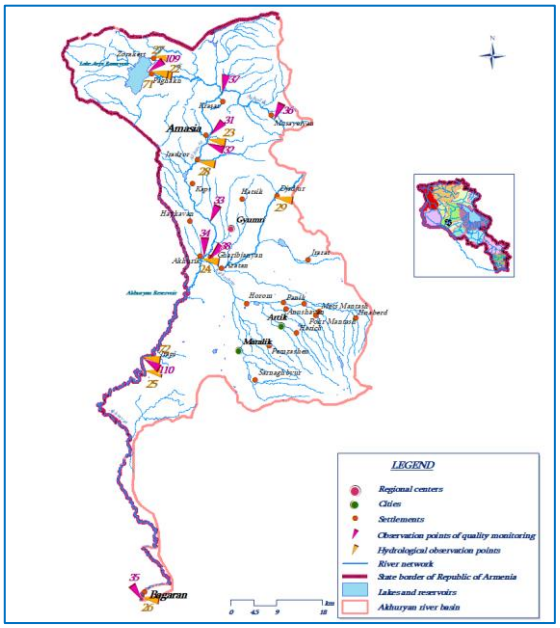



**Figure 6-5. Map of surface water monitoring network of Akhuryan River basin**




As described in **Sub-section 6.1.3**, the Artik River originates from two separate streams that flow through the town of Artik and receive communal wastewater discharges from the settlement[72]. These two streams merge on the outskirts of the town, forming a single flow with a final discharge rate of approximately 120-150 l/sec. This combined stream continues across the plain along the Artikjur riverbed and together with water supplied through the feeding channel (pipeline), will provide inflow to the planned reservoir.

However, the quality of water in the Artikjur River downstream of Artik town is unknown, as it was not analysed during the national EIA study or compared with the water quality standards established by RA Government Decree №75-N for the watercourses of the Akhuryan River basin. According to this Decree, five water quality classes are defined for the river basins of Armenia: Class 1 - Excellent, Class 2 - Good, Class 3 - Fair, Class 4 - Poor, and Class 5 - Bad.

The water quality of the Artikjur and Karkachun River flows are not monitored by the Hydrometeorology and Monitoring Centre under the Ministry of Environment (**Figure 6-5**).

Groundwater Resources

According to data from the former Geological Department of the Republic of Armenia, the regional groundwater table in this area is typically found at depths of 50-60 m.

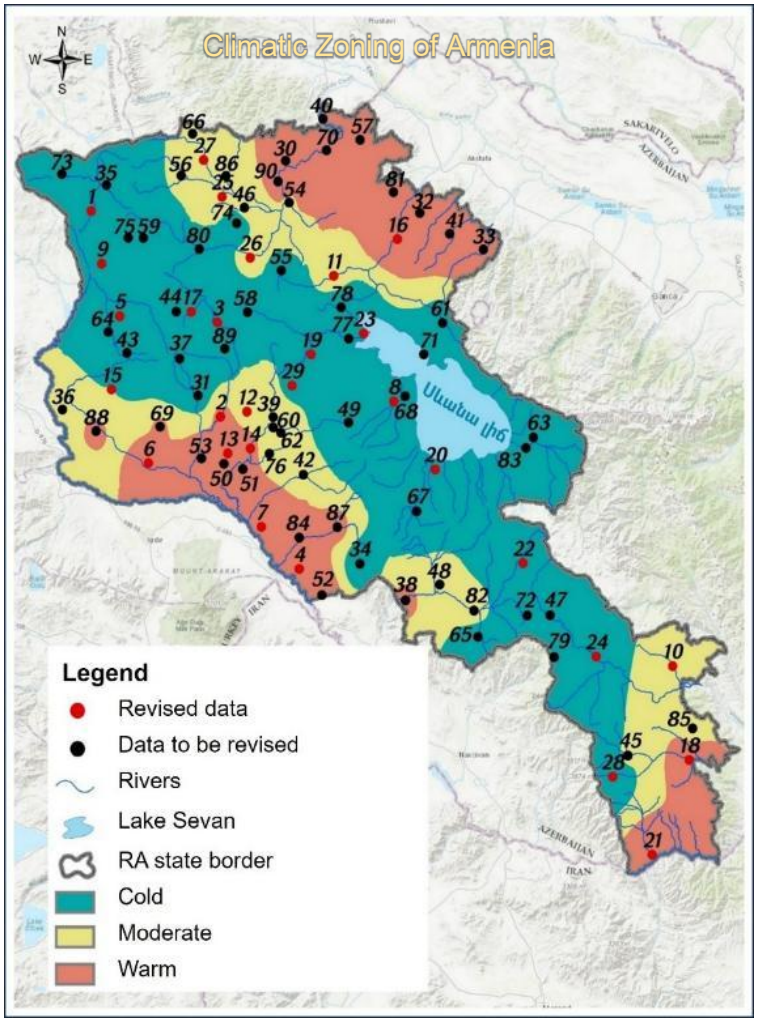
Based on the engineering–geological survey conducted by the Project designer in 2024, no continuous groundwater horizons were encountered down to a depth of 25.0 m within the area designated for reservoir construction. However, localized groundwater was detected in borehole №13, located in the central part of the dam axis, and in borehole №10, situated on the upper slope, at depths of 10.5 m and 4.5 m, respectively. These occurrences are associated with a buried riverbed and are local in nature, appearing as isolated, lens-shaped pockets.

[72]Population of Artik town is about 17,950 as per the Armstat annual bulletin - Socio-economic characteristics of marzes and Yerevan city of the RA, 2024 (https://armstat.am/file/Map/MARZ_08.pdf)

The groundwater monitoring network of Armenia comprises 119 groundwater sources located within six water basin management areas of the Republic (Northern, Akhuryan, Hrazdan, Sevan, Araratyan, and Southern). However, there are no monitoring points situated in the vicinity of the Project area.

### 6.1.6 Climate and Meteorology

According to the RA Construction Norms CN 22-01-2024 "Construction Climatology"[73] the Project site (№5) is located within the cold climatic zone (see map of climatic zoning of Armenia).




The data presented in this section were obtained from the meteorological station located in the Artik community, approximately 3.5 km from the Project site. According to the Artik station records, the average annual air temperature in the Project area is 6.3°C. The coldest month is January, with an average temperature of -7.0°C, while the warmest month is August, averaging 18.4°C. The absolute minimum temperature of -26.3°C was recorded in January, and the absolute maximum temperature of 35.9°C was observed in July.

The average annual relative humidity is 68%, and total annual precipitation amounts to 554 mm. The highest rainfall occurs between June and October, contributing up to 240 mm. The maximum recorded soil freezing depth is 110 mm, while the number of days with snow cover is 100.

The average temperature, relative humidity, precipitation, and snow cover data observed at the 'Areni' meteorological station, as well as wind velocity in different directions recorded at the 'Yeghegnadzor' meteorological station, derived from CN 22-01-2024 "Construction Climatology", are summarized in **Tables 6-2** to **6-6**, respectively.

**Table 6-2. Average air temperature**

| Meteorological station | Average temperature by month, °C | | | | | | | | | | | | Average annual, °C | Absolute minimum, °C | Absolute maximum, °C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | | | |
| Artik | -7.0 | -5.7 | -0.8 | 6.0 | 10.9 | 14.7 | 18.3 | 18.4 | 14.4 | 8.4 | 1.9 | -4.2 | 6.3 | -26.3 | 35.9 |

[73] https://www.arlis.am/DocumentView.aspx?DocID=188846

**Table 6-3. Relative humidity**

| Meteorological station | Air relative humidity by month, % | | | | | | | | | | | | Average annual | Humidity of the coldest month, % | | Humidity of the hottest month, % | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | Average monthly | Average monthly at 3 p.m. | Average monthly | Average monthly at 3 p.m. |
| | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | 13 | 14 | 15 | 16 | 17 |
| Artik | 76 | 74 | 70 | 65 | 66 | 65 | 62 | 58 | 58 | 65 | 72 | 76 | 68 | 76 | 69 | 58 | 43 |

**Table 6-4. Precipitation**

| Meteoro-logical station | Amount of precipitation by month, mm<br>average monthly<br>daily maximum | | | | | | | | | | | | Yearly | November-March, mm | April-October, mm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | | | |
| Artik | 22 | 26 | 38 | 63 | 97 | 81 | 53 | 37 | 32 | 50 | 31 | 24 | 554 | 141 | 413 |
| | 22 | 22 | 26 | 35 | 36 | 51 | 51 | 51 | 37 | 50 | 43 | 31 | 51 | | |

**Table 6-5. Snow cover**

| Meteoro-logical station | Snow cover | | | |
|---|---|---|---|---|
| | Maximum ten-day height | The number of days with snow cover in a year | Maximum amount of water in snow, mm | Maximum depth of soil freezing, mm |
| Artik | 51 | 100 | 252 | 110 |

**Table 6-6. Wind**

| Monitoring station | Months | Repeatability, %<br>Average velocity, m/s, in directions | | | | | | | | Tranquility repeatability, % | Average monthly velocity, m/s | Prevailing direction in June-August | Minimum average velocity among the directions in July, m/s | The prevailing direction in December-February | Minimum average velocity among the directions in January, m/s |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Northern | North-Eastern | Eastern | South-Eastern | Eastern | South-Western | Western | North-Western | | | | | | |
| Artik | January | 11 | 8 | 12 | 16 | 25 | 12 | 6 | 10 | 47 | 1.8 | North-Eastern | 3.6 | Southern | 3.9 |
| | | 1.4 | 1.1 | 1.2 | 1.1 | 3.9 | 2.4 | 1.3 | 1.1 | | | | | | |
| | April | 8 | 7 | 16 | 13 | 25 | 15 | 8 | 8 | 25 | 2.8 | | | | |
| | | 2.1 | 2.2 | 2.5 | 1.8 | 4.2 | 3.5 | 2.7 | 2.3 | | | | | | |
| | July | 9 | 17 | 39 | 9 | 6 | 7 | 6 | 7 | 18 | 3.3 | | | | |
| | | 2.6 | 3.6 | 4.1 | 1.8 | 2.3 | 2.1 | 2.0 | 2.3 | | | | | | |
| | October | 8 | 7 | 18 | 19 | 17 | 12 | 9 | 10 | 31 | 2.0 | | | | |
| | | 1.8 | 1.7 | 2.0 | 1.5 | 2.9 | 2.3 | 1.9 | 1.6 | | | | | | |

### 6.1.7 Climate Risk Profile

Background

According to the Armenia's Fourth National Communication on Climate Change (2020)[74] over the past decades a significant increase in temperature has been observed in Armenia. Particularly, over the period of 1929-1996, the annual mean temperature increased by 0.4°C, during 1929-2007 - by 0.85°C, during 1929-2012 - by 1.03°C, and during 1929-2016 - by 1.23°C. The ambient air temperature change has had different trends in different seasons. During the period of 1966-2016, the average summer temperature increased by about 1.3°C; moreover, over the last century, extremely hot summers were observed in Armenia within the last 20 years.

During the period of 1935-1996, the average annual precipitation decreased by 6% and in 1935-2016 - by about 9%. The spatial distribution of precipitation is quite irregular. During the period of 1935-2016 the climate in the north, south and central regions of the country has become more arid, while precipitations have increased in the Shirak plain, in the Lake Sevan basin and in Aparan-Hrazdan regions.

The frequency and intensity of natural disasters have increased significantly. Over the period of 1975-2016, the total number of observed hazardous phenomena increased by about 40 cases, as compared to the average of 1961-1990 (168 cases). The highest number of hailstorms was observed in the Shirak plain, the maximum number of cases with heavy rainfall occurred in Tashir and Ijevan regions, and frosts - in the Ararat valley and foothill regions. According to drought indices, the number of days with strong and very strong droughts during the period of 2000-2017 increased by 33 days, as compared to the 1961-1990 average (87). In recent years, the upper boundary of the drought zone has expanded and includes mountainous areas, with an earlier timed start of drought.

Climate change scenarios for Armenia

The results of the CCSM4[75] Global Climate Model used and reported in the NC3[76] were reviewed for the projection of changes in air temperature and atmospheric precipitation, as well as high resolution METRAS (12×12 km) regional climate model was applied.

The average annual temperature across the territory of Armenia is projected to increase by up to 1.6°C by 2040, by 3.3°C - by 2070 and by 4.7°C - by 2100, relative to the baseline annual average (5.5°C) for 1961-1990. As for atmospheric precipitations, these are projected to decline by up to 2.7% by 2040, 5.4% - by 2070 and 8.3% - by 2100, relative to the baseline annual average (592 mm) for 1961-1990.

The projected climate change is expected to have negative effects on the country's water resources, energy, agriculture, ecosystems, human health, settlements and infra structures, as well as a number of other climate-sensitive sectors, including tourism.

Water resources

**River flow.** Analysis of water resources vulnerability in Armenia was carried out using the CCSM4 model data with the emission scenarios of RCP8.5[77] and RCP6.0, as well as the METRAS model with the RCP8.5 scenario. The vulnerability of the river flow to climate change varies across different river basins, due to the differences in natural and climatic conditions of the basins, and the various factors that impact on the flow formation. The vulnerability of the annual river flow assessed with the

[74] https://unfccc.int/sites/default/files/resource/NC4_Armenia_.pdf
[75] CCSM4 - Community Climate System Model, version 4
[76] NC3 - Third National Communication
[77] RCP - Representative Concentration Pathway

above-mentioned climate models and scenarios for 2040, 2070 and 2100 are summarized in Table 6-7.

**Table 6-7. Vulnerability of the river flow to climate change in Armenia**

| Scenario | Time period | River flow studied, mln. $m^3$ | Change in flow | |
|---|---|---|---|---|
| | | | mln. $m^3$ | % |
| CCSM4 RCP6.0 | 1961-1990 | 6,279.9 | 0 | 0 |
| | 2011-2040 | 5,760.4 | -519.5 | -8.27 |
| | 2041-2070 | 5,450.5 | -829.4 | -13.2 |
| | 2071-2100 | 5,037.9 | -1,242.0 | -19.8 |
| CCSM4 RCP8.5 | 2011-2040 | 5,513.5 | -766.4 | -12.2 |
| | 2041-2070 | 5,148.2 | -1,131.7 | -18.0 |
| | 2071-2100 | 4,165.1 | -2,114.8 | -33.7 |
| METRAS RCP8.5 | 2011-2040 | 5,433.4 | -846.5 | -13.5 |
| | 2041-2070 | 4,547.9 | -1,732.0 | -27.6 |
| | 2071-2100 | 3,832.0 | -2,447.9 | -39.0 |

**Lake Sevan.** The assessment of the water balance of Lake Sevan under the predicted climate change scenarios was implemented through a multifactor correlation analysis of the annual inflow into the Lake and multi annual observation data of atmospheric precipitation and air temperature at the meteorological stations of the basin. Based on the RCP8.5 and RCP6.0 emission scenarios used with the CCSM4 climate model and the RCP8.5 scenario used with the METRAS model, changes in the river inflow into the Lake Sevan for 2040, 2070 and 2100 were projected (Table 6-8).

**Table 6-8. Projection of the Lake Sevan water balance elements**

| Scenario | Time period | River flow, mln. $m^3$ | Precipitation, mln. $m^3$ | Evaporation, mln. $m^3$ |
|---|---|---|---|---|
| CCSM4 RCP6.0 | 1961-1990 | 783.8 | 503.9 | 1074.5 |
| | 2011-2040 | 712.6 | 519.0 | 1194.9 |
| | 2041-2070 | 681.6 | 513.9 | 1246.2 |
| | 2071-2100 | 646.4 | 524.0 | 1316.9 |
| CCSM4 RCP8.5 | 2011-2040 | 693.7 | 508.9 | 1203.3 |
| | 2041-2070 | 648.0 | 529.1 | 1326.0 |
| | 2071-2100 | 552.8 | 513.9 | 1467.1 |
| METRAS RCP8.5 | 2011-2040 | 687.5 | 488.7 | 1186.1 |
| | 2041-2070 | 597.0 | 478.7 | 1335.4 |
| | 2071-2100 | 519.0 | 463.6 | 1467.1 |

The analysis of climate change scenarios shows a negative impact for the Lake's habitat; and under the pessimistic scenario a decrease in the total river inflow into Lake Sevan by about 34% (265 mln. $m^3$) by 2100 is projected. In addition to the anthropogenic impact, the quality of the Lake water is significantly affected by climate change. Along with the air and water temperature increase, the biomass of phytoplankton in the Lake is increasing, which leads to an abrupt deterioration of the Lake's water quality and the acceleration of eutrophication processes.

**Reservoirs.** The vulnerability of the river inflow during spring (April-June) months was estimated for the strategically significant reservoirs - Akhuryan, Aparan, Azat and Marmarik, for 2040, 2070, and 2100. The impact of climate change on the river inflow into the reservoirs during spring will be particularly significant for the Akhuryan and Marmarik reservoirs. Based on the assessment by the METRAS model and the RCP8.5 scenario, a decrease of around 60% can be projected for the river inflow during the spring months in 2100.

Agriculture

The vulnerability of the agriculture sector to natural hazards is relatively high, and it considerably varies across land zones and specific crops. It is more evident in low-lying and medium-altitude zones in the country. About 80% of the territory of Armenia is exposed to various degrees of desertification, which is not only the consequence of anthropogenic activity, but is also affected by natural factors, such as water and wind erosion of soils, hot dry spells, drought, lack of humidity, landslides, natural salinization, alkalization, etc. Climate change, along with various anthropogenic phenomena, contributes to the vulnerability of organic carbon reserves in soils. According to climate change forecasts for Armenia over the next 100 years, the following changes are expected in the field of agriculture:

- Decrease in the level of soil moisture by 10-30%, decrease in soil moisture provision for various agricultural crops by 7-13%,
- Shortage of water for irrigation, increase of soil water deficit by 25-30%,
- Reduced productivity of irrigated land by about 24%,
- Degradation of lands and natural pastures; decrease in overall pasture area and productivity by 4-10% by 2030, decrease in pasture yield by 7-10%, decrease in fodder production volumes,
- Crop yield decline by 8-14% by 2030.

Hailstorms, frosts, heat waves, and drought have a particularly significant impact on the loss of agricultural crop yields due to hazardous hydrometeorological phenomena. In recent years, annual damage caused to agriculture by drought, hail, floods, spring frosts and mudflows has been estimated at about 15-30 billion AMD. In particular, the largest share in the damage caused is attributable to hailstorms. According to climate change scenarios, the frequency of thunderstorms and weather fluctuations accompanied by hailstorms is likely to increase in spring and summer.

### 6.1.8 Soil

The following main soil zones are distinguished within the Arpikjur River basin:

Mountain brown soils

These soils are distributed in the southern part of the region, within the dry steppe areas of the foothill zone, extending from the lower slopes of Mount Aragats to the Akhuryan River valley at elevations of 1,450-1,600 m. They form under hot and relatively dry climatic conditions and contain 3-4% humus.

Mountain-steppe black soils

These soils occur at elevations of 1,500-2,200 m, occasionally reaching 2,400-2,500 m in some areas. They cover most of the Shirak and Ashotsk plateaus, as well as the adjacent foothill and mid-mountain zones. The upper layer is rich in humus, with humus content ranging from 4-5% up to 10-11%. The average thickness of the black soil layer is 50-65 cm.

Mountain meadow-steppe soils

These soils are found above the black soil zone, at elevations of approximately 2,200-2,600 (up to 2,700) m. The humus content ranges from 8-12%.

Mountain meadow soils

Located above the meadow-steppe soils, these soils have a relatively thin profile, with the soil layer rarely exceeding 15-20 cm in the upper parts. Mountain meadow areas are typically covered with high-quality pastures.

During the national EIA study, the quality of soil within and around the planned Artik Reservoir area was not analysed and compared with the Admissible Concentration Limits (ACL) for chemical elements in soil, as established by Sanitary Rules and Norms №2.1.7.003-10 "Hygienic Requirements for Soil Quality"[78].

### 6.1.9 Ambient Air Quality

There are no industrial facilities currently operating within the Artik community or the Project area, with the exception of a tuff mine located approximately 5.5 km southeast of the planned reservoir site, which is presently non-operational. The principal sources of atmospheric emissions in the area are agricultural machinery and vehicular traffic; however, their contribution to ambient air pollution levels is assessed as negligible and not exceeding admissible limits. Accordingly, the Hydrometeorology and Monitoring Center under the Ministry of Environment does not perform routine air quality monitoring within Artik community or its surrounding areas, as the locality is not considered an air pollution risk zone under national monitoring criteria.

As reported by the RA Ministry of Environment, the background concentrations of air pollutants in residential areas where air quality monitoring[79] is not conducted are shown in **Table 6-9**.

**Table 6-9. Background concentrations of air pollutants in residential areas without air quality monitoring**

| Population (thousand people) | Background concentrations (mg/m$^3$) | | | |
|---|---|---|---|---|
| | Dust | Sulfur dioxide ($SO_2$) | Nitrogen dioxide ($NO_2$) | Carbon oxide (CO) |
| 50-100 | 0.098 | 0.007 | 0.034 | 1.3 |
| 10-50 | 0.095 | 0.006 | 0.033 | 1.1 |
| <10 | 0.071 | 0.006 | 0.023 | 0.8 |

Taking into account that the population of Artik town is 17950, the following background concentrations of air pollutants are specified:

- Dust - 0.095 mg/m$^3$,
- Sulfur dioxide - 0.006 mg/m$^3$,
- Nitrogen dioxide - 0.033 mg/m$^3$,
- Carbon oxide - 1.1 mg/m$^3$.

[78] https://www.arlis.am/DocumentView.aspx?docid=146741
[79] https://meteomonitoring.am/page/1591

The criteria for assessing ambient air quality in the residential areas in Armenia is defined by the RA Government Decree №160-N and the World Health Organization (WHO) *Air Quality Guidelines - Global Update 2021*[80], and are summarized in **Table 6-10**.

**Table 6-10. Air quality standards highlighting (in blue cells) the most stringent**

| № | Pollutant | Averaging period | Maximal Permissible Concentrations (MPC), mg/m³ | | |
|---|---|---|---|---|---|
| | | | WHO | | Armenian standards |
| | | | 2005 | 2021 | |
| 1 | PM2.5 | 24-hour | 0.025 | 0.015 | 0.035 |
| | | Annual | | 0.01 | |
| | | Maximum | | | 0.16 |
| 2 | PM10 | 24-hour | 0.05 | 0.045 | 0.06 |
| | | Annual | 0.02 | 0.015 | |
| | | Maximum | | | 0.3 |
| 3 | Sulphur dioxide | 1-hour | | | |
| | | 24-hour | 0.02 | 0.04 | 0.05 |
| | | Maximum | | | 0.5 |
| 4 | Nitrogen dioxide | 1-hour | | | |
| | | 24-hour | | 0.025 | 0.04 |
| | | Annual | 0.04 | 0.01 | |
| | | Maximum | | | 0.2 |
| 5 | Carbon monoxide | Maximum daily 8hour | | | |
| | | 24-hour | | 4.0 | 3.0 |
| | | Maximum | | | 5.0 |

### 6.1.10 Noise and Vibration

The baseline noise and vibration conditions in the Project area have been characterized based on the existing land use, sources of noise and available information on local activities.

There are no major industrial facilities operating within or near the Project area. The nearest potential sources of noise and vibration include agricultural machinery operating within farmlands surrounding the site and vehicular traffic along the H21 "H75-Horom-Alagyaz" road, passed around 500 m from the Project area. Occasional local traffic within Artik and Nor Kyanq settlements is unlikely to contribute to the general ambient noise levels.

Given the rural setting of the Project site, background noise and vibration levels are expected to be typical of agricultural and low-traffic environments, characterized primarily by natural sounds (wind, fauna, and limited human activity). No permanent or significant sources of vibration have been identified in the vicinity of the proposed reservoir footprint or associated infrastructure areas.

At the national level, there are no continuous noise monitoring stations in Artik community or its surroundings. Therefore, baseline noise conditions can be estimated based on the nature of existing activities and comparable rural environments in Armenia.

[80] https://www.who.int/publications/i/item/9789240034228

Threshold Limit Values (TLVs) for equivalent (average) and maximum noise/sound levels set by the RA Sanitary Norms №2-III-11.3 *Noise in the workplaces, in residential and public buildings and housing in construction areas*[81] are comparable with the IFC *Environmental, Health, and Safety General Guidelines (2007)*[82] and WHO *Guidelines for Community Noise (1999)*[83]. The national TLVs and IFC/WHO guidelines for noise are presented in **Table 6-11**.

**Table 6-11. Threshold limit values (TLV) for noise**

| № | Premises and territories, receptors | | TLV, dBA | | |
|---|---|---|---|---|---|
| | | | National | | IFC/WHO |
| | | | Equivalent to sound level | Maximum sound level | One hour equivalent sound level |
| 1 | Workplace | | 80 | | 85 |
| 2 | Shops, trading halls, airport and railway stations waiting rooms, drop-off points of public service providers | | 60 | 75 | |
| | Industrial, commercial | | | | 70 |
| 3 | Territories adjacent to residential buildings, clinics, ambulatories, rest houses, care homes, disabled persons homes, libraries, kinder gardens, schools and other educational facilities | day-time[84] | 55 | 70 | 55 |
| | | night-time[85] | 45 | 60 | 45 |

### 6.1.11 Natural Hazards

Armenia is prone to several natural hazards due to its geological, topographical, and climatic conditions. Here are the main natural hazards typical to Armenia:

1. **Earthquakes**
   - Armenia is located in a seismically active zone (part of the Alpine-Himalayan seismic belt).
   - Strong earthquakes have historically caused significant damage (e.g., the 1988 Spitak earthquake).
   - Earthquake risk is high in northern and central parts of the country.
2. **Landslides**
   - Common in mountainous and hilly areas, especially where there is deforestation, road construction, or heavy rainfall.
   - Southern and northeastern regions are particularly vulnerable.
3. **Floods and Flash Floods**
   - Caused by intense rainfall, rapid snowmelt, or dam breaches.
   - More frequent in spring and early summer.
   - Rivers like the Arpa, Debed, and Vorotan can flood surrounding areas.

[81] https://www.arlis.am/hy/acts/163246
[82] https://www.ifc.org/content/dam/ifc/doc/2000/2007-general-ehs-guidelines-en.pdf
[83] https://www.who.int/publications/i/item/a68672
[84] between 07:00 and 23:00
[85] between 23:00 and 07:00

4. **Mudflows (Debris flows)**
   - Occur in mountainous river valleys, especially during heavy rains.
   - Common in the Lori, Tavush, Syunik, and Vayots Dzor regions.
5. **Droughts**
   - Particularly affect the Ararat Valley and other agricultural regions.
   - Reduced water availability impacts farming and hydropower.
6. **Hailstorms**
   - Can occur during spring and summer, causing severe damage to crops.
   - Agriculture in regions like Armavir, Ararat, and Shirak is often affected.

## 6.2 Biological Environment

### 6.2.1 Biodiversity

The biodiversity baseline presented in this section is based on key findings of the national EIA report for the Artic Reservoir site, including data from field surveys conducted in April-May 2024. These findings are further supplemented by the results of additional studies performed by the Consultant, including field surveys carried out in spring-summer 2025.

### 6.2.2 Vegetation and Flora

*Methods*

The types of vegetation within the Project-affected area were determined and categorized based on the results of field surveys conducted under the national EIA.

The surveys employed itinerary method. A complete inventory of plant species was carried out in the area with all habitats and plant species documented and digitally photographed.

Most plant species were identified visually during field surveys. Species requiring laboratory identification were collected, preserved in herbariums, and subsequently analysed. Vegetation descriptions were developed based on these surveys.

The flora study focused on identifying the diversity of higher vascular plants. Species identification was guided by the Flora of Armenia book (11 volumes, 1954-2009). Scientific plant names are presented in accordance with S. Tcherepanov's manual (Tcherepanov, 1995).

*Vegetation types*

Based on the floristic divisions by A.L. Takhtajyan (1954), the proposed site for the Artik reservoir falls within the Yerevan floristic region. The studied area is located near the Nor Kyank community of the Shirak region, on the site of a previously constructed reservoir.

The vegetation has a pronounced xerophilous, mesophilous and hydrophilic nature, it is unique to the steppe, meadow-steppe (**Figure 6-6, a)**, developed weedy, and partly wetland vegetation **(Figure 6-6, b)**.

The local ecosystem is considerably disturbed, with widespread growth of weedy vegetation. Most of the area is overgrazed. In some parts of the area, especially along the banks of the river, accumulations of household garbage were observed.

**Figure 6-6. The view of the Artik River valley**

*a) steppe and meadow-steppe vegetation (in the background is the city of Artik)*

*b) wetland vegetation*

*Flora*

Species of the higher vascular plants found in the Project area are listed in **Table 6-12**. The flora is presented by 103 species of 33 families.

The arrangement of the flora families, in its general outlines, is typical of the flora of the Irano-Turanian province, where the leading positions in terms of species diversity are occupied by the families of Asteraceae, Labiatae, Broccoli, Fabaceae, Apiaceae and others.

**Table 6-12. List of plant species registered in the study area**

| Family | Latin name of species |
|---|---|
| Equisetaceae | Equisetum arvense L. |
| Alismataceae | Alisma plantago-aquatica L. |
| Alliaceae | Allium atroviolaceum Boiss. |
| Apiaceae | Astrodaucus orientalis (L.) Drude |
| | Bupleurum persicum Boiss. |
| | Pimpinella rhodantha Boiss. |
| | Pimpinella saxifraga L. |
| | Seseli peucedanoides (Bieb.) Kos.-Pol. |
| | Trinia leiogona (C.A. Mey.) B. Fedtsch. |
| Asteraceae | Achillea millefolium L. |
| | Artemisia absinthium L. |
| | Artemisia fragrans Willd. |
| | Carduus nutans L. |
| | Centaurea diffusa Lam. |
| | Centauera glehnii Trautv. |
| | Cirsium echinus (Bieb.) Hand.-Mazz. |

| Family | Latin name of species |
|---|---|
| | Cousinia brachyptera DC. |
| | Crepis foetida L. |
| | Echinops polyacanthus Iljin. |
| | Helichrysum plicatum DC. |
| | Helichrysum rubicundum (K. Koch) Bornm. |
| | Hieracium cymosum L. |
| | Hieracium murorum L. |
| | Lactuca serriola L. |
| | Matricaria matricarioides (Less.) Porter ex Britt. |
| | Senecio racemosus (Bieb.) DC. |
| | Tanacetum parthenium (L.) Sch. Bip. |
| | Taraxacum officinale Wigg. |
| | Tragopogon reticulatus Boiss. et Huet |
| | Xeranthemum squarrosum Boiss. |
| Boraginaceae | Cerinthe minor L. |
| | Lappula heteracantha (Ledeb.) Borb. |
| | Myosotis micrantha Pall. ex Lehm. |
| | Onosma microcarpa Stev. ex DC. |
| Brassicaceae | Alyssum tortuosum Waldst. et Kit. ex Willd. |
| | Bunias orientalis L. |
| | Lepidium ruderale L. |
| | Meniocus linifolius (Steph.) DC. |
| | Sisymbrium loeselii L. |
| Caryophyllaceae | Dianthus raddeanus Vierh. |
| | Melandrium latifolium (Poir.) Maire |
| | Scleranthus annuus L. |
| | Silene ruprechtii Schischk. |
| Chenopodiaceae | Chenopodium foliosum Aschers. |
| Convolvulaceae | Convolvulus arvensis L. |
| Crassulaceae | Sedum acre L. |
| Cyperaceae | Carex acuta L. |
| Dipsacaceae | Scabiosa bipinnata C. Koch |
| Euphorbiaceae | Euphorbia iberica Boiss. |
| Fabaceae | Astragalus galegiformis L. |
| | Astragalus hyalolepis Bunge |
| | Astragalus microcephalus L. |
| | Astragalus pseudoutriger Grossh. |
| | Lotus corniculatus L. tenuis Waldst. et Kit. ex Willd. |
| | Medicago lupulina L. |

| Family | Latin name of species |
|---|---|
| | Melilotus albus Medik. |
| | Trifolium arvense L. |
| Geraniaceae | Erodium cicutarum (L.) L'Her. |
| | Geranium ibericum Cav. |
| Hypericaceae | Hypericum perforatum L. |
| Lamiaceae | Ajuga chia Schreb. |
| | Ballota nigra L. |
| | Lamium amplexicaule L. |
| | Mentha longifolia (L.) Huds. |
| | Nepeta mussinii Spreng. |
| | Phlomis pungens Willd. |
| | Salvia verticillata L. |
| | Satureja hortensis L. |
| | Sideritis montana L. |
| | Stachys atherocalyx K. Koch |
| | Teucrium orientale L. |
| | Teucrium polium L. |
| | Ziziphora persica Bunge |
| Lemnaceae | Lemna minor L. |
| Linaceae | Linum nervosum Waldst. et Kit. |
| Malvaceae | Alcea rugosa Alef. |
| | Malva neglecta Wallr. |
| | Malva pusilla Smith |
| Papaveraceae | Papaver fugax Poir. |
| Plantaginaceae | Plantago lanceolata L. |
| | Plantago media L. |
| Poaceae | Anisantha tectorum (L.) Nevski |
| | Bromopsis tomenthella (Boiss.) Holub |
| | Dactylis glomerata L. |
| | Elytrigia trichophora (Link) Nevski |
| | Eremopoa multiradiata (Trautv.) Roshev. |
| | Helictotrichon armeniacum (Schischk.) Grossh. |
| | Koeleria albovii Domin |
| | Melica taurica K. Koch |
| | Phleum pratense L. |
| | Poa bulbosa L. |
| | Sclerochloa dura (L.) P. Beauv. |
| Polygonaceae | Polygonium avicularis L. - |
| | Rumex crispus L. |

| Family | Latin name of species |
|---|---|
| Ranunculaceae | Ranunculus arvensis L. |
| Resedaceae | Reseda lutea L. |
| Rosaceae | Alchemilla grossheimii Juz. |
| | Potentilla canescens Bess. |
| Rubiaceae | Galium verum L. |
| | Veronica anagallis-aquatica L. |
| Solanaceae | Hyoscyamus niger L. |
| Urticaceae | Urtica dioica L. |
| Violaceae | Viola arvensis Murr. |

There are no tree species in the study area, with the majority of the area covered with perennial and annual plant species, while some areas are not covered with vegetation.

No species registered in the RA Red Book (2010) were recorded within the area designated for the construction of the reservoir. There are no endemic or otherwise specially protected species of Armenia in the studied area, and no relict species.

### 6.2.3 Fauna

#### Terrestrial mammals

*Methods*

The fauna of mammals of the area was only superficially examined during previous biodiversity studies. The data from the previous studies conducted in the area, and the available scientific information related to the region was used during the desktop research, and included articles, reports. Namely, it covered the literature materials at our disposal (Dal 1954, Geptner et al. 1967, Martirosyan & Papanian 1983, Bibikov 1985, Agadzhanyan 1986,1993, Kasabyan 1986, 2001,2014, Popov 2003, Avagyan 2010, RA Red Book (1987, 2010), and other).

*Results*

Based on the abovementioned sets of data, the list of mammalian species that are found or expected to be found in the area is provided below (**Table 6-13**).

**Table 6-13. Mammalian species of the study area**

| № | Latin Name | English Name | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| **Erinacedae** | | | | | | | | |
| 1 | *Erinaceus concolor* | Southern white-breasted hedgehog | | + | | | | |
| **Leporidae** | | | | | | | | |
| *2* | *Lepus europaeus* | European hare | | + | | | | |
| **Mustellidae** | | | | | | | | |
| 3 | *Vormela peregusna (Guldenstaedt, 1770)* | Marbled polecat | + | + | VU/ VU | + | + | + |
| 4 | *Mustela nivalis* | Least weasel | | + | | | | |

| № | Latin Name | English Name | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| 5 | *Meles meles* | European badger | | + | | | | |
| **Canidae** | | | | | | | | |
| 6 | *Vulpes vulpes* | Red fox | + | + | | | | |
| **Cricetidae** | | | | | | | | |
| 7 | *Microtus (Sumeriomys) schidlovskii, Argyropulo, 1933* | Schidlovsky's vole | + | + | EN | | | |
| **Sciuridae** | | | | | | | | |
| 8 | *Spermophilus xanthoprymnus, Bennet 1835* | Asia Minor ground squirrel | + | - | EN/ NT | | | |

***Keys to Table 6-13***

**Column titles:**
1- Information from various sources
2 - Data obtained during scientific expeditions
3 - IUCN Red List/Red Book of Armenia
4 - Resolution 6 of Bern Convention
5 - Annex II of the Habitats Directive
6- Annex IV of the Habitats Directive

**Signs:**
+ listed or registered
- not registered
no sign - not listed

**Conservation status** (in the RA Red Book, IUCN Red List):
EN – Endangered
NT – Near Threatened
LC - Least Concern

As shown in **Table 6-13**, the area is home to eight mammal species belonging to six families.

Three species are listed in the RA Red Book; two species are listed in the IUCN Red list - Marbled polecat in Category “Vulnerable”, and Asia Minor ground squirrel in Category “Least Concern”.

Of the eight identified species, one (Marbled polecat) is classified as Priority Biodiversity Features under EBRD PR6, Criterion 12(i), as this is listed in Resolution No. 6 of the Bern Convention, and Annex II of the EU Habitats Directive (see **Table 6-13**). This species is also qualified as Critical Habitat under EBRD PR6, Criterion 14(ii), as the species is listed in Annex IV of the EU Habitats Directive.

Two species (Schidlovsky's vole and Asia Minor ground squirrel) are classified as Priority Biodiversity Features under EBRD PR6, Criterion 12(i), as listed in the RA Red Book in Category "Endangered".

**Birds**

*Methods*

Data collection methods included transect count and count of breeding pairs.

Transect counts were conducted along routes that were 200 m long and 200 m wide (extending 100 m on each side of the central line). The counts were carried out from 6:00 to 11:00, during which most uniformly distributed species are active.

The count of breeding pairs of large-ranged and colonial species was implemented opportunistically when such species appeared. In such cases, the breeding behaviour of the species was observed to identify the highest possible breeding code (Voříšek et al. 2008).

Data processing included visualization of the bird community in the form of a table that also shows priority species and estimation of their abundance. The priority species are those listed either in the

RA Red Book, in the IUCN Red List, in the Resolution 6 of the Bern Convention, in the Annex I of EU Birds Directive, or are considered Restricted Range species[86].

Estimation of the abundance of uniformly distributed species was done through computation of their density per one ha and multiplication of the density on the area of typical habitat. The estimation of abundance of large-ranged and colonial species was done through the direct count of breeding pairs (pairs with high breeding codes).

*Results*

The bird's diversity of the study area is presented in **Table 6-14** below and includes 78 species. Among those, there are 28 bird species, which breed in the area, six species, which breed in proximity to the site and use the area as a part of their foraging range, and 44 species pass the area during the seasonal migration.

Among breeding birds, one species is listed in the RA Red Book (2010), and two species are included in the Resolution No.6 of the Bern Convention, and in Annex 1 of the EU Birds Directive

Among large-ranged birds, which use the area as a part of their foraging range in the breeding season, none of the species is listed in the RA Red Book, and two species are included in the Resolution No. 6 of the Bern Convention, and in Annex 1 of the EU Birds Directive.

Among migratory and wintering birds, which use the area for stopover (to get a rest) or foraging during the non-breeding period, there are 19 species listed in the RA Red Book, and 23 species included in the Resolution No. 6 of the Bern Convention, and in Annex 1 of the EU Birds Directive.

From 78 identified species, 30 species are assessed as the Priority Biodiversity Features (PBF) according to the EBRD PR6 criterion 12: namely, 28 species are listed in the Resolution No. 6 of Bern Convention and Annex I of the EU Birds Directive, two species are considered "significant biodiversity features" by a broad set of stakeholders or governments (and listed in the RA Red Book, category "Vulnerable") (**Table 6-14**).

[86]For terrestrial vertebrates and plants, restricted-range species are defined as those species that have an extent of occurrence (EoO) of less than 50,000 km$^2$. Source: Guidance Notes to the EBRD PR 6 (March, 2023)

**Table 6-14. Bird species of the Artik site area**

| № | Armenian names | English names | Scientific names | Occurrence Status in Armenia | Occurrence Status in Project site | Unit | Number | IUCN | RDB RA | Bern Res6 | BD Annex 1 | RR species |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pelecanidae** | | | | | | | | | | | | |
| 1 | Գանգրափետուր հավալուսն | Dalmatian Pelican | *Pelecanus crispus* | Yr - regular | Migratory | ind | 2-3 | LC | | + | + | |
| 2 | Վարդագույն հավալուսն | Great White Pelican | *Pelecanus onocrotalus* | M - regular | Migratory | ind | 3-5 | LC | | | | |
| **Phalacracoridae** | | | | | | | | | | | | |
| 3 | Մեծ ձկնկուլ | Great Cormorant | *Phalacrocorax carbo* | Yr - regular | Migratory | ind | 2-3 | LC | VU | + | + | |
| **Ardeidae** | | | | | | | | | | | | |
| 4 | Սպիտակ փոքր տառեղ | Little Egret | *Egretta garzetta* | B - regular | Migratory | ind | 2-3 | LC | | + | + | |
| 5 | Մոխրագույն տառեղ | Grey Heron | *Ardea cinerea* | Yr - regular | Migratory | ind | 3-5 | LC | | | | |
| **Ciconiidae** | | | | | | | | | | | | |
| 6 | Սպիտակ արագիլ | White Stork | *Ciconia ciconia* | B - regular | Migratory | ind | 3-5 | LC | | + | + | |
| 7 | Սև արագիլ | Black Stork | *Ciconia nigra* | B - regular | Migratory | ind | 3-5 | LC | EN | + | + | |
| **Anatidae** | | | | | | | | | | | | |
| 8 | Կարմիր բադ | Ruddy Shelduck | *Tadorna ferruginea* | B - regular | Breeding | pair | 2-3 | LC | VU | + | + | |
| 9 | Մոխրագույն բադ | Gadwall | *Mareca strepera* | Yr - regular | Migratory | ind | 3-10 | | | | | |
| 10 | Սուլող մրտիմն | Eurasian Teal | *Anas crecca* | W - regular | Migratory | ind | 10-30 | | | | | |
| 11 | Կոնչան բադ | Mallard | *Anas platyrhynchos* | Yr - regular | Migratory | ind | 10-30 | | | | | |
| **Accipitridae** | | | | | | | | | | | | |
| 12 | Կրետակեր | European Honey-buzzard | *Pernis apivorus* | B - regular | Migratory | ind | 5000-8000 | LC | | + | + | |

| № | Armenian names | English names | Scientific names | Occurrence Status in Armenia | Occurrence Status in Project site | Unit | Number | IUCN | RDB RA | Bern Res6 | BD Annex 1 | RR species |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | Սև ցին | Black Kite | *Milvus migrans* | Yr - regular | Migratory | ind | 2000-5000 | LC | | + | + | |
| 14 | Օձակեր արծիվ | Short-toed Snake-eagle | *Circaetus gallicus* | B - regular | Migratory | ind | 20-70 | LC | VU | + | + | |
| 15 | Դաշտային մկնաճուռակ | Hen Harrier | *Circus cyaneus* | W - regular | Migratory | ind | 30-70 | LC | | + | + | |
| 16 | Մարգագետնային մկնաճուռակ | Montagu's Harrier | *Circus pygargus* | B - regular | Migratory | ind | 500-1300 | LC | VU | + | + | |
| 17 | Տափաստանային մկնաճուռակ | Pallid Harrier | *Circus macrourus* | M - regular | Migratory | ind | 70-120 | NT | VU | + | + | |
| 18 | Ճահճային մկնաճուռակ | Marsh Harrier | *Circus aeruginosus* | Yr - regular | Migratory | ind | 150-300 | LC | | + | + | |
| 19 | Գիշանգղ | Egyptian Vulture | *Neophron percnopterus* | B - regular | Migratory | ind | 10-20 | EN | EN | + | + | |
| 20 | Տափաստանային արծիվ | Steppe Eagle | *Aquila nipalensis* | M - regular | Migratory | ind | 1100-1700 | EN | VU | + | + | |
| 21 | Գերեզմանարծիվ | Imperial Eagle | *Aquila heliaca* | M - regular | Migratory | ind | 10-30 | VU | EN | + | + | |
| 22 | Փոքր ենթաարծիվ | Lesser Spotted Eagle | *Clanga pomarina* | B - regular | Migratory | ind | 2500-3700 | LC | VU | + | + | |
| 23 | Գաճաճ արծիվ | Booted Eagle | *Hieraaetus pennatus* | B - regular | Migratory | ind | 400-700 | LC | VU | + | + | |
| 24 | Լորաճուռակ | Eurasian Sparrowhawk | *Accipiter nisus* | Yr - regular | Migratory | ind | 300-500 | LC | | | | |
| 25 | Եվրոպական ճնճղաճուռակ | Levant Sparrowhawk | *Tachyspiza brevipes* | B - regular | Migratory | ind | 50-100 | LC | VU | + | + | |
| 26 | Մեծ ճուռակ | Eurasian Buzzard | *Buteo buteo* | B - regular | Migratory | ind | 8000-12000 | LC | | | | |

| № | Armenian names | English names | Scientific names | Occurrence Status in Armenia | Occurrence Status in Project site | Unit | Number | IUCN | RDB RA | Bern Res6 | BD Annex 1 | RR species |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27 | Տափաստանային ճուռակ | Long-legged Buzzard | *Buteo rufinus* | Yr - regular | Foraging | ind | 600-1200 | LC | | + | + | |
| **Falconidae** | | | | | | | | | | | | |
| 28 | Սովորական հողմավար բազե | Common Kestrel | *Falco tinnunculus* | Yr - regular | Foraging | ind | 100-300 | LC | | | | |
| 29 | Տափաստանային հողմավար բազե | Lesser Kestrel | *Falco naumanni* | B - regular | Migratory | ind | 1000-2000 | LC | VU | + | + | |
| 30 | Արտույտաբազե | Hobby | *Falco subbuteo* | B - regular | Migratory | ind | 50-90 | LC | | | | |
| **Phasianidae** | | | | | | | | | | | | |
| 31 | Լոր | Common Quail | *Coturnix coturnix* | B - regular | Breeding | | | | | | | |
| 32 | Մոխրագույն կաքավ | Grey Partridge | *Perdix perdix* | Yr - regular | Breeding | | | | | | | |
| **Rallidae** | | | | | | | | | | | | |
| 33 | Սև փարփար | Common Coot | *Fulica atra* | Yr - regular | Breeding | pair | 5-9 | | | | | |
| 34 | Եղեգնահավ | Eurasian Moorhen | *Gallinula chloropus* | Yr - regular | Breeding | pair | 3-5 | | | | | |
| **Gruidae** | | | | | | | | | | | | |
| 35 | Մոխրագույն կռունկ | Common Crane | *Grus grus* | M - regular | Migratory | ind | 150-300 | LC | EN | + | + | |
| 36 | Գեղանի կռունկ | Demoiselle Crane | *Anthropoides virgo* | M - regular | Migratory | ind | 1000-3000 | LC | VU | + | + | |
| **Tringidae** | | | | | | | | | | | | |
| 37 | Սպիտակավիզ կտցար | Common Sandpiper | *Actitis hypoleucos* | B - regular | Breeding | | | | | | | |
| **Laridae** | | | | | | | | | | | | |
| 38 | Հայկական որոր | Armenian Gull | *Larus armenicus* | B - regular | Migratory | ind | 50-100 | LC | VU | | | |
| **Columbidae** | | | | | | | | | | | | |
| 39 | Թխակապույտ աղավնի | Rock Pigeon | *Columba livia* | Yr - regular | Foraging | | | | | | | |

| № | Armenian names | English names | Scientific names | Occurrence Status in Armenia | Occurrence Status in Project site | Unit | Number | IUCN | RDB RA | Bern Res6 | BD Annex 1 | RR species |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Strigidae** | | | | | | | | | | | | |
| 40 | Տնային բվիկ | Little Owl | *Athene noctua* | Yr - regular | Breeding | | | | | | | |
| **Apodidae** | | | | | | | | | | | | |
| 41 | Սև մանգաղաթև | Common Swift | *Apus apus* | B - regular | Breeding | | | | | | | |
| **Meropidae** | | | | | | | | | | | | |
| 42 | Ոսկեգույն մեղվակեր | European Bee-eater | *Merops apiaster* | B - regular | Breeding | | | | | | | |
| 43 | Ներկարար | European Roller | *Coracias garrulus* | B - regular | Migratory | ind | 20-30 | LC | VU | + | + | |
| **Upupidae** | | | | | | | | | | | | |
| 44 | Հոպոպ | Eurasian Hoopoe | *Upupa epops* | B - regular | Breeding | | | | | | | |
| **Alaudidae** | | | | | | | | | | | | |
| 45 | Դաշտային արտույտ | Eurasian Skylark | *Alauda arvensis* | B - regular | Breeding | | | | | | | |
| **Hirundinidae** | | | | | | | | | | | | |
| 46 | Առափնյա ծիծեռնակ | Sand Martin | *Riparia riparia* | B - regular | Migratory | | | | | | | |
| 47 | Գյուղական ծիծեռնակ | Barn Swallow | *Hirundo rustica* | B - regular | Foraging | | | | | | | |
| 48 | Քաղաքային ծիծեռնակ | House Martin | *Delichon urbica* | B - regular | Migratory | | | | | | | |
| **Motacillidae** | | | | | | | | | | | | |
| 49 | Դեղին խաղտտնիկ | Yellow Wagtail | *Motacilla flava* | B - regular | Migratory | | | | | | | |
| 50 | Դեղնագլուխ խաղտտնիկ | Citrine Wagtail | *Motacilla citreola* | B - regular | Migratory | ind | 5-30 | LC | VU | | | |
| 51 | Լեռնային խաղտտնիկ | Grey Wagtail | *Motacilla cinerea* | Yr - regular | Breeding | | | | | | | |

| № | Armenian names | English names | Scientific names | Occurrence Status in Armenia | Occurrence Status in Project site | Unit | Number | IUCN | RDB RA | Bern Res6 | BD Annex 1 | RR species |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52 | Սպիտակ խաղտտնիկ | White Wagtail | *Motacilla alba* | Yr - regular | Breeding | | | | | | | |
| **Muscicapidae** | | | | | | | | | | | | |
| 53 | Սևուկ կարմրատուտ | Black Redstart | *Phoenicurus ochruros* | B - regular | Breeding | | | | | | | |
| 54 | Հարավային սոխակ | Common Nightingale | *Luscinia megarhynchos* | B - regular | Migratory | | | | | | | |
| 55 | Մարգագետնային չքչքան | Whinchat | *Saxicola rubetra* | B - regular | Breeding | | | | | | | |
| 56 | Սիբիրյան սևագլուխ չքչքան | Siberian Stonechat | *Saxicola maurus* | B - regular | Migratory | | | | | | | |
| 57 | Եվրոպական սևագլուխ չքչքան | European Stonechat | *Saxicola rubicola* | B - regular | Migratory | | | | | | | |
| 58 | Սովորական քարաթռչնակ | Northern Wheatear | *Oenanthe oenanthe* | B - regular | Breeding | | | | | | | |
| 59 | Խայտաբղետ քարակեռնեխ | Rufous-tailed Rock-thrush | *Monticola saxatilis* | B - regular | Migratory | | | | | | | |
| **Acrocephalidae** | | | | | | | | | | | | |
| 60 | Ճահճային եղեգնաթռչնակ | Marsh Warbler | *Acrocephalus pallustris* | B - regular | Breeding | | | | | | | |
| **Sylviidae** | | | | | | | | | | | | |
| 61 | Մոխրագույն շահրիկ | Greater Whitethroat | *Curruca communis* | B - regular | Breeding | | | | | | | |
| **Laniidae** | | | | | | | | | | | | |
| 62 | Ժուլան | Red-backed Shrike | *Lanius collurio* | B - regular | Breeding | pair | 2-3 | LC | NE | + | + | |
| 63 | Սևաճակատ շամփրուկ | Lesser Grey Shrike | *Lanius minor* | B - regular | Migratory | ind | 300-800 | LC | NE | + | + | |

| № | Armenian names | English names | Scientific names | Occurrence Status in Armenia | Occurrence Status in Project site | Unit | Number | IUCN | RDB RA | Bern Res6 | BD Annex 1 | RR species |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Corvidae** | | | | | | | | | | | | |
| 64 | Սովորական կաչաղակ | Black-billed Magpie | *Pica pica* | Yr - regular | Breeding | | | | | | | |
| 65 | Կարմրակտուց ճայ | Red-billed Chough | *Pyrrhocorax pyrrhocorax* | Yr - regular | Foraging | pair | 1 | LC | NE | + | + | |
| 66 | Սերմնաքաղ | Rook | *Corvus frugilegus* | Yr - regular | Breeding | | | | | | | |
| 67 | Մոխրագույն ագռավ | Hooded Crow | *Corvus corone* | Yr - regular | Breeding | | | | | | | |
| 68 | Սև ագռավ | Common Raven | *Corvus corax* | Yr - regular | Breeding | | | | | | | |
| **Sturnidae** | | | | | | | | | | | | |
| 69 | Սովորական սարյակ | Common Starling | *Sturnus vulgaris* | Yr - regular | Migratory | | | | | | | |
| **Passeridae** | | | | | | | | | | | | |
| 70 | Տնային ճնճղուկ | House Sparrow | *Passer domesticus* | Yr - regular | Migratory | | | | | | | |
| 71 | Ձյան ճնճղուկ | White-winged Snowfinch | *Montifringilla nivalis* | Yr - regular | Migratory | | | | | | | |
| 72 | Ժայռային ճնճղուկ | Rock Sparrow | *Petronia petronia* | Yr - regular | Breeding | | | | | | | |
| **Fringillidae** | | | | | | | | | | | | |
| 73 | Կարմրակատար | European Goldfinch | *Carduelis carduelis* | Yr - regular | Migratory | | | | | | | |
| 74 | Կանեփնուկ | Eurasian Linnet | *Carduelis cannabina* | Yr - regular | Breeding | | | | | | | |
| 75 | Լեռնային վշասարեկ | Twite | *Carduelis flavirostris* | Yr - regular | Breeding | | | | | | | |
| 76 | Սովորական ոսպնուկ | Common Rosefinch | *Carpodacus erythrinus* | Yr - regular | Breeding | | | | | | | |
| **Emberizidae** | | | | | | | | | | | | |
| 77 | Այգու դրախտապան | Ortolan Bunting | *Emberiza hortulana* | B - regular | Breeding | pair | 2-3 | LC | | + | + | |

| № | Armenian names | English names | Scientific names | Occurrence Status in Armenia | Occurrence Status in Project site | Unit | Number | IUCN | RDB RA | Bern Res6 | BD Annex 1 | RR species |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 78 | Կորեկնուկ | Corn Bunting | *Emberiza calandra* | Yr - regular | Breeding | | | | | | | |

***Keys to the Table 6-14***

**Column titles**

- IUCN - status in IUCN Red List
- RDB RA - status in the RA Red Book
- Bern Res6 - presence in Resolution 6 of Bern Convention
- BD Annex 1 - presence in Annex 1 of the EU Bird Directive
- RR - Restricted Range species

**Occurrence status**

- Yr - regular – year-round resident
- B - regular – resident in breeding season
- M – regular – regular migrant

**Conservation status**

- EN - Endangered
- VU - Vulnerable
- NT - Near Threatened
- LC - Least Concern
- DD - Data Deficient

**Units**

- ind - number of individuals
- pair - number of breeding pairs

**Signs**

"+" listed

no sign – no data or not listed

### Amphibians and Reptiles

*Methods*

The fauna of reptiles and amphibians was only superficially studied in the area during the previous biodiversity studies. This information was further combined with other available scientific information related to the region during desktop research. It included articles, reports, and data from the national EIA report.

*Results*

The list of reptiles and amphibians presented in **Table 6-15**.

**Table 6-15. Reptiles and Amphibians of the study area**

| № | Latin Name | Armenian Name | English Name | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|
| **Reptilia** | | | | | | | | |
| **Lacertidae** | | | | | | | | |
| 1 | *Darevskia unisexualis* | Սպիտակափոր մողես | Valentin's lizard | + | + | VU | | |
| 2 | *Lacerta agilis* | | Sand lizard | | + | | | + |
| 3 | *Lacerta strigata* | | Caucasus emerald lizard | | + | | | |
| 4 | *Ophisops elegans* | | Snake-eyed lizard | | + | | | + |
| **Colubridae** | | | | | | | | |
| 5 | *Hemorrhois ravergieri* | | Spotted whip snake | | + | | | |
| 6 | *Natrix natrix* | | Common grass snake | | + | | | |
| **Amphibia** | | | | | | | | |
| **Pelobatidae** | | | | | | | | |
| 7 | *Pelobates syriacus* | Սիրիական սխտորագորտ | Syrian spadefoot | - | + | VU | | |
| **Bufonidae** | | | | | | | | |
| 8 | *Bufo viridis* | Կանաչ դոդոշ | European green toad | + | + | | | + |
| 9 | *Rana ridibunda* | Լճագորտ | Marsh frog | + | + | | | |

***Keys to the Table 6-15***

**Column titles:**
1 - Information from various sources
2 - Data obtained from scientific expeditions
3 - Red Book of the RA
4 - IUCN Red List
5 - Annex IV of the EU Habitats Directive

**Signs:**
+ listed or registered
- not registered
no sign - not listed

**Conservation status** (in - IUCN Red List, RA Red Book):
VU - vulnerable

Based on the above, six species of reptiles (including four species of lizards and two species of snakes), and three species of amphibians can potentially inhabit the area.

During the ichthyological studies, tadpoles of the Syrian spadefoot *Pelobates syacrius*, listed in the RA Red Book, measuring 9-12 cm in length, were caught using crab traps set in the pond (**Figure 6-**

7). Considering the body size of the tadpoles, it can be assumed that these amphibians bred here in April, and the large number of tadpoles caught (a total of 38 individuals were caught, all of which were returned to their habitat unharmed) indicates that the pond has favorable conditions for breeding, growth, and development of this Red Book species.

**Figure 6-7. A tadpole of the Syrian spadefoot *Pelobates syacrius,* caught in the pond located in the area**

Of the identified species, one species of Reptilia and one species of amphibia are qualified as the Priority Biodiversity Features (PBFs) according to the EBRD PR6 criterion 12 iii - as listed in the RA Red Book under the category "Vulnerable".

Two reptilian species and one amphibian species are assessed as Critical Habitat according to the EBRD PR 6 criterion 14-ii as they are listed in Annex IV of the EU Habitats Directive (**Table 6-15**).

**Ichthyofauna**

*Methods*

So far, there is no scientific data on the fish species of the pond around Artikjur river and Nor Kyank villages (Barach, 1940; Dadikyan, 1986, Pipoyan, Tigranyan, 2002; Pipoyan, 2012; Gabrielyan, 2001; Kuljinashvili et al., 2020; Pipoyan, 2021). In order to study fish species, on 01.07.2025, fish sampling and visual observations were carried out using the set of fishing tools in the pond and river Artikjur.

The catch of fishes was carried out with:

- a 70 cm diameter bottom fishing net (mesh mesh size 0.5 cm),

- a hand fishing net (mesh mesh size 1.0 cm),
  a 90 cm diameter bottom crayfish trap,
- a bottom fishing net (mesh mesh size 2.0 cm),
- 10 bottom crayfish traps with a diameter of 90 cm,
- a bottom fishing net.

The bottom crayfish traps and bottom nets were placed in separate sections around the entire perimeter of the pond, at two-three meters from the shore and at a depth of 0.8-3.0 m. The bottom crayfish traps and nets remained in the water for two hours. A hand-held fishing net was used to study the Articjur river water, periodically dipping it into the water and fishing from the river mouth to 1 km upstream.

Water temperature measurements were taken at each studied point, in three different parts of each study point, the obtained values were than averaged.

*Results*

Ichthyological surveys conducted on 01.07.2025 showed that there are no fish species in the pond and surveyed areas of Artikjur river. According to the information from local residents, years ago, the pond was inhabited by Silver carp (*Carassius gibelio*), which was eliminated by poachers using prohibited fishing methods such as electric stunning and the use of toxic substances.

**Terrestrial invertebrates**

*Methods*

*Data collection* included a Pollard Walk for butterflies and an active search for visual sightings of beetles in the grass, on the ground, and under stones.

In addition, the observations and collections made by the expert in previous years from the area and its immediate vicinity were taken into account.

Representatives of the order of beetles (Coleoptera) were selected as the primary indicator group for study. Traditional entomological research methods were applied to determine the species composition within this group. Special attention was given to the detection of protected invertebrate species listed in the RA Red Book, Annex 2 of the Bern Convention, and the IUCN Red List of Threatened Species.

*Data processing* included visualization of the insects' community in the table form, that also shows the priority species. The priority species are those listed either in the RA Red Book, in the IUCN Red List, in the Resolution 6 of the Bern Convention, or are considered Restricted Range species.

*Results*

Results of the Lepidoptera' diversity survey are presented in **Table 6-16** and include 53 species.

**Table 6-16. Lepidoptera species registered in the study area**

| № | Latin names | RDB AM | Regional endemic | Bern Res 6 |
|---|---|---|---|---|
| **Hesperiidae** | | | | |
| 1 | Erynnis tages | | | |
| 2 | Carcharodus alceae | | | |

| № | Latin names | RDB AM | Regional endemic | Bern Res 6 |
|---|---|---|---|---|
| 3 | Spialia orbifer | | | |
| 4 | Pyrgus sidae | | | |
| 5 | Pyrgus serratulae | | | |
| 6 | Thymelicus lineola | | | |
| 7 | Thymelicus sylvestris | | | |
| 8 | Ochlodes sylvanus | | | |
| **Papilionidae** | | | | |
| 9 | Papilio machaon | | | |
| **Pieridae** | | | | |
| 10 | Anthocharis cardamines | | | |
| 11 | Pontia edusa | | | |
| 12 | Pieris pseudorapae | | | |
| 13 | Pieris rapae | | | |
| 14 | Pieris brassicae | | | |
| 15 | Colias sareptensis | | | |
| 16 | Colias crocea | | | |
| **Lycaenidae** | | | | |
| 17 | Lycaena phlaeas | | | |
| 18 | Lycaena alciphron | | | |
| 19 | Lycaena thersamon | | | |
| 20 | Cupido osiris | | | |
| 21 | Celastrina argiolus | | | |
| 22 | Pseudophilotes vicrama | | | |
| 23 | Glaucopsyche alexis | | | |
| 24 | Plebeius argus | | | |
| 25 | Plebejides sephirus | | | |
| 26 | Aricia agestis | | | |
| 27 | Ultraaricia crassipuncta | | X | |
| 28 | Neolysandra coelestina | | X | |
| 29 | Lysandra bellargus | | | |
| 30 | Lysandra corydonius | | | |
| 31 | Meleageria daphnis | | | |
| 32 | Polyommatus (icarus) icarus | | | |
| 33 | Polyommatus amandus | | | |
| 34 | Polyommatus thersites | | | |
| 35 | Polyommatus (Agrodiaetus) ripartii | | | |
| **Nymphalidae** | | | | |
| 36 | Lasiommata megera | | | |
| 37 | Lasiommata maera | | | |

| № | Latin names | RDB AM | Regional endemic | Bern Res 6 |
|---|---|---|---|---|
| 38 | Melanargia galathea | | | |
| 39 | Coenonympha pamphilus | | | |
| 40 | Hyponephele lycaon | | | |
| 41 | Maniola jurtina | | | |
| 42 | Arethusana arethusa | | | |
| 43 | Pseudochazara geyeri | | X | |
| 44 | Chazara briseis | | | |
| 45 | Chazara persephone | | | |
| 46 | Vanessa atalanta | | | |
| 47 | Vanessa cardui | | | |
| 48 | Aglais urticae | | | |
| 49 | Argynnis pandora | | | |
| 50 | Issoria lathonia | | | |
| 51 | Euphydryas aurinia | | | X |
| 52 | Melitaea didyma | | | |
| 53 | Melitaea cinxia | | | |

***Keys to the Table 6-16***

**Column titles:**
RDB AM - Red Book of the RA
Regional endemic - endemic of Caucasus region
Bern Res 6 - Resolution 6 of the Bern Convention

**Signs:**
X regional endemic of listed in Resolution 6 list of the Bern Convention
no sign - not endemic or not listed

From Coleoptera, there are 107 species of beetles belonging to 22 families were recorded for the area (see Table 6-19). The fauna in the area is characterized by an impoverished fauna typical of the mountain steppe, as well as a number of species of hyper humid ecosystems.

No invertebrates listed in the RA Red Book were found in the area, including the Armenian grasshopper *Gomphocerus armeniacus*, known from the region. However, a number of beetles with a narrow distribution are found here, which may have some ecological significance. These are endemic to the Caucasus ecoregion (EC), of which three species were found.

**Table 6-17. Invertebrates registered in the study area**

| № | Latin name of species | Range restricted |
|---|---|---|
| **Կարգ Բզեզներ (Coleoptera)** | | |
| **Ընտանիք Գնայուկ բզեզներ - Carabidae** | | |
| 1. | Carabus maurus Ad. | RR |
| 2. | Carabus cribratus | |
| 3. | Callisthenes breviusculum | |
| 4. | Clivina fossor | |
| 5. | Elaphropus diabrachys | |
| 6. | Bembidion lampros | |
| 7. | Bembidion quadripustulatum | |

| № | Latin name of species | Range restricted |
|---|---|---|
| 8. | Bembidion tetragrammum | |
| 9. | Acinopus picipes | |
| 10. | Harpalus serripes | |
| 11. | Harpalus rubripes | |
| 12. | Harpalus rufipes | |
| 13. | Ophorus azureus | |
| 14. | Harpalus affinis | |
| 15. | Harpalus saxicola | |
| 16. | Acupalpus maculatus | |
| 17. | Agonum dorsale | |
| 18. | Calathus ambiguus | |
| 19. | Calathus melanocephalus | |
| 20. | Poecilus cupreus | |
| 21. | Amara aenea | |
| 22. | Amara similata | |
| 23. | Amara saxicola | |
| 24. | Zabrus trinii | |
| 25. | Chlaenius vestitus | |
| 26. | Lebia cyanocephala | |
| 27. | Cymindis scapularis | |
| 28. | Brachinus crepitans | |
| 29. | Brachinus explodens | |
| **Ընտանիք լողաբզեզներ - Dytiscidae** | | |
| 30. | Platambus lunulatus | |
| 31. | Deronectes sp. | |
| 32. | Gaurodytes biguttatus | |
| **Ընտանիք Լեշակերներ - Silphidae** | | |
| 33. | Silpha obscura L. | |
| 34. | Aclypea undata verrucosa | |
| **Ընտանիք Staphylinidae** | | |
| 35. | Stenus sp. | |
| 36. | Alaeochara sp. | |
| 37. | Omalium caesum | |
| 38. | Paederus fuscipes | |
| 39. | Philontus sp. | |
| 40. | Quedius sp. | |
| **Ընտանիք Histeridae** | | |
| 41. | Saprinus cf. stussineri | |
| 42. | Hister quadrimaculatus | |
| 43. | Atholus bimaculatus | |
| **Ընտանիք Hydrophilidae** | | |
| 44. | Sphaeridium scarabaeoides | |
| **Ընտանիք Glaphyridae** | | |

| № | Latin name of species | Range restricted |
|---|---|---|
| 45. | Eulasia chrysopyga | |
| **Ընտանիք Թերթիկաբեղավորներ – Scarabaeidae** | | |
| 46. | Scarabaeus armeniacus | |
| 47. | Copris lunaris | |
| 48. | Heptaulacus carinatus | |
| 49. | Calamosternus granarius | |
| 50. | Bodilus lugens | |
| 51. | Melinopterus prodromus | |
| 52. | Onthophagus fracticornis | |
| 53. | Onthophagus furcatus | |
| 54. | Oniticellus fulvus | |
| 55. | Blitopertha nigripennis | |
| 56. | Oxythyrea cinctella | |
| 57. | Netocia ungarica armeniaca | |
| **Ընտանիք Չրխկաններ - Elateridae** | | |
| 58. | Athous sp. | |
| **Ընտանիք Ոսկեբզեզներ - Buprestidae** | | |
| 59. | Sphenoptera fallatrix | |
| 60. | Anthaxia cichorii | |
| 61. | Meliboeus robustus | |
| 62. | Meliboeus parvulus | |
| 63. | Coroebus rubi | |
| **Ընտանիք Փափկամարմին բզեզբեր - Cantharidae** | | |
| 64. | Cantharis melaspis | |
| **Ընտանիք Սևամարմիններ - Tenebrionidae** | | |
| 65. | Blaps lethifera | |
| 66. | Gonocephalum pusillum | |
| 67. | Opatrum geminatum | |
| 68. | Opatrum sabulosum | |
| 69. | Dailognatha caraboides | RR |
| 70. | Tentyria tesselata tesselata | |
| 71. | Omophlus caucasicus | RR |
| 72. | Omophlus sp. | |
| **Ընտանիք Թարախահաններ - Meloidae** | | |
| 73. | Mylabris cincta | |
| 74. | Mylabris variabilis | |
| 75. | Meloe violaceus | |
| **Ընտանիք Mordellidae** | | |
| 76. | Mordellisthena sp. | |
| **Ընտանիք Փայլաբեզներ - Nitidulidae** | | |
| 77. | Meligethes sp. | |
| **Ընտանիք Կաշվեկերներ - Dermestidae** | | |
| 78. | Attagenus orientalis | |

| № | Latin name of species | Range restricted |
|---|---|---|
| | **Ընտանիք Զատիկներ - Cocinellidae** | |
| 79. | Hippodamia variegata | |
| 80. | Adalia bipunctata | |
| 81. | Bulaea lichatschevi | |
| 82. | Coccinella septempunctata | |
| 83. | Exochomus nigromaculatus | |
| 84. | Scymnus sp. | |
| | **Ընտանիք Երկարաբեղիկներ – Cerambycidae** | |
| 85. | Cortodera alpina umbripennis | |
| 86. | Phytoecia coerulescens | |
| 87. | Phytoecia coerulea | |
| 88. | Phytoecia hirsutula | |
| | **Ընտանիք Տերևակերներ - Chrysomelidae** | |
| 89. | Chrysolina herbacea | |
| 90. | Entomoscelis adonidis | |
| 91. | Galeruca cf. interrupta | |
| 92. | Altica sp. | |
| | **Ընտանիք Ընդակերներ - Bruchidae** | |
| 93. | Bruchidius sp. | |
| | **Ընտանիք Apionidae** | |
| 94. | Apion s.l. sp. 1 | |
| 95. | Apion s.l. sp. 2 | |
| 96. | Apion s.l. sp. 3 | |
| | **Ընտանիք Փղիկներ - Curculionidae** | |
| 97. | Polydrusus inustus | |
| 98. | Eusomus cf. ovulum | |
| 99. | Psallidium maxillosum | |
| 100. | Sitona sp. | |
| 101. | Larinus latus | |
| 102. | Larinus onopordi | |
| 103. | Lixus cardui | |
| 104. | Cleonis pigra | |
| 105. | Coniocleonus nigrosuturalis | |
| 106. | Rhynusa asellus | |
| 107. | Cionus scrophulariae | |

***Keys to the Table 6-17***

**Column titles:**
Range restricted - endemic of Caucasus region

**Signs:**
RR - regional endemic

Totally, from the 160 identified species, seven species are assessed as the Priority Biodiversity Feature (PBF) according to the EBRD PR6 criterion 12 (ii) - six species as range-restricted species of the Caucasian region, and one species as listed in Resolution No.6 of the Bern Convention.

### Habitats

to the habitat classification for Armenia, developed based on the EUNIS classification system. The identified habitats are assessed for overlap with those listed in Resolution No. 4 of the Bern Convention and Annex I of the EU Habitats Directive, in order to identify any Priority Biodiversity Features and Critical Habitats.

Three habitats are identified according to the habitat classification for Armenia (**Table 6-18**).

Of the three identified habitats, one habitat is assessed as the Priority Biodiveristy Feature according to the EBRD PR 6 criterion 12s-i as it is listed in Resolution No. 4 of the Bern Convention and Annex 1 of the EU Habitats Directive, and one habitat is assessed as the Critical Habitat according to the EBRD PR 6 criterion 14-i as it is listed in Annex 1 of EU Habitats Directive marked as "priority habitat type".

They are the following (the code and name according the Armenain classification is indicated first, the code and name according to the Resolution No. 4 of the Bern Convention is indicated second, Annex 1 of the EU Habitats Directive is indicated third, estimated lost area is indicated in brackets):

- C1.4. Permanent dystrophic lakes, ponds and pools = C1.4Permanent dystrophic lakes, ponds and pools = 3160 Natural dystrophic lakes and ponds (1.42 ha),
- E1.2217-AM Wheat-grass steppes = E1.2 Perennial calcareous grasslands and basic steppes = 62C0* Ponto-Sarmatic steppes (28.54 ha).

Map of the identified habitats in the footprint area is shown in the **Figure 6-8**. Map of the habitat listed in Resolution No.4 of the Bern Convention is shown in the **Figure 6-9**. Map of the habitat listed in Annex the EU Habitats Directive is shown in the **Figure 6-10**.

**Figure 6-8. Map of the habitats identified in the reservoir footprint area**

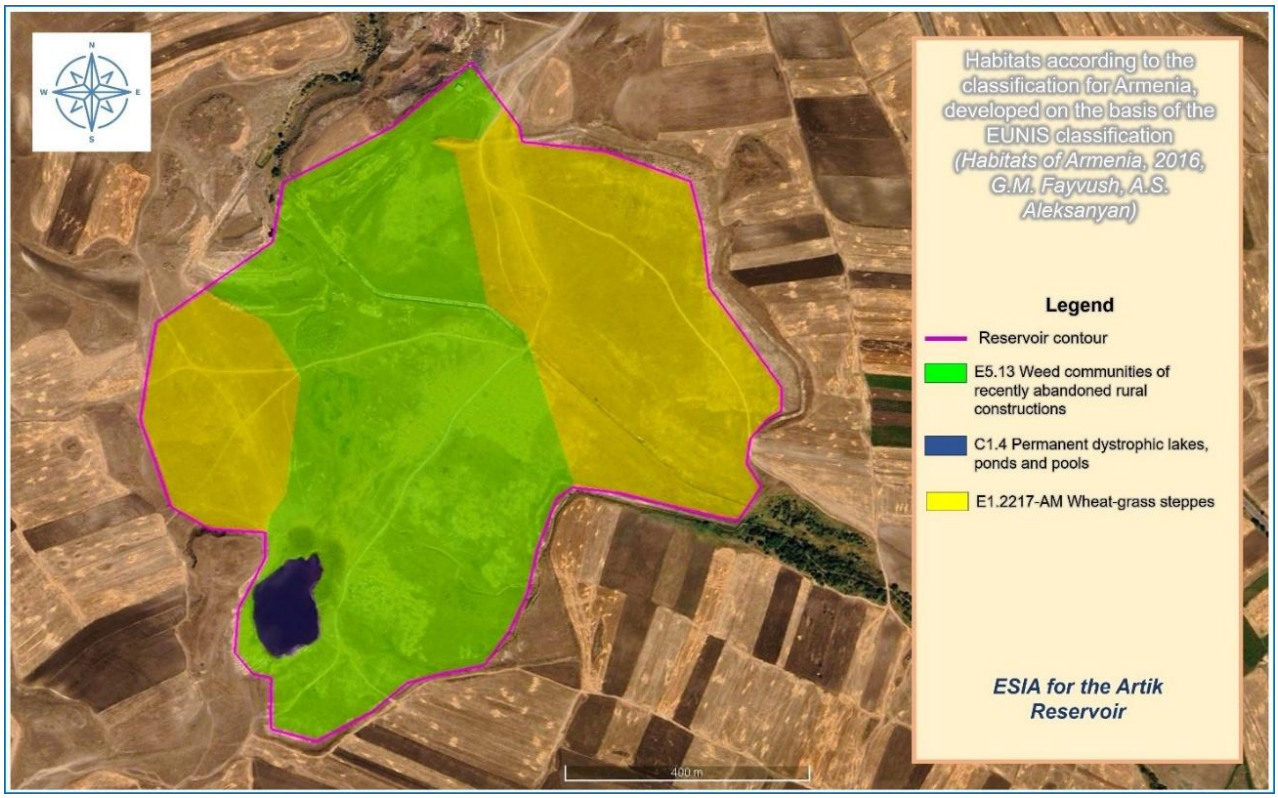


**Figure 6-9. Map of the habitats in the footprint area listed in Resolution No.4 of the Bern Convention**

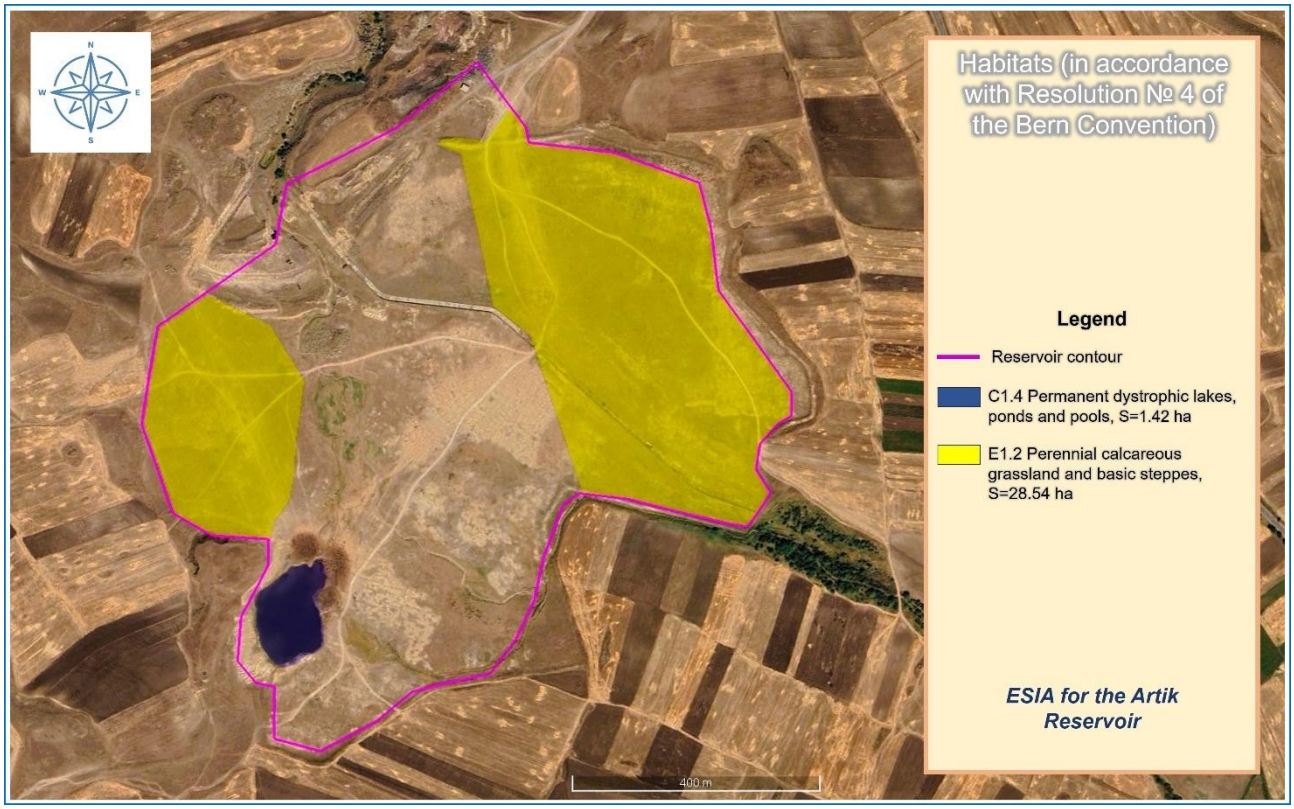



**Figure 6-10. Map of the habitats in the footrpint area listed in Annex I of the EU Habitat Directive**

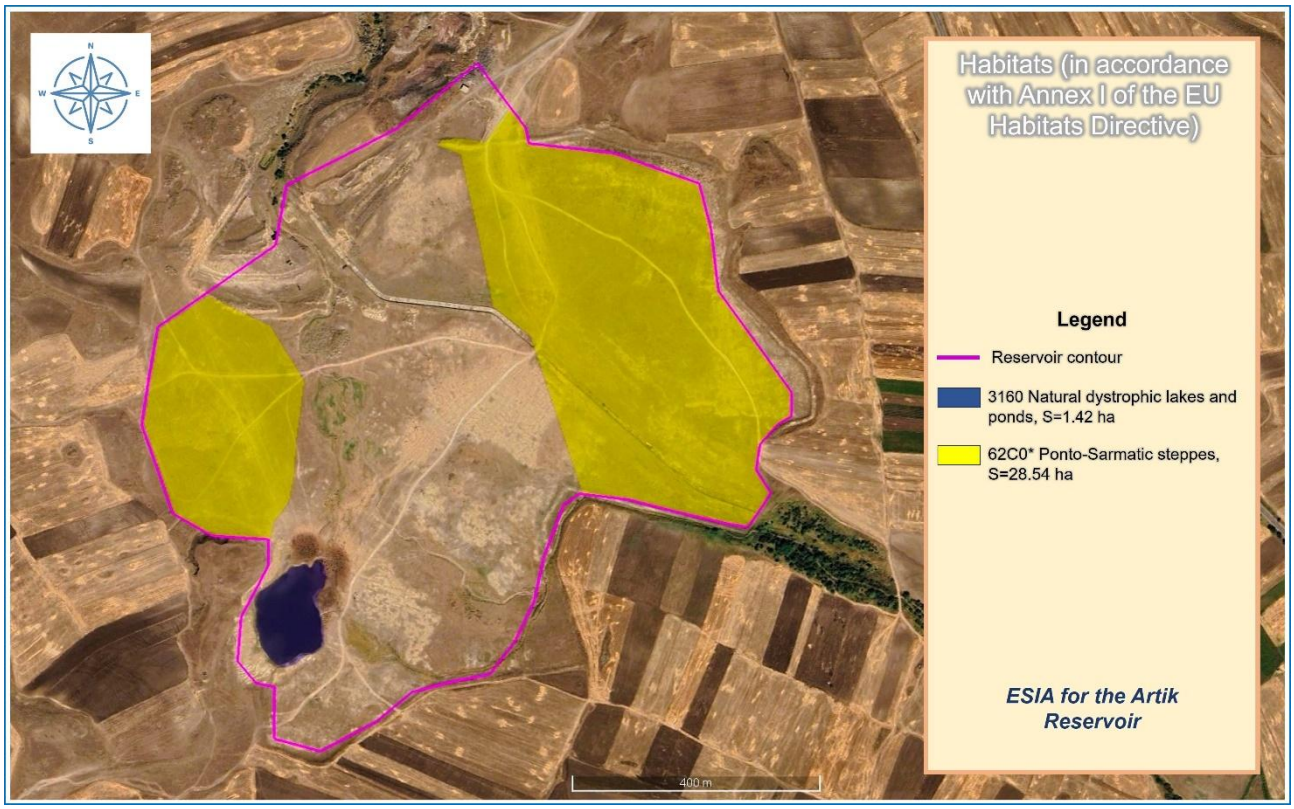


**Table 6-18. Habitats identified in the Artik water reservour area**

| Habitat according to the classification for Armenia, developed on the basis of the EUNIS classification (Habitats of Armenia, 2016, G.M. Fayvush, A.S. Aleksanyan) | | Habitat (in accordance with Resolution No. 4 of the Bern Convention) | | Habitat (in accordance with Annex 1 of the EU Habitats Directive | | Comments (from: Habitats of Armenia, 2016, G.M. Fayvush, A.S. Aleksanyan) |
|---|---|---|---|---|---|---|
| *Code* | *Name* | *Code* | *Name* | *Code* | *Name* | |
| C1.4 | Permanent dystrophic lakes, ponds and pools | C1.4 | Permanent dystrophic lakes, ponds and pools | 3160 | Natural dystrophic lakes and ponds | In Armenia, lakes and ponds with acidic water - typically brown or brownish in color (pH often 3-5) due to high humus content. These habitats typically include small artificial and semi-artificial ponds, small lakes, and reservoirs. |
| E1.2217-AM | Wheat-grass steppes | E1.2 | Perennial calcareous grasslands and basic steppes | 62C0* | Ponto-Sarmatic steppes | Steppes dominated by *Agropyron spp*. and *Elytrigia spp*. are very common across Armenia, especially in the middle mountain belt, though they generally cover relatively small areas. |
| E5.13 | Weed communities of recently abandoned rural constructions | - | - | - | - | Pioneer communities of introduced or nitrophilous plants typically develop in wastelands, disturbed natural or semi-natural areas, roadsides, and other disturbed substrates. These habitats are widespread across Armenia and occur in nearly all rural settlements - particularly near residential areas, along boundaries, and in abandoned vegetable gardens. Plant communities usually include ruderal plants (Urtica dioica, Symphytum asperum, Anchusa azurea, etc.), and less commonly, invasive species (Ambrosia artemisiifolia, Silybum marianum, Cardaria draba, etc.) or species from the surrounding natural ecosystems. |

### 6.2.4 Specially Protected and Internationally Recognized Areas and Forests

*National sites*

Armenia is rich in Specially Protected Areas of Nature (SPAN). There are 34 officially registered SPANs in Armenia, of which: three state reserves - Khosrov Forest, Shikahogh, and Erebuni, occupying a total area of 35,439.6 ha (1.19% of Armenia's territory); four national parks - Sevan, Dilijan, Lake Arpi, and Arevik, covering 236,802.1 ha (7.96% of the country's area); 27 state sanctuaries, and 232 natural monuments together occupying 114,812.7 ha (3.95% of Armenia's territory).

The planned Artik reservoir site does not fall within any SPAN. The closest SPAN Aragats Alpine sanctuary is located about 25 km to the site.

*Internationally Recognized Areas*

Armenia signed the Bern Convention in 2006 and ratified in 2008. Since then, the country has worked on establishing the Emerald Network and listed more than 110 species requiring protection and habitat conservation, according to the Bern Convention Resolutions No. 4 (1994) and No. 6 (1998).

As of June 2025, Armenia had not officially adopted any Emerald Network sites. However, 23 sites within the territory of the Republic of Armenia had been officially nominated as Candidate Emerald Sites (last confirmation of the candidate sites list was done at the 44th meeting of the Standing Committee of the Convention on the Conservation of European Wildlife and Natural Habitats, December 2024)[87].

At the same time, as a reaction to the immediate challenges identified by the Ministry of Environment (ME), the Emerald Network database was completely revised and optimized by the World Bank under the European Union for Environment (EU4Environment) Action Program[88]. The proposed set consists of 30 Emerald sites, covering 707,739.22 ha (23.8 percent of the national coverage, almost a third less than previously)[89]. But this revision was not approved yet.

The Artik reservoir area does not fall within any of the Candidate Emerald Sites. The site is located among three the Candidate Emerald Sites but at a considerable distance: 23 km to the "Aragats alpine" site (AM0000010), 11 km to the "Akhuryan reservoir" site (AM0000020), and 25 km to the "Djadjur" site (AM0000006).

The Artik reservour site is located at a considerable distance from the KBAs - about 30 km from the KBA/IBA Pombak mountain chain, and about 24 km from the KBA Ani.

### 6.2.5 Critical Habitat Assessment Findings

Among the three habitats, 103 flora species, and 255 fauna species identified during biodiversity surveys, the following features (see **Table 6-19)** have been assessed as triggering Priority Biodiversity Feature (PBF) or Critical Habitat (CH) according to the EBRD PR6.

PBFs include one habitat and 41 species - two mammal species, 30 bird species, one reptile and one amphibia species, and seven invertebrate species, CHs - one habitat and four species - one species of mammal, two species of reptile and one amphibia.

[87] https://rm.coe.int/pa18e-2024-draft-candidate-list-emerald-network-sites-2779-8956-4427-1/1680b27e33
[88] EU4Environment. 2024. Recommendations for Review of the Candidate Emerald Sites in Armenia. Washington DC: World Bank. https://www.eu4environment.org/app/uploads/2024/11/Recommendations-for-Review-of-the-Candidate-Emerald-Sites-in-Armenia.pdf
[89] Ibid

- C1.4. Permanent dystrophic lakes, ponds and pools = C1.4Permanent dystrophic lakes, ponds and pools = 3160 Natural dystrophic lakes and ponds (1,42 ha)
- E1.2217-AM Wheat-grass steppes = E1.2 Perennial calcareous grasslands and basic steppes = 62C0* Ponto-Sarmatic steppes (28,54 ha)

**Table 6-19. Summary Table of Priority Biodiversity Features and Critical Habitats Identified in the footprint area[90]**

| № | Criterion | Features (Habitats/species) |
|---|---|---|
| **Priority Biodiversity Features as per EBRD PR6 (§12)** | | |
| i | 12.i.a EAAA[91] is habitat type listed in Resolution 4 of the Bern Convention | Habitats (×1 - according the Bern Convention/EU Habitats directive)<br>C1.4 Permanent dystrophic lakes, ponds and pools = 3160 Natural dystrophic lakes and ponds (1.42 ha) |
| ii | 12.ii.a EAAA for species and their habitats listed in Annex II of the Habitats Directive, Annex I of the Birds Directive, or Resolution 6 of the Bern Convention | Birds (×28)<br>*Pelecanus crispus (LC)*<br>*Phalacrocorax carbo (LC)*<br>*Egretta garzetta (LC)*<br>*Ciconia Ciconia (LC)*<br>*Ciconia nigra (LC)*<br>*Tadorna ferruginea (LC)*<br>*Pernis apivorus (LC)*<br>*Milvus migrans (LC)*<br>*Circaetus gallicus (LC)*<br>*Circus cyaneus (LC)*<br>*Circus pygargus (LC)*<br>*Circus macrourus (NT)*<br>*Circus aeruginosus (LC)*<br>*Neophron percnopterus (EN)*<br>*Aquila nipalensis (EN)*<br>*Aquila heliaca (VU)*<br>*Clanga pomarina (LC)*<br>*Hieraaetus pennatus (LC)*<br>*Tachyspiza brevipes (LC)*<br>*Buteo rufinus (LC)*<br>*Falco naumanni (LC)*<br>*Grus grus (LC)*<br>*Anthropoides virgo (LC)*<br>*Coracias garrulus (LC)*<br>*Lanius collurio* (LC)<br>*Lanius minor* (LC)<br>*Pyrrhocorax pyrrhocorax (LC)*<br>*Emberiza hortulana* (LC)<br>Invertebrates (×1)<br>*Euphydryas auriia* |

[90] In case a species would trigger several criteria in the PBF and CH, it is listed in this table once as the highest conservation concern, which is CH.
[91] EAAA - ecologically appropriate area of analysis

| № | Criterion | Features (Habitats/species) |
|---|---|---|
| iii | 12.ii.d EAAA for regularly occurring nationally or regionally listed EN or CR species | Mammals (×2)<br>*Microtus (Sumeriomys) schidlovskii*<br>*Spermophilus xanthoprymnus*<br>Birds (×2, already triggering cr.12 ii.a)<br>*Neophron percnopterus (EN)*<br>*Aquila nipalensis (EN)* |
| | 12.ii.e EAAA for regularly occurring range-restricted species | Invertebrates (×6)<br>*Ultraaricia crassipuncta*<br>*Neolysandra coelestina*<br>*Pseudochazara geyeri*<br>*Carabus maurus Ad.*<br>*Dailognatha caraboides*<br>*Omophlus caucasicus* |
| | 12.iii Significant biodiversity features identified by a broad set of stakeholders or governments | Birds (×2, listed in the Red Book of RA as Vulnerable)<br>*Larus armenicus*<br>*Motacilla citreola*<br>Reptiles (×1, listed in the Red Book of RA as Vulnerable)<br>*Darevskia unisexualis*<br>Amphibians (×1, listed in the Red Book of RA as Vulnerable)<br>*Pelobates syriacus* |
| **Critical Habitats as per EBRD PR6 (§14)** | | |
| i | 14.i EAAA is habitat type listed in Annex 1 of the EU Habitats Directive marked as “priority habitat type” | Habitats (×1 - according the Bern Convention/EU Habitats directive)<br>E1.2 Perennial calcareous grasslands and basic steppes = 62C0* Ponto-Sarmatic steppes (28,54 ha) |
| ii | 14.ii EAAA for species and their habitats listed in Annex IV of the Habitats Directive | Mammals (×1)<br>*Vormela peregusna (VU)*<br>Reptiles (×2)<br>*Lacerta agilis*<br>*Ophisops elegans*<br>Amphibians (×1)<br>*Bufo viridis* |

## 6.3 Social and Socio-economic Environment

The sections below are informed by the review of primary data obtained as a result of the on-interviews with the representatives of Artik municipality and secondary sources, such as publications and bulletins of Statistical Committee of the Republic of Armenia (Armstat), Artik Community Annual Work Plan for 2025, and Environmental and Social Report, 2023, Institute of Water Problems and Hydro-Engineering after I.V. Yeghiazarov Cjsc & Shushi University of Technology Foundation (Consortium).

### 6.3.1 Overview of the Project area

Artik Reservoir will be constructed in Artik community of Shirak Marz, northwest of Artik town, along the Artikjur River.

Shirak Marz is situated in the north-western part of Armenia, with Gyumri city serving as the administrative centre of the marz. In the west it borders the Republic of Türkiye, in the north it borders Georgia, in the east - Lori Marz, and in the south - Aragatsotn Marz. Artik is an enlarged community, which includes 24 settlements.

The Artik Reservoir is designed to irrigate the agricultural lands of five settlements within Artik community, located approximately 6–8 km away, namely Nor Kyanq, Panik, Vardakar, Anushavan, and Meghrashen villages. The irrigation and feeding channels will traverse the lands of these villages, as well as the territories of Artik town, and the villages of Tufashen and Pemzashen. The map of Project area, showing the planned reservoir site, supporting infrastructure and the locations of the aforementioned settlements, is presented in **Figure 2-2**.

### 6.3.2 Demography[92]

The population of Shirak Marz as of January 1, 2024, was 238,900 people, of whom 52% were women. The population of Artik community on the same date was 52,921 people, of whom 49.3% were women.

The permanent registered population of the settlements affected by the project is 8,975 people, with the current actual population standing at 8,581 individuals (**Table 6-20**). This represents approximately 16-17% of the Artik community population. Panik is the most populous of the affected beneficiary settlements, while Vardakar is the least populated. The population of Tufashen and Pemzashen villages is 418 and 3,074 people, respectively, and the number of households is 113 and 790, respectively. Artik town is inhabited by 17,950 residents and has 5,531 households.

**Table 6-20. Population of the settlements positively affected by the Project (descending), person**

| Settlement | Number of permanent residents/persons | Factual number of residents/person | Including women |
|---|---|---|---|
| Panik | 3,136 | 2,927 | 1,590 |
| Anushavan | 1,983 | 2,148 | 937 |
| Nor Kyank | 1,859 | 1,562 | 995 |
| Meghrashen | 1,272 | 1,248 | 612 |
| Vardakar | 725 | 696 | 352 |
| **Total** | **8,975** | **8,581** | **4,486** |

### 6.3.3 Regional and Local Economy[93]

Agriculture is the prevailing economic sector of Shirak Marz and Artik community in terms of total production volumes. Furthermore, there is a prominent opportunity for internal and external tourism

[92]Information for this sub-section was mainly extracted from the website of Armstat's publication RA Shirak Marz in figures, 2024 available at https://armstat.am/file/doc/99553353.pdf and Artik Community Annual Work Plan for 2025 available at https://artik.am/upload/DocFlow/Projects/We2543017482681174_20251.pdf

[93] Information for this sub-section was mainly extracted from the Environmental & Social Report. 2023 by the Institute of Water Problems and Hydro-Engineering after I.V. Yeghiazarov Cjsc & Shushi University of Technology Foundation (Consortium).

development in the Marz. An official average monthly nominal wage in Shirak Marz is 141,959 AMD (369 USD).

In 2025, Artik community operates under an approved master plan[94], that outlines its socio-economic development priorities, including community infrastructure improvement, enhancement of living conditions for residents, and other development initiatives.

Majority of Artik community population is engaged in agriculture, hunting, and forestry, with particular emphasis on irrigated agriculture. In the privately owned and leased agricultural lands of the community, the residents sow grain crops, namely wheat and barley. However, the lack of irrigation water in the area hinders the community's ability to generate significant income. The land's favourable conditions make it suitable for cultivating grain crops, growing potatoes, and raising livestock. Although grain crop production and animal husbandry are essential for the economic development of the community, their current development rate is moderate. This is primarily attributed to the sectors' low level of capitalization and the absence of processing technologies.

The Akhuryan River provides favourable conditions for fishing, with fish species like bream, crucian carp, and common carp. Nevertheless, this activity has no industrial significance.

There are several large farms within Artik community. Generally, each household utilizes its produce locally. Community residents cultivate cereals, as well as vegetables and fruits, namely apples, plums, pears, and cherries in small plots or orchards near their houses.

In the Artik community, there are limited opportunities for selling agricultural products, and local farms encounter challenges in selling large quantities. Aside from the sale of dairy products, there are no other agricultural procurement and processing enterprises in the area. Some agricultural products are utilized for personal consumption. Tables below provide a summary of the Artik community's livestock and agriculture production volumes by settlement.

**Table 6-21. The number of livestock in the Project affected settlements (2022)**

| Settlement | Large cattle | | Sheep (animal) | Birds (animal) | Bee (hive) | Pig (animal) | Meat production (ton) | Milk production (ton) | Fodder (ton) |
|---|---|---|---|---|---|---|---|---|---|
| | Total (animal) | Cow (animal) | | | | | | | |
| Panik | 903 | 411 | 212 | 4128 | 265 | 448 | 91 | 1710 | 690 |
| Vardakar | 333 | 181 | 313 | 937 | 54 | 24 | 25 | 725 | 304 |
| Anushavan | 419 | 212 | 72 | 2181 | 97 | 22 | 32 | 783 | 356 |
| Meghrashen | 588 | 269 | 445 | 2251 | 738 | 181 | 55 | 1232 | 452 |
| Nor Kyank | 407 | 233 | 63 | 1110 | 59 | 46 | 27 | 758 | 391 |
| Pemzashen | 767 | 311 | 450 | 1705 | 323 | 237 | 76 | 1560 | 522 |
| Tufashen | 308 | 163 | 91 | 566 | 71 | 5 | 27 | 591 | 274 |
| Artik | 1108 | 484 | 384 | 3191 | 440 | 560 | 37 | 2148 | 813 |

Artik town has by far the highest numbers of large cattle (cows), pigs and beehives while Panik village - number of poultry birds. Thus, milk production is the highest in Artik town and meat production - in Panik village and both settlements have highest volumes of fodder. Pemzashen and Meghrashen villages have the highest number of sheep and high numbers of cows. The village also

[94] Artik community Annual Work Plan for 2025 available at https://artik.am/upload/DocFlow/Projects/We2543017482681174_20251.pdf

specialises in honey production and has large quantities of bee hives. It is second in terms of meat and milk production, while being second least populated of the five Project affected settlements.

**Table 6-22. Volumes of farm products and agricultural production in the Project affected settlements (2022)**

| Settlement | Cereals | | | Potatoes | | | Vegetables | | | Fruits & berries | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sowing area (ha) | Gross yield (ton) | Yield per ha | Sowing area (ha) | Gross yield (ton) | Yield per ha | Sowing area (ha) | Gross yield (ton) | Yield per ha | Sowing area (ha) | Gross yield (ton) | Yield per ha |
| Panik | 280 | 616 | *2.2* | 11 | 8.3 | *0.75* | 6 | 4 | *0.67* | 14 | 4 | *0.29* |
| Vardakar | 310 | 682 | *2.2* | 5 | 15 | *3.00* | 2 | 2 | *1.00* | 8 | 2 | *0.25* |
| Anushavan | 350 | 770 | *2.2* | 10 | 15 | *1.50* | 5 | 2 | *0.40* | 1 | 0.7 | *0.70* |
| Meghrashen | 450 | 990 | *2.2* | 10 | 5 | *0.50* | 5 | 2 | *0.40* | 10 | 3 | *30.0* |
| Nor Kyank | 415 | 913 | *2.2* | 7 | 10 | *1.43* | 1 | 0.7 | *0.70* | 5.1 | 3.2 | *0.63* |
| Pemzashen | 15 | 35 | *2.3* | 7 | 10 | *1.43* | 1 | 0.7 | *0.70* | 5 | 3.2 | *0.64* |
| Tufashen | 251 | 552.2 | *2.2* | 0 | 0 | *0* | 0 | - | *0* | 1 | 1.5 | *1.5* |
| Artik | 250 | 535 | *2.14* | 8 | 20 | *2.5* | 12 | 15 | *1.25* | 23 | 20 | *0.86* |

According to the **Table 6-22**, cereals yield per ha of sowing area is similar in all settlements - around 2.2 tonnes. Meghrashen village has the largest sowing area, and consequently the highest gross yield of cereals as well as the highest yield per ha of fruits and vegetables. The highest land productivity for potatoes is in Vardakar village whereas for vegetables - in Artik town.

### 6.3.4 Poverty and Unemployment, Incomes and Expenditures[95]

The share of poor population in Shirak Marz increased slightly from 42.9% in 2020 to 43.1% in 2023. The poverty level in the marz is significantly higher than the national average (23.7%). Moreover, the share of extremely poor population almost doubled from 2.2% in 2020 to 4% in 2023. This increase is much higher than the national average (1.1%). The poverty rate increases with the number of members in a household. There are more poor and extremely poor people among households composed of seven or more members.

Number of socially vulnerable people receiving financial assistance from government prevails in Anushavan, followed by Panik (**Table 6-23**).

**Table 6-23. Number of socially vulnerable people receiving financial assistance**

| Panik | Vardakar | Anushavan | Meghrashen | Nor Kyank |
|---|---|---|---|---|
| 87 | 21 | 90 | 20 | 62 |

The average monthly nominal wage in Shirak Marz in 2023 was 135,002 AMD (352 USD), which is considerably lower than the national average 295,132 AMD (768 USD).

The affected communities are characterised by the active labour migration of working-age males abroad, leading to women, the elderly, and occasionally children taking on agricultural responsibilities.

[95]Information for this section was mainly extracted from the website of Armstat's publication RA Shirak Marz in figures, 2024 available at https://armstat.am/file/doc/99553353.pdf

Unemployment rate in Shirak Marz decreased from 17.3% in 2020 to 16.1% in 2023 (RA average - 12.4%). Urban unemployment rate (21.2%) is higher than rural (9.5%).

The unemployment rate in Artik community stands at 43.6%, with 942 registered unemployed individuals. Unemployment levels in the affected settlements are shown below (**Table 6-24**).

**Table 6-24. Unemployment levels in the Project benefiting settlements**

| Panik | Vardakar | Anushavan | Meghrashen | Nor Kyank |
|---|---|---|---|---|
| 25% | 30% | 20% | 43% | 40% |

The main source of household income comes from employment and state social benefits. One of the obstacles for agriculture becoming a significant source of income for the households is lack of irrigation water to create a sufficient surplus. Main expenditures of the residents are on food, utilities and other services.

### 6.3.5 Ethnic Minorities

The majority of the Shirak Marz population are ethnic Armenians who belong to the Armenian Apostolic Church.

97% of Artik Community population are Armenians while the remaining 3% are ethnic minorities, including Russians, Yezidis, Kurds, Ukrainians and Greeks. Presence of the ethnic minorities representatives in the Project affected settlements is not known.

### 6.3.6 Social Infrastructure

There are 114 pre-school institutions, 162 secondary schools, two specialized theatres, 75 libraries, eight functioning museums, and 33 sports organizations in Shirak Marz[96].

There are preschools, schools, libraries, gymnasiums, cultural houses, and various other educational and cultural institutions operating in the Artik community (**Table 6-25**). Namely, each Project affected settlement has one pre-school, one general school, and one art school. Factual number of children enrolled in the pre-schools and secondary schools is below the maximum capacities in all project affected settlements, except for Nor Kyanq.

**Table 6-25. Data on educational institutions by communities (school, preschool and vocational educational institutions, 2022)[97]**

| № | Name of the community | Name of the educational institution | Capacity (number of children) | Factual number of children |
|---|---|---|---|---|
| 1 | Meghrashen | "Meghrashen Secondary School" | 100 | 50 |
| | | Meghrashen Preschool | 360 | 160 |
| | | "Meghrashen Art School" | 48 | 48 |
| 2 | Nor Kyanq | "Nor Kyank Secondary School" | 12 | 48 |
| | | "Nor Kyank preschool educational institution" | 335 | 412 |
| | | "Nor KyankArt School" JSC | 60 | 60 |
| 3 | Panik | "Panik Secondary School" NOC | 100 | 73 |

[96]Armstat. Main statistical indicators of the Shirak Marz, 2019-2023. Available at https://armstat.am/file/Map/Shirak.pdf
[97]Environmental & Social Report. 2023. Institute of Water Problems and Hydro-Engineering after I.V. Yeghiazarov Cjsc & Shushi University of Technology Foundation (Consortium).

| № | Name of the community | Name of the educational institution | Capacity (number of children) | Factual number of children |
|---|---|---|---|---|
| | | "Panik preschool educational institution" JSC | 450 | 299 |
| | | "Panik Art School" JSC | 60 | 55 |
| 4 | Vardaqar | "Vardakar Secondary School" NOC | | 45 |
| 5 | Anushavan | "Anushavan Secondary School" NOC | 170 | 92 |
| | | "Anushavan preschool educational institution" JSC | 320 | 177 |
| | | "Art School named after Suren Sosyan of Anushavan" | 60 | 60 |
| 6 | Pemzashen | "Pemzashen Secondary School" NOC | 100 | 63 |
| 7 | Tufashen | "Tufashen Secondary School" NOC | 92 | 67 |
| 8 | Artik | "Artik Primary School No. 1" SNCO | 540 | 538 |
| | | "Artik Primary School No. 2" SNCO | 600 | 578 |
| | | "Artik No. 3 High School" SNCO | 520 | 252 |
| | | "Artik Primary School No. 4" SNCO | 800 | 201 |
| | | "Artik Primary School No. 5" SNCO | 1200 | 274 |
| | | "Artik Primary School No. 5" SNCO preschool | | 35 |
| | | "Artik Primary School No. 6" SNCO | 360 | 194 |
| | | "Artik Primary School No. 8" SNCO | 250 | 153 |
| | | "Artik State College" SNCO | 400 | 286 |
| | | "Artik Medical College" SNCO | 160 | 54 |
| | | "Artik Territorial Pedagogical Psychological Support Center" SNCO | 300 | 292 |
| | | "Artik Kindergarten No. 1" | 140 | 78 |
| | | "Artik Kindergarten No. 2" | 140 | 101 |
| | | "Artik Kindergarten No. 3" | 120 | 112 |
| | | "Artik Kindergarten No. 4" | 120 | 71 |
| | | "Music School named after Daniel Ghazaryan" SNCO | 220 | 189 |
| | | "Artik Art School" SNCO | 160 | 145 |
| | | "Artik Aesthetic Education Center" | 200 | 170 |
| | | Artik Arts Center | 120 | 112 |
| | | "Artik Tigran Mansuryan Culture Center" JSC | 160 | 123 |
| | | "House of Culture named after Varaz Samuelyan" | 200 | 94 |
| | | Artik sport school | 300 | 96 |
| | | "Artik sports complex" | 400 | 112 |
| | | "Artik Sports Complex SNCO | 250 | 149 |
| | | "Artik Football Sports School" | 60 | 44 |

The main railway and automobile highway connecting Armenia with Georgia pass through the marz territory. The enlarged community is traversed by both the M1 "Yerevan-Gyumri-Georgian Border" highway and the Artik railway station. Distance from the Project affected settlements to the administrative centre of the marz - Gyumri city, is 20 km, Anushavan being the closest and Merhrashen the farthest.

All project affected settlements have access to centralised electricity and water supply, however only residents of Artik town, Nor Kyanq (fully) and Meghrashen (partly) are connected to natural gas supply.

### 6.3.7 Gender Issues

According to the data of the National Statistical Committee, 52% of women in Armenia are not employed and are not seeking employment[98]. A major reason for women's absence from the labour market is their engagement in unpaid household activities. The gender pay gap in Armenia was 39.2% in 2022. National gender problems such as underrepresentation in labour market, gender pay gap, underrepresentation in decision-making processes etc. are characteristic of settlements as well. The poorest households in the country tend to be women-headed households.

In general, women's participation in decision-making at the community level, especially in rural communities is low. The principal reasons for their limited involvement in community leadership include public opinion, men's lack of acceptance of women's leadership, women's fear of expressing themselves, and a lack of self-confidence among women[99]. Women underrepresentation remains also a problem in Water Users Associations.

### 6.3.8 Socially Less Protected / Vulnerable Population[100]

As of the end of 2023, 10,274 families in Shirak Marz were beneficiaries of state social support.

Groups of population with special needs in Artik community include:

- 2,893 people with disabilities, of which 1,308 are women,
- 6,105 pensioners, of which 3,690 are women,
- 190 single pensioners, of which 150 are women,
- 1,803 beneficiary families, of which 1,286 are families headed by women.

There are 2 displaced persons, of whom one is socially vulnerable in Anushavan village.

### 6.3.9 Public Health and Safety

There are 32 institutions providing primary health care services in the Shirak Marz. Number of doctors per 10,000 population in the marz, increased slightly from 24.1 in 2020 to 24.6 in 2023 (46.6 in the RA). Number of paramedical personnel however decreased from 54.5 per 10,000 population in 2020 to 49.7 in 2023 (53.9 in the RA)[101]. Number of hospital beds similarly decreased from 821 in 2020 to 751 in 2023.

The largest hospital is Artik Medical Centre located in Artik city. Each village has a medical unit operating with one paramedic each. Main chronical diseases of Artik community residents include cardiovascular disease and arthritis.

[98]European Union. 2024. Country Gender Profile Armenia. Eu4genderequality Reform Helpdesk. Available at: https://euneighbourseast.eu/wp-content/uploads/2024/04/eu4genderhelpdesk_armenia_countrygenderprofile_2024-cgp_v3__compressed.pdf
[99]Ibid
[100] Information for this sub-section was mainly extracted from the website of Armstat's publication RA Shirak Marz in figures, 2024 available at https://armstat.am/file/doc/99553353.pdf and Artik Community Annual Work Plan for 2025 available at https://artik.am/upload/DocFlow/Projects/We2543017482681174_20251.pdf
[101]Armstat. RA Main statistical indicators of the Shirak marz, 2019-2023. available at https://armstat.am/file/Map/Shirak.pdf

### 6.3.10 Land Use Issues

Territory of Shirak Marz is 268,000 ha, which is 9% of the territory of the RA. Agricultural land comprises 210,954.5 ha, of which 78,139.8 ha (37%) is arable land.

The total area of Artik community is 48,541.96 ha, with agricultural land covering 41,387.9 ha (85.2%), household land comprising 2,946.1 ha (6%), industrial land occupying 1,109.3 ha (2.3%), and energy, transport, communication, and communal land spanning 167.1 ha (0.3%). The remaining 6% of the area are covered by forest land - 870.6 ha, special conservation lands - 336.5 ha, special-purpose lands - 152.7 ha, and water lands - 416.7 ha.

**Table 6-26** shows land resources of the affected settlements.

**Table 6-26.** Land resources of the villages, ha

| Communities | Panik | Vardaqar | Anushavan | Meghrashen | Nor Kyanq |
|---|---|---|---|---|---|
| Agricultural | 1410.35 | 712.82 | 912. 26 | 1406.13 | 1035.76 |
| Residential | 320.76 | 89.34 | 163.29 | 140.87 | 127.08 |
| Industrial | 29.59 | 16.40 | 25.72 | 13.89 | 12.83 |
| Energy, transport, communications, utilities | 13.07 | 6.20 | 16.21 | 21.88 | 4.51 |
| Cultural heritage | 4.95 | 16.27 | 12.31 | 2.22 | 21.86 |
| Water | 5.96 | 102.78 | 4.73 | 3.09 | 73.08 |
| **Total** | **1784.68** | **945.33** | **1134.52** | **1588.08** | **1275.12** |

Artik Reservoir is planned within the existing 1992 year's boundaries (though the dam is planned to be placed 400 m away from the old facilities) with land acquisition required only for the canals. It will require around 96,065 $m^2$ of private, communal and state land in Nor Kyanq, Anushavan, Panik, Artik, Tufashen, and Pemzashen settlements.

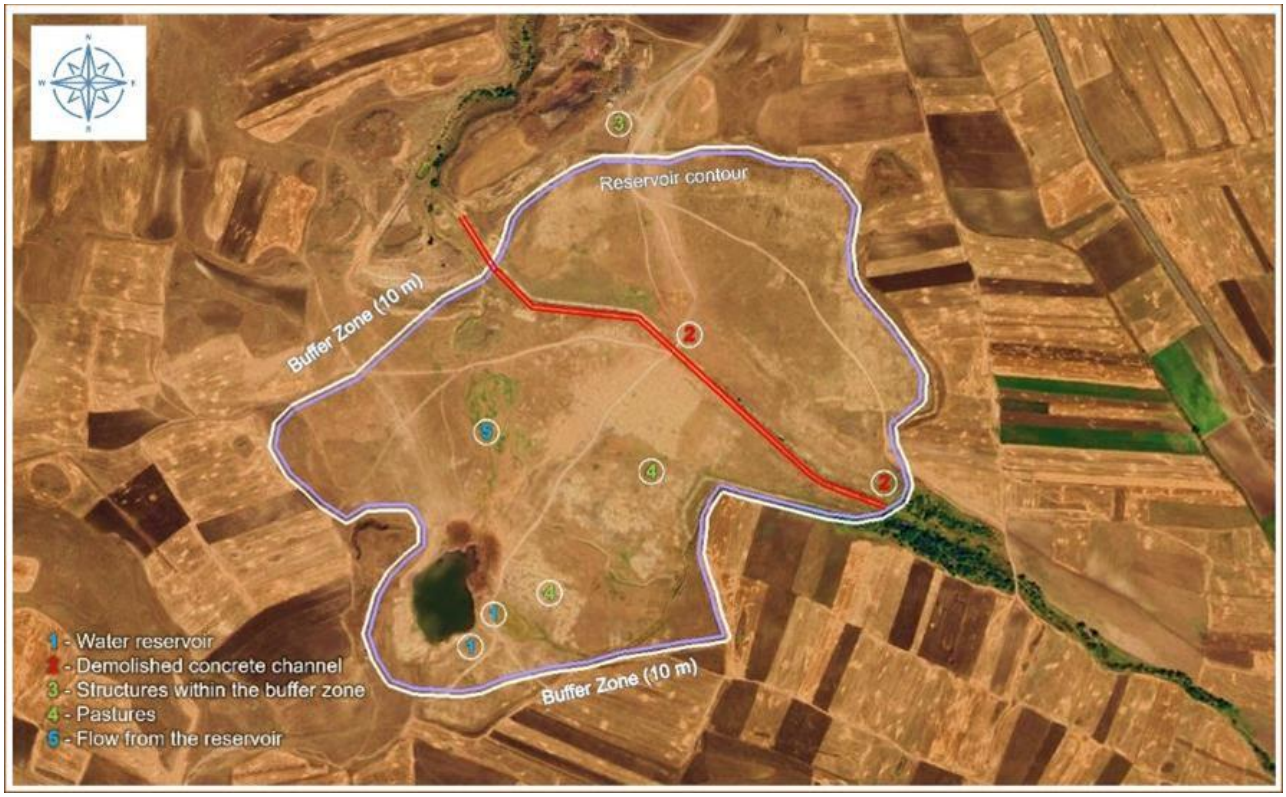
There are approximately 7 ha of communal land that will be affected by reservoir construction. Additionally, there are about 0.6 ha of private lands. More detailed information about the land take in provided in the land impact assessment section.

The affected private land plots are mainly agricultural lands. Most private land owners are engaged in agriculture activities; during the EIA consultations they complained about the shortage of water and thus limited crops. Yet, impact on crops is expected. Some project affected households will need support in legalizing their rights to land. According to the secretary of Artik Community, the construction of the reservoir will positively affect the agricultural development of the community, especially during the summer season when there is a lack of irrigation water in the region.

There is also one tuff mine in the project area (about 4.0-4.5 km from the Artik Reservoir's site), which is currently not in operation due to the exhausted reserves, however the owner of the mine can still retain the mining rights and thus the area is to be either avoided by infrastructure of Artik Reservoir or compensated in line with this RF.

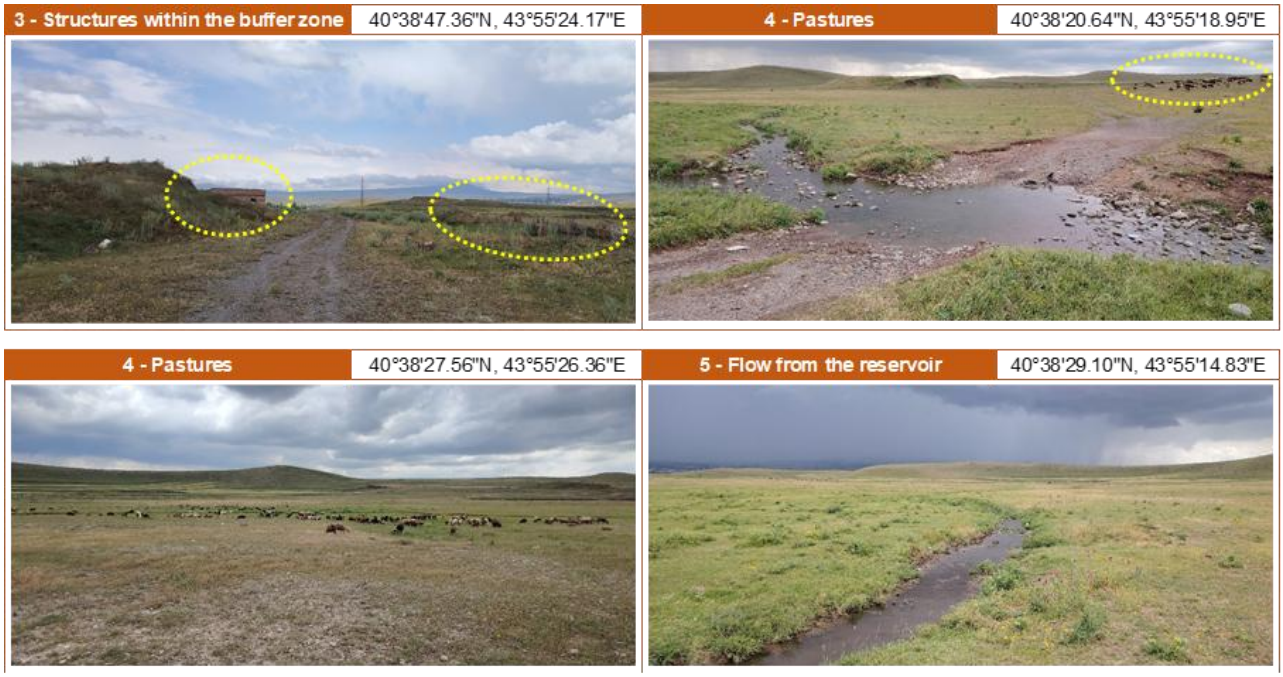
The land earlier allocated for the reservoir site host a small water reservoir and old concrete canals and structures (**Figure 6-11**). Some locations are used as pasture land. If the water protection zone is extended to 90-100 m, some old (most likely unused) structures will fall within it (currently, the design envisions a 10 m inalienable strip around the reservoir).

**Figure 6-11. Artik Reservoir: schematic map and photographs illustrating the site**




| 1 - Water reservoir | 40°38'20.13"N, 43°55'15.30"E | 1 - Water reservoir | 40°38'17.83"N, 43°55'13.98"E |
|---|---|---|---|

| 2 - Demolished concrete channel | 40°38'34.64"N, 43°55'29.41"E | 2 - Demolished concrete channel | 40°38'26.44"N, 43°55'43.89"E |
|---|---|---|---|




## 6.4 Cultural Heritage

### 6.4.1 Tangible Cultural Heritage

According to RA Government Decree №1270-N dated 09.09.2004, there are 21 and 8 cultural heritage values registered in the state list of cultural and historical monuments of Artik town and Nor Kyanq rural settlement, respectively, including:

**Artik town:**

- Castle "Hayrenyats Tokhq" and associated tomb field,
- Ancient settlement with tomb field,
- Old rural settlement,
- Cemetery,
- Tomb field - 2,
- Dwelling houses - 2,
- Churches (St. Illuminator, Holy Mother of God, and one unnamed) - 3,
- Memorial monuments - 3,
- Memorial monuments with water springs - 3,
- Statues - 4.

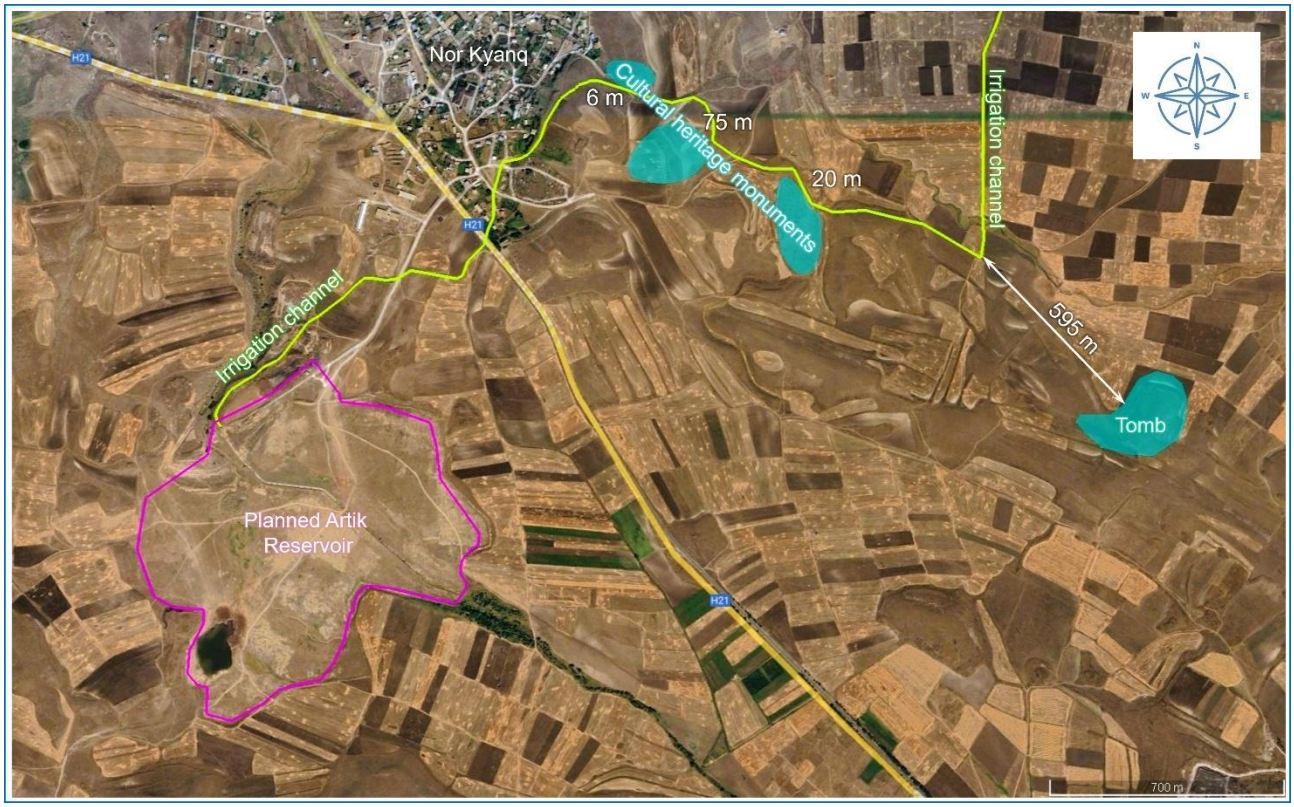
**Nor Kyanq village:**

- Church after St. Grigor Illuminator,
- Cemeteries - 2,
- Old settlement,
- Tomb field,
- Cross-stone,
- Chapel,

- Memorial monument.

As per the letter 1-16 dated 04.06.2024 from the "Historical and Cultural Reserves-Museums and Historical Environment Preservation Service" SNCO under the Ministry of Education, Science, Culture and Sports, four cultural heritage units were identified in the vicinities of the planned Artik Reservoir irrigation channel: one tomb field and three cultural and historical monuments (**Figure 6-12**).

**Figure 6-12. Location of the cultural heritage values in the vicinity of the Artik Reservoir and its components**




The tomb field, located approximately 595 m southeast of the irrigation channel, is situated well outside the Project site and is unlikely to be impacted by the Project implementation. Another cultural heritage monument lies 75 m from the irrigation channel and will similarly remain unaffected. However, two other historical and cultural monuments are within the Project's direct impact area, at distances of 6 m and 20 m, respectively.

The conclusion of the Historical and Cultural Reserves-Museums and Historical Environment Preservation Service SNCO regarding the potential impact of the Project on cultural heritage sites is that the scale of construction work for the irrigation channel is limited, involving a small land area. Therefore, the moderate impact on cultural heritage is expected.

During the interviews with the population of Artik and Nor Kyanq settlements, no spiritual sites were identified near the planned reservoir site and its feeding and irrigation channels.

### 6.4.2 Intangible Cultural Heritage

The Intangible Cultural Heritage (ICH) in the context of the Project is considered at both the national (**Sub-section 6.4.2.1**) and community (**Sub-section 6.4.2.2**) levels.

#### *6.4.2.1 National Context*

Armenia is one of the oldest countries in the world, known for its ancient history and unique culture. Scientific research, numerous archaeological discoveries, and ancient manuscripts indicate that the Armenian Highlands are one of the Cradles of Civilization. References to Armenia and the Armenian people are preserved in Sumerian, Assyrian, Persian, Egyptian, and other ancient texts. Today, the Republic of Armenia is located in the northeastern part of the Armenian Highland and occupies about one-tenth of its historical territory. Armenia's rich archaeological heritage dates back 2 million years and includes remains from the Paleolithic, Neolithic, and Chalcolithic periods, as well as the Bronze and Iron Ages, Hellenistic period, and Middle Ages. The world's oldest leather shoe (5,500 years old), sky observatory (7,500 years old), depictions of agriculture (7,500 years old), and a wine-making facility (6,100 years old) have all been discovered in Armenia.

Armenia is often referred to as the Land of Noah, based on biblical scriptures. According to the Bible, Noah's Ark came to rest on Mount Ararat, which at that time was part of historical Armenia. Some of his sons and grandsons are believed to have settled in the region. It is commonly accepted that Armenians are direct descendants of his son Japheth.

Armenia was the first country in the world to adopt Christianity as a state religion in 301 A.D. Since then, Christianity has played a critical role in shaping the Armenian people. Religion has been an essential part of Armenian identity and has significantly influenced the course of the nation's history.

Armenia has eight elements inscribed on the UNESCO Representative List of the Intangible Cultural Heritage of Humanity[102]:

1) **Duduk and its music** (2008): The distinctive Armenian woodwind instrument made of apricot wood, traditionally played in pairs.
2) **Armenian cross-stones art: symbolism and craftsmanship of Khachkars** (2010): carved memorial steles bearing crosses and intricate motifs.
3) **Performance of the Armenian epic "Daredevils of Sassoun" (David of Sassoun)** (2012): oral storytelling of the national heroic epic.
4) **Lavash: the preparation, meaning and appearance of traditional bread** (2014): the communal baking of flatbread in clay ovens.
5) **Kochari, traditional group dance** (2017): a vigorous circle dance embodying bravery and unity.
6) **Armenian letter art and its cultural expressions** (2019): the decorative art of the Armenian alphabet, created by Mesrop Mashtots.
7) **Pilgrimage to the St. Thaddeus Apostle Monastery** (2020): a joint Armenian-Iranian nomination honouring historic religious pilgrimages.
8) **Tradition of blacksmithing in Gyumri** (2023): the local craft of forging iron objects central to Gyumri's identity.

The photos of the Armenian ICH values registered in the UNESCO Representative List of the Intangible Cultural Heritage of Humanity are presented in **Figure 6-13**.

[102] https://ich.unesco.org/en/state/armenia-AM?info=elements-on-the-lists

**Figure 6-13. Photos of Armenia's elements inscribed on the UNESCO Representative List of the Intangible Cultural Heritage of Humanity**

1) 2) 3) 4)

5) 6) 7) 8)

In addition to the eight intangible cultural heritage elements inscribed on UNESCO's Representative List, Armenia also has ICH elements of national significance. According to the latest amendment (dated 31.10.2024) to Annex 2 of RA Government Decision №310-A[103], the national list currently includes 68 ICH elements, including the eight internationally recognized ones. These encompass traditional songs and musical instruments, dances, ethnic cuisine, handicrafts (such as carpet weaving, knitting, embroidery, woodwork, pottery, forging, etc.), winemaking, ceremonies (including weddings, funerals, Christmas, New Year, Easter, baptisms, and more), pilgrimages, regional dialects, and other cultural expressions.

#### *6.4.2.2 Community Context*

According to Annex 2 of the RA Government Decision №310-A, more than 10 of the 68 nationally registered Intangible Cultural Heritage (ICH) elements are practiced across all regions of Armenia. These include: (i) the preparation of lavash, inscribed on both the UNESCO and national ICH lists, which is an integral part of Armenian cuisine; (ii) the tradition of producing tondir (underground clay ovens), used for baking lavash and other traditional dishes, recognized as an ICH element of national significance; (iii) the making and playing of the duduk; (iv) the Kochari dance; (v) the celebration of Christmas, New Year, and Easter, among others.

The Shirak Marz is distinguished by a number of traditional practices that continue to be observed within the enlarged community of Artik. Among the most notable are:

(i) Batola - a traditional folk and ceremonial wedding dance performed during festive occasions. This dance is widely practiced across the communities of the Aragatsotn, Gegharkunik, Vayots Dzor, and Shirak Marzes of Armenia, symbolizing communal unity, joy, and the continuity of local cultural heritage.

(ii) Satirical Folklore of Shirak - a distinctive element of the region's intangible cultural heritage, particularly characteristic of the residents of Shirak Marz and, most prominently, the city of Gyumri. This form of folklore reflects the local people's sharp wit, humour, and creative expression, serving as both social commentary and an enduring marker of Shirak's cultural identity.

[103] https://www.arlis.am/hy/acts/199058

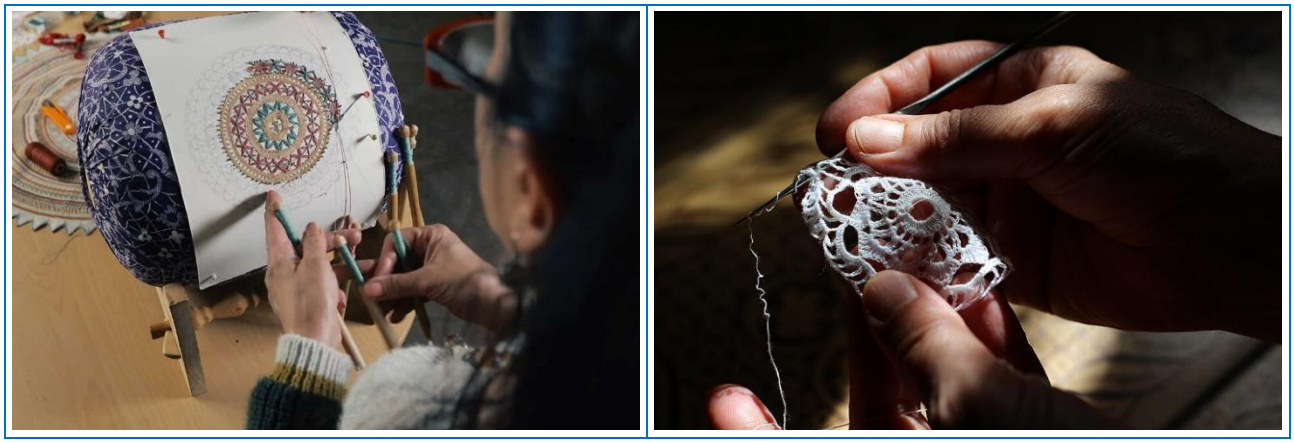
Several traditions registered in Annex 2 of the RA Government Decision №310-A are predominantly characteristic of the Artik enlarged community. These include:

(i) Lacemaking, or the art of making lace, a traditional craft performed by hand using threads of linen, silk, cotton, or occasionally metal (Item 19 in Annex 2; see **Figure 6-14**).

(ii) The tradition of making "chechil" cheese in the Shirak region, a distinctive local dairy practice that reflects the region's pastoral heritage and artisanal skills (Item 49 in Annex 2; see **Figure 6-15**).

(iii) "Karno" slang, a unique linguistic expression typical of the local communities, representing an important element of the region's intangible cultural identity (Item 56 in Annex 2).

**Figure 6-14. "Chechil" cheese making process**



Source: https://int-heritage.am/

**Figure 6-15. "Chechil" cheese making process**

Source: https://1or.am/?p=154783&l=en

Weddings, funerals, and baptisms in the villages of Artik enlarged community are also carried out with respect to local traditions and customs.

### *6.4.2.3 Cultural Landscape*[104]

Recognized types of cultural landscapes are:

[104]Cultural landscapes include tangible and intangible characteristics, such as natural systems and features, spatial organization and land use. Cultural landscapes are historically significant places that show evidence of human interaction with the physical environment. Their authenticity is measured by historical integrity, or the presence and condition of physical characteristics that remain from the historic period.

- **Designed** (planned gardens, estates),
- **Associative** (spiritually or culturally meaningful landscapes),
- **Evolved** (traditional agricultural areas like vineyards),
- **Vernacular** or **Ethnographic** (day-to-day or group-specific traditional use),
- **Agricultural** or **Working** (subtype often included under evolved or vernacular landscapes).

The residential areas within the five beneficiary rural settlements, namely Nor Kyanq, Panik, Meghrashen, Anushavan, and Vardaqar, are characterized by a vernacular cultural landscape (**Figure 6-16**), reflecting traditional settlement patterns and locally adapted architectural forms. The agricultural lands surrounding these settlements represent a combination of agricultural and working cultural landscapes shaped by long-standing land-use practices.

Within the planned reservoir command area, the main agricultural products include wheat, vegetables, and potatoes, with potatoes occupying more than 50% of the cultivated land (see **Section 2.2**, **Table 2-2**). Due to the cold climatic conditions, the area is generally unsuitable for orchard and grape cultivation.

The availability of irrigation water is expected to enhance agricultural productivity, leading to an expansion of areas under potato, vegetable, and wheat cultivation. As a result, the newly developed farmlands may exhibit characteristics of both designed and organically evolved cultural landscapes, reflecting a gradual transformation of traditional land-use patterns.

**Figure 6-16. Vernacular cultural landscape in the Project beneficiary rural settlements**

*Nor Kyanq village*

*Panik village*


*Meghrashen village*


*Anushavan village*


*Vardaqar village*

# 7. Stakeholder Consultation

## 7.1 Introduction

This chapter provides the overview of the Project stakeholder engagement and consultation activities carried out to date as part of both the national EIA and this ESIA study and summarizes their key findings. The stakeholder identification and engagement process for the Project was initiated in accordance with the RA Law on Environmental Impact Assessment and Expert Examination, the Procedure on Public Notification and Discussions approved by RA Government Decree №1325-N[105], as well as the stakeholder identification approach recommended by the EBRD.

## 7.2 Stakeholder Identification

The identification of stakeholders relevant to the Project was conducted according to the following criteria:

- **Impact:** the implementation of the Project may significantly affect a certain social group (stakeholders),
- **Influence:** the social group may have the capacity to significantly influence the process of Project implementation,
- **Partnership:** there are opportunities for building partnerships between the Project proponent and the given social group, and
- **Expressed Interest:** a social group or individuals not necessarily directly affected by the Project may (or may not) show interest in it.

On the other hand, the RA Law on Environmental Impact Assessment and Expert Examination defines **stakeholders** or the **stakeholder society** as individuals or legal entities that are directly or potentially affected by Project implementation or who show interest in decisions related to the Project. The same law also defines **participants of the EIA process** as state and local self-government bodies, individuals, and legal entities, including the affected community, affected settlements, and the interested public who in accordance with the Law participate in the assessment or expert examination process.

Stakeholder engagement requires the identification of stakeholders considering the above noted national and international criteria and the definition of appropriate methods for engagement with them. Different stakeholders have varying interests and influence in any project. Generally, those with low interest and low influence are to be kept informed, while those with high interest and high influence should be collaborated with.

The Project stakeholders can be grouped into two major categories: namely, external stakeholders and internal stakeholders (Water Committee, its staff, consultants and contractors).

For the purposes of effective and tailored engagement, the external stakeholders of the Project have been clustered into the following groups:

- Potentially affected parties,
- Vulnerable groups,

[105]The procedure for public notification and discussions was amended by the RA Government Decree №1343-N, dated 28.12.2023. However, at the time the first public notification was initiated, the previous version of the public notification and discussions procedure was still in force.

- Governmental authorities,
- Local self-governing bodies,
- Private sector and business,
- Other interested parties (civil society organizations, mass media, academia, etc.).

## 7.3 Public Discussions during the National EIA

In accordance with the procedure established by RA Government Decree №1325-N, four public discussions/hearings must be conducted as part of the national EIA and expert examination process in the project-affected community or settlement. The date, location and agenda of each of the four public discussions are outlined below:

**1st public discussions**

Date: 15.09.2023, 12:00

Location: Artik Municipality

Agenda:

- Presentation of the Project objective and main components,
- Environmental and social framework,
- Initial consent of the affected community.

**2nd public discussions**

Date: 15.12.2023, 12:00

Location: Nor Kyanq settlement

Agenda:

- Key findings of the preliminary environmental impact assessment,
- Draft Terms of Reference to be issued by the State Authorized Body (ME).

**3rd public discussions**

Date: 11.07.2024, 13:00

Location: Nor Kyanq settlement

Agenda:

- Key findings of the EIA studies,
- Recommended mitigation and monitoring measures.

**4th public discussions**

Date: 12.11.2024, 12:00

Location: Nor Kyanq settlement

Agenda:

- Main outputs of the EIA report,
- Feedback to the comments raised by the EIA process participants and stakeholders,
- Draft environmental impact expert examination conclusion.

The details and phases, as well as the main concerns and recommendations raised by stakeholders (participants) during the four public discussion events described above, are summarized in **Table 7-1**. These were taken into account by the national EIA developers during both the preliminary and

main EIA studies. However, if any concern was not addressed in the national EIA report, it has been reviewed and, if relevant, considered in this ESIA report.

**Table 7-1. Summary of public discussion events conducted as a part of national EIA study**

| Moderation and presentation | Date, time | The place | Number of participants (women) | Participants | Questions and suggestions raised |
|---|---|---|---|---|---|
| **1st public discussions**<br>- Presentation of the Project objective and main components,<br>- Environmental and social framework,<br>- Initial consent of the affected community. | | | | | |
| Discussion moderator: Deputy Head of Artik Municipality<br>The project was presented by: Director of the "Institute of Water Problems and Hydraulic Engineering named after Academician I.V. Yeghiazarov" CJSC (hereinafter - Project Designer), Chief engineer and Chief specialist of the Project, Environmental specialist | 15.09.2023 12:00 | Artik Municipality,<br>Artik Community, Shirak Marz | 36 (12) | Deputy Head and Secretary of the Staff of Artik Municipality, other officials, Administrative Heads of Nor Kyanq, Panik, Vardaqar, Meghrashen and Anushavan villages, residents of Artik community, Director and Chief engineer of the Project Designer, Chief specialist of the Project, Environmental specialist | - How will irrigation water be supplied to the highlands? Will a pumping station and distribution facility be required?<br>- Will sewage from the Artik community be discharged into the reservoir?<br>- Will the necessary infrastructure be built as part of this project, or is it planned under a separate initiative?<br>- Since 30% of the water from the Artik reservoir will eventually be released into the Vardaqar reservoir, could this lead to the reduction of the project's reservoir capacity and land-plots to be irrigated?<br>- What is the timeline for completing the construction of the reservoir and bringing it into operation?<br>- What is the yield of cultivated crops in the region, both with and without irrigation?<br>- To prevent water loss in the reservoir, whether anti-filtration measures are planned for |

| Moderation and presentation | Date, time | The place | Number of participants (women) | Participants | Questions and suggestions raised |
|---|---|---|---|---|---|
| | | | | | implementation in the reservoir basin.<br>- What is the cause of the reduction in water sources and groundwater levels? Is there a scientific explanation for this?<br>- There is also concern regarding the size of the fish farm wells and the large water usage permits they have been granted.<br>*All concerns and questions raised were addressed by the representatives of the Project Designer.*<br>***Conclusion:** There were no objections from the participants. They welcomed the project initiation and implementation.* |
| **2nd public discussions**<br>- Key findings of the preliminary environmental impact assessment,<br>- Draft Terms of Reference to be issued by the State Authorized Body (ME). | | | | | |
| Discussion moderator: Deputy Head of Artik Municipality<br>The project was presented by: Director of the Project Designer, Chief engineer and Chief specialist of the Project, Environmental specialist | 15.12.2023 12:00 | Residence of the administrative head of Nor Kyanq settlement (Artik community, Shirak Marz) | 44 (2) | Deputy Head and Secretary of the Staff of Artik Municipality, Assistant to the Head of Artik Municipality, Member of the Artik Community Council, Administrative Heads of Nor Kyanq and Panik villages, Director of the Project Designer, Chief engineer and Chief specialist | - Is it planned to connect the Artik reservoir to the Vardaqar reservoir via a pipeline? It will be better to use all water stored in the Artik reservoir exclusively for irrigating agricultural land within the project's command area?<br>- Will any trees or vegetation need to be removed prior to the commencement of construction work?<br>- There was an earthen dam in the past, which collapsed. |

| Moderation and presentation | Date, time | The place | Number of participants (women) | Participants | Questions and suggestions raised |
|---|---|---|---|---|---|
| | | | | of the Project, Environmental specialist, experts of the "Environmental Impact Expert Examination Centre" (EIEEC) SNCO, affected population | From a safety perspective, is it advisable to rebuild the reservoir with an earthen dam, given the previous experience?<br>- Will the Artik reservoir be filled with sewage or only clean water?<br>- Will water be released from the dead volume during a drought, or not?<br>- Will the environmental flows be secured?<br>- Will the environmental flow allow water to be supplied to the Vardaqar reservoir through filtration from the Artik reservoir?<br>- Is there a borrow-pit in the area?<br>*All concerns and questions raised were addressed by the representatives of the Project Designer.*<br>***Conclusion:** There were no objections from the participants, and the initiation and implementation of the project were welcomed.* |
| **3rd public discussions**<br>- Key findings of the EIA studies,<br>- Recommended mitigation and monitoring measures. | | | | | |
| Discussion moderator: Head of the Urban Development and Land Use Department of Artik Municipality | 11.07.2024 13:00 | Residence of the administrative head of Nor Kyanq settlement (Artik community, Shirak Marz) | 50 (22) | Head of the Urban Development and Land Use Department of the Artik Municipality, Assistant to the Head of Artik Municipality, Administrative | - A total of 25 ha of land in Anushavan village will be irrigated. Where is this land located?<br>- Will the construction of the internal network be part of the project, |

| Moderation and presentation | Date, time | The place | Number of participants (women) | Participants | Questions and suggestions raised |
|---|---|---|---|---|---|
| The project was presented by: Director of the Project Designer, Chief engineer of the Project, Environmental specialist | | | | Heads of Nor Kyanq, Panik and Anushavan villages, Director of the Project Designer, Chief engineer of the Project, Environmental specialist, affected population | or will it be funded by the community?<br>- There are an additional 27 hectares of agricultural land in the Panik settlement that also require irrigation.<br>- Will a pumping station be required to supply water to the irrigable land?<br>*All concerns and questions raised were addressed.*<br>***Conclusion:** There were no objections from the participants, and the initiation and implementation of the project were welcomed.* |
| **4th public discussions**<br>- Main outputs of the EIA report,<br>- Feedback to the comments raised by the EIA process participants and stakeholders,<br>- Draft environmental impact expert examination conclusion | | | | | |
| Discussion moderator: Secretary of the Staff of Artik Municipality<br>The project was presented by: Director of the Project Designer, Chief engineer of the Project, Environmental specialist | 12.11.2024 12:00 | Residence of the administrative head of Nor Kyanq settlement (Artik community, Shirak Marz) | 47 (1) | Secretary of the Staff of Artik Municipality, Assistant to the Head of Artik Municipality, Administrative head of Nor Kyanq village<br>Director of the Project Designer, Chief engineer of the Project, Environmental specialist, expert of the EIEEC, affected population | After presenting the main findings of the EIA report and the key provisions of the Draft Environmental Impact Expert Examination Conclusion, no comments were raised by the participants.<br>***Conclusion:** There were no objections from the participants, and the initiation and implementation of the project were welcomed.* |

## 7.4 Consultations with Project Stakeholders during the Socio-Economic Studies

Consultations with representatives of the Artik community were initiated following the submission of Letter №286-HSE-04 by the Consultant to the Head of Artik Municipality on 22 July 2024. The letter provided an overview of the Project and outlined the following key information:

i) a description of the Project and its main components;
ii) the current status of Project implementation;
iii) the scope of the environmental and socio-economic assessment studies;
iv) potential land use constraints, as well as land acquisition and compensation considerations; and
v) the list of municipal officials and groups of Project Affected Persons (PAPs) proposed for consultation.

The Head of the Development Programs, Tourism and Internal Affairs Department was appointed as the official focal point representing the Artik Municipality. This individual was responsible for maintaining communication with the Consultant and facilitating the provision of relevant data and information necessary for the consultation process.

Consultations with municipal representatives were conducted online. Participants included staff from the Development Programs, Tourism and Internal Affairs Department, as well as representatives from the social services sector. During the meetings, participants were informed about the Project, its anticipated socio-economic benefits, and key environmental considerations. They also confirmed their participation in previous public discussions held under the national Environmental Impact Assessment (EIA) process, as well as in meetings with the Project design team.

The consultation agenda with Artik Municipality covered a range of issues related to the socio-economic and environmental profile of the Project area, including:

- the total area of the settlement, land types, and land use patterns;
- the level of community engagement in EIA consultations and key environmental concerns raised;
- population dynamics, migration trends, main occupations, and vulnerable groups;
- individuals and groups likely to be affected by the Project and potential economic displacement;
- restrictions within the protection zones surrounding the planned reservoir area.

Overall, the attitude of the Artik enlarged community toward the Project was positive. The Project is expected to have a beneficial impact on the socio-economic development of the community, particularly for households engaged in agricultural activities. In addition, Project implementation is anticipated to generate temporary employment opportunities during the construction phase and create permanent jobs during the reservoir's operation phase.

## 7.5 Summary of Stakeholders Concerns, Questions and Recommendations

During the public discussions and stakeholder consultation events within the national EIA study, participants raised several questions and concerns regarding the potential implications of the Project's implementation. Where applicable, these issues have been addressed in the relevant sections of this ESIA Report. The key questions and comments included the following:

- What is the existing vegetation cover within the Project area, and will any tree removal be required?
- Will wastewater or sewage from the Artik community be discharged into the planned reservoir?
- Does the Project include only the construction of the reservoir structure, or does it also cover supporting infrastructure? Will water supply be ensured through a gravity system, or will a pumping station be required?
- Where will the dam structure of the reservoir be located?
- What are the planned timelines for the construction and commissioning of the Artik Reservoir?
- Will anti-infiltration measures be required to ensure the reservoir's integrity?
- Where are the lands included within the command area of the Artik Reservoir located?
- Is there a plan to use part of the stored water from the Artik Reservoir to supply the downstream Vardaqar Reservoir?
- Will environmental flow requirements be adequately ensured?

The questions and concerns raised by participants during the four public discussions were jointly addressed by the Project designer and the EIA consultant. Where necessary, the results of relevant calculations and assessments, as well as project-related maps and layouts, were shared with the participants. Each public discussion was considered complete only after all questions raised had been adequately responded to.

## 7.6 Planned Stakeholder Engagement

The next stakeholder consultation meetings will take place during the 120-day public disclosure period of the ESIA package, which includes the ESIA Report, Non-Technical Summary (NTS), Environmental and Social Management Plan (ESMP), Environmental and Social Action Plan (ESAP), Stakeholder Engagement Plan (SEP), Resettlement Framework (RF), and Biodiversity Action Plan (BAP).

Two public consultation events are planned: one in Artik Municipality and another in Yerevan, with the participation of relevant state authorities, NGOs, and other project stakeholders. These meetings are tentatively scheduled for the third quarter of 2026. This component will be led by the ESIA Consultant, with support from the Water Committee.

The Stakeholder Engagement Programme, developed as part of the SEP, aims to ensure effective engagement with all identified stakeholders, foster and maintain constructive relationships between the Water Committee and affected parties, and help prevent potential conflicts. It covers the Project's design, pre-construction, and construction phases.

The Programme will be reviewed and updated at least annually after the start of construction and again prior to the commissioning of the Artik Reservoir. It includes a detailed action plan defining responsibilities and timelines for implementing the proposed engagement activities. Should any project changes occur that require adjustments to the engagement mechanisms, or if new stakeholders are identified, the Programme will be revised accordingly.

Stakeholder engagement will continue in parallel with the ESIA information disclosure process and will comprise several activities designed to ensure ongoing, meaningful consultation and the timely dissemination of information on the Project and its E&S implications.

# 8. Environmental and Social Impacts, Benefits and Opportunities, Mitigation Measures

## 8.1 Introduction

This chapter provides a summary of the environmental and social impacts and benefits identified during the national EIA study, which were subsequently updated through supplementary surveys and analyses conducted by the Consultant. These efforts were undertaken to align this ESIA report with the requirements of the EBRD ESP (2019) and the provisions of the applicable Good International Practices (GIPs). This process ensures that the environmental and social information used for decision-making presents a comprehensive understanding of the potential effects of the proposed Project, including issues of particular relevance to affected groups and individuals. The methodology applied for impact assessment and management is described in detail in **Chapter 5** of this ESIA report.

## 8.2 Environmental Impacts and Benefits, Mitigation Measures

### 8.2.1 Transboundary Impact

The construction of the Artik reservoir is not planned on transboundary water resources. The Artikjur is a river in Armenia that flows through the Artik town, Shirak Marz. It originates from the northwestern slope of Mount Aragats and flows for 26 km before joining the Karkachan River, which is a tributary of the Akhuryan[106] River. The Artik River is known for its role in supplying water to the Artik reservoir and for the potential flood risks it presents during snowmelt and heavy rainfall.

The hydrological impact assessment[107] has been undertaken comparing the average and dry year flows at the boundary with relevant neighbouring countries, with and without the project. The hydrology baseline considered for this assessment was that defined using the SWAT+ model established for the purpose of the present study[108]. The main conclusion is that it is unlikely that the Project generates significant hydrological impacts downstream of the proposed reservoir.

Artik reservoir is not expected to cause significant sediment impacts, as existing dams or lakes located between these reservoirs and the borders already trap sediments. It is very unlikely that the project will have significant sediment load and soil stability impacts.

The SWAT+ model and the site visit show that the rivers feeding Artik reservoir, the Artik and Artikjur rivers are non-perennial flow which is unsuitable condition for the development of a stable fish community. In addition, the Vardakar reservoir located downstream of Artik already acts as an obstacle to fish migration. Therefore, it is very unlikely that Artik reservoir will have any significant impact on fish resources and aquatic habitats.

A conservative evaluation of the planned reservoir' impacts downstream of the reservoir has been made possible through basic hydrological modelling (SWAT+) and expert judgment. The assessment indicates that the Artik reservoir is unlikely to cause significant impacts. This conclusion is primarily based on the upstream positions relative to existing lakes or reservoirs, and the relatively small size of the rivers they impound.

[106] Arpacay River in Turkey
[107] SLR Consulting. Armenia reservoirs Project: Transboundary Impact Assessment Report, Revision A, June 2025.
[108] Ibid

### 8.2.2 GET Assessment[109]

#### *8.2.2.1 Introduction*

The Project is assessed as aligned with the goals of the Paris Agreement[110] based on the directly financed methodology. Specific assessments for climate adaptation and climate mitigation have been undertaken for the Artik reservoir site and outlined below.

#### *8.2.2.2 Paris Alignment Assessment*

Alignment with the mitigation goals of Paris Agreement: general screening

The Project is on the aligned list under the water supply and wastewater category[111]. No Project activities have been identified as on the 'non-aligned list'.

Alignment with the mitigation goals of Paris Agreement: specific assessments

*Review against Nationally Determined Contribution (NDC) and Low Emission Development Strategy*

In the case of Armenia, the NDC outlines an intention to achieve an unconditional Greenhouse Gas (GHG) emissions reductions target of at most 2.07 t CO2eq/capita by 2050. These are reflected in Armenia's Draft Long Term - Low Emission Development Strategy (LT-LEDS). Armenia's LT-LEDS outlines improvements in water supply and irrigation as a priority area to reduce energy consumption, with an estimated total GHG emissions reduction of 8.946 Gg CO2eq until 2050.

As such, the Project does align with some of the targets outlined in Armenia's draft LT-LEDS and, therefore, the country's NDC in that it is designed to improve water supply and efficiency in irrigation. However, it is noted that GHG emission estimates at this stage show net positive carbon emissions for reservoir over 100 years.

*Review against energy policies in Armenia*

In 2022, the International Energy Agency, in partnership with the European Union, produced an in-depth review of the energy policies of Armenia which sets the path for the sector's transition through 2040 including guidance on energy efficiency and security of supply. Water supply, construction and agriculture do not feature explicitly in this review. However, the economic assessment identifies that the Project will result in an annual decrease in energy costs due to decreased pumping costs. Therefore, the Project is concluded to align with Armenia's energy transition policies through to 2040.

*Carbon lock-in test*

Carbon lock-in occurs when technical, economic or institutional factors mean an asset will continue to operate in an emissions-intensive way, even when there are feasible and economically preferable lower carbon options that could replace it. The risk of lock-in is considered low if the project entails investment in assets that will cease to operate in an emissions-intensive way in the near future or the project credibly demonstrates low-carbon readiness.

A review of the Project has not identified (at this stage) the use of any low-carbon alternatives and use of renewable energy sources. However, there are still opportunities to embed low-carbon alternatives into the design of the Project and there are no barriers identified to the use of renewable

[109]This GET Assessment has been prepared based on the Chapter 5 and Section 8.3 of the *Armenia Water Reservoirs - Technical, Economic and Green Due Diligence Gap Analysis, Draft Final Report*, 2023-2024, Ove Arup & Partners
[110]https://unfccc.int/sites/default/files/english_paris_agreement.pdf
[111]Implementing the Green Economy Transition Technical Guide, EBRD, March 2024 and Annexes to Implementing the Green Economy Transition - Technical Guide, EBRD, March 2024

energy in the operation of the project. Therefore, the risk the Project's overall lock-in risk can be considered low.

*Economic viability test*

An economic viability test has not been completed as the CO2 emissions assessment has not identified that any of the individual reservoirs exceeds the 'significant' emissions thresholds outlined in the EBRD Methodology to determine the Paris Agreement alignment of EBRD investments.

Conclusion: The Project is assessed as aligned with the mitigation goals of Paris Agreement (BB1 aligned).

Alignment with the adaptation goals of Paris Agreement

Internal screening of the Project has identified increased heat stress, increased water stress and drought / flooding / sea-level rise / mass movement[112] / forest fires / erosion] as potentially material physical climate risk(s) for the Project location.

A climate risk assessment was conducted as part of the Project's technical due diligence[113] (**Sub-section 8.2.2.3**). In response, the Project incorporates adaptation measures to ensure the assets are resilient to the identified material risks:

- Extreme heat (affecting the reservoir and dam),
- Heavy precipitation and flooding (affecting the reservoir, dam, and spillway).

The Project is unlikely to undermine climate resilience of the system in which it operates. Although it is noted that uncertainties regarding downstream flood impacts mean that, at this stage, the downstream receptors remain potentially at high risk to heavy precipitation and flooding. This also takes into account the fact that the reservoir is primarily designed to address future water storages and support agriculture.

Potential high risks are also identified for extreme high temperatures and forest fires for ecological receptors downstream. This is a conservative rating applied in the absence of information on the ecological receptors, and also the vegetation clearing and planting approach for the reservoirs.

### *8.2.2.3 Climate Change Adaptation and Mitigation Assessment*

Climate adaptation (Climate change risk assessment)

*Step One: Current and future baseline*

To define the current and future baseline the assessment has utilised historical climate data and climate projections from national, regional and site-specific sources, where available. Regional-level climate projections and site-specific climate data provided by "Modul" design company has been used to look in further detail at the current and future climate conditions for the Artik Reservoir. A summary of the key trends is provided in **Table 8-1**.

[112]The assessment of mass movement considers it occurring as a result of heavy rainfall/storms, i.e., as a climatic factors. Seismic risk is covered by the technical review
[113]*Armenia Water Reservoirs - Technical, Economic and Green Due Diligence Gap Analysis, Draft Final Report*, 2023-2024, Ove Arup & Partners

**Table 8-1. Summary of current and future climate trends for the Artik reservoir**

| Climate hazard | Baseline | Projected change[114] | | |
|---|---|---|---|---|
| | | 2020-2039 | 2040-2059 | 2060-2079 |
| Average temperature | Observed annual average temperatures have increased between 1901 and 2022 in the Shirak region. | ↑ For both the SSP2-4.5 and SSP5-8.5 scenarios average temperatures are projected to increase in Shirak region. | | |
| Extreme high temperatures | The extreme heat hazard rating for the Artik community is assigned as low, meaning that there is between a 5% and 25% chance of at least one prolonged exposure to extreme heat. | ↑ For both the SSP2-4.5 and SSP5-8.5 scenarios, average maximum air temperatures are projected to increase in the Shirak region. | | |
| Extreme low temperatures | For the time period of 1990-2014, the observed annual average minimum temperature in the Shirak region was 0.53°C with an average number of 166 frost days and 73 ice days. | ↑ Future projections for both the SSP2-4.5 and SSP5-8.5 scenarios project that minimum air surface temperature will increase.<br>↓ Future projections for both the SSP2-4.5 and SSP5-8.5 scenarios project that the number of frost days and ice days will decrease. | | |
| Wildfire & Forest Fires | The wildfire hazard rating for the Artik community is assigned as high. | ↑ Modelled projections indicate a likely increase in the frequency of fire weather across Armenia. | | |
| Extreme wind | Data available on wind is limited. Data from the Global Wind Atlas indicates an average wind speed of 3.59 m/s for the top 10% windiest areas in the location of the Artik Reservoir. | Changes in wind speed as a result of climate change are difficult to predict and are affected by high levels of uncertainty. | | |
| Average precipitation | Between 1901 and 2022, annual average precipitation values have shown both increasing and decreasing trends between individual years. Most recently between 2001 and 2007 there was a more notable increase but between 2008 and 2022, there has been a decreasing trend. | ↓↑ For both the SSP2-4.5 and SSP5-8.5 scenarios, both increases and decreases are projected in monthly average precipitation compared to baseline conditions. The greatest increased across all time periods and scenarios are projected in March. | | |
| Heavy precipitation and flooding | The river flood hazard ratings for the Artik community are assigned as very low, this means there is a chance of less than 1% that potentially damaging and life-threatening river floods occur in the coming 10 years.<br>The urban flood hazard ratings for the Artik community are assigned as low, meaning that there is a chance of more than 1% that potentially damaging and life-threatening river floods occur in the coming 10 years | ↑ In the Shirak region, for both the SSP2-4.5 and SSP5-8.5 scenario the projected average largest 5-day cumulative precipitation is projected to increase. | | |
| Drought | The water scarcity hazard rating for the Artik municipality is assigned as low, meaning there is up to 1% chance droughts will occur in the coming ten years. | ↑ The current low hazard rating for the Artik community may increase in the future due to climate change. | | |
| Erosion | Localised data on current and future erosion patterns has not been identified. | | | |
| Mass movement | The landslide hazard rating for the Artik community is medium, meaning that there are conditions that contribute to making localised.<br>Landslides an infrequent hazard phenomenon. | Climate change is likely to alter slope and bedrock stability through changes in precipitation and/or temperature. However, it is difficult to determine future locations and timing of large rock avalanches, as these depend on local geological conditions and other non-climatic factors. | | |

[114]Consulting Services for the Preparation of Design and Estimate Documentation for the Reconstruction of the Artik Reservoir, Shirak Region, Republic of Armenia, Book №1 - Explanatory Note, 2024

### *Step Two: Definitions of exposure of impacts to climate change*

**Table 8-2** outlines the definitions used to rate the exposure of the Artik reservoir to relevant climate hazards. The rating considers current and future climate conditions that may occur across the Project lifecycle. On the basis of the exposure ratings, the mass movement hazard is not considered further.

**Table 8-2. Exposure ratings for the Artik reservoir**

| Climate hazard | Exposure rating |
|---|---|
| Extreme high temperatures | Probable |
| Extreme low temperatures | Probable |
| Forest fires | Plausible |
| Extreme wind | Plausible |
| Heavy precipitation and flooding | Plausible |
| Drought and increased water stress | Plausible |
| Erosion | Plausible |
| Mass movement | Not likely |

### *Step Three: Definition of sensitivity impacts to climate change*

**Table 8-3** outlines the definitions used to rate the sensitivity of the Artik reservoir to relevant climate hazards. The rating considers current and future climate conditions that may occur across the Project lifecycle.

**Table 8-3. Sensitivity ratings for the Artik reservoir**

| Climate hazard | Sensitivity rating | | |
|---|---|---|---|
| | Reservoir and Dam | Spillway | Guard house and instrumentation |
| Extreme high temperatures | Low | Low | Low |
| Extreme low temperatures | Low | Low | Low |
| Forest fires | Low | Low | Medium |
| Extreme wind | Medium | Medium | Low |
| Heavy precipitation and flooding | High | High | Medium |
| Drought and increased water stress | Medium | Medium | Low |
| Erosion | Medium | Medium | Low |

**Table 8-4** outlines the definitions used to rate the sensitivity of receptors located downstream of Artik reservoir to relevant climate hazards. The rating considers current and future climate conditions that may occur across the Project lifecycle.

**Table 8-4. Sensitivity ratings for receptors located downstream of the Artik reservoir**

| Climate hazard | Sensitivity rating | | |
|---|---|---|---|
| | Agricultural land | Water users (including farmers) | Ecological receptors |
| Extreme high temperatures | Low | Low | Medium |
| Extreme low temperatures | N/A - The Project is not anticipated to impact on the sensitivity of the receptors to extreme low temperatures. | | |
| Forest fires | Low | Low | Low |
| Extreme wind | N/A - The Project is not anticipated to impact on the sensitivity of the receptors to extreme winds. | | |
| Heavy precipitation and flooding | High | High | High |
| Drought and increased water stress | Low | Low | Medium |

| Climate hazard | Sensitivity rating | | |
|---|---|---|---|
| | Agricultural land | Water users (including farmers) | Ecological receptors |
| Erosion | Low | Low | Medium |

*Heavy precipitation and flooding hazard*

It is understood from design summary information that Artik dam is designed to Armenian Class II and that a 1 in 1000-year return period safety check flood has been used. The safety check should be selected based on the downstream hazard posed by an uncontrolled release of water from the dam. However, no extreme flood flows have been provided for the Artik reservoir and it is not clear what hydrological assessment has been made.

In addition, no evidence has been provided that climate change has been taken into account in the selection of the safety check flood. Whilst overall decreasing trends are reported in river flows in Armenia, climate change still has the potential to increase the frequency and magnitude of flood events that do occur.

Therefore, the Artik reservoir, dam and spillway are identified as having a "High" sensitivity to heavy precipitation and flooding.

*Step Four: Definition of a risk assessment level*

**Table 8-5** outlines the risk ratings for the Artik reservoir for relevant climate hazards. The rating considers current and future climate conditions that may occur across the Project lifecycle.

**Table 8-5. Risk ratings for the Artik reservoir**

| Climate hazard | Risk rating (Exposure × Sensitivity) | | |
|---|---|---|---|
| | Reservoir and Dam | Spillway | Guard house and instrumentation |
| **Extreme high temperatures** | High | Medium | Medium |
| **Extreme low temperatures** | Medium | Medium | Medium |
| **Forest fires** | Low | Low | Medium |
| **Extreme wind** | Medium | Medium | Medium |
| **Heavy precipitation and flooding** | High | High | Medium |
| **Drought and increased water stress** | Medium | Medium | Low |
| **Erosion** | Medium | Medium | Low |

**Table 8-6** outlines the risk ratings for receptors located downstream of Artik reservoir for relevant climate hazards. The rating considers current and future climate conditions that may occur across the Project lifecycle.

**Table 8-6. Risk ratings for receptors located downstream of the Artik reservoir**

| Climate hazard | Risk rating (Exposure x Sensitivity) | | |
|---|---|---|---|
| | Agricultural land | Water users (including farmers) | Ecological receptors |
| Extreme high temperatures | Medium | Medium | High |
| Forest fires | Medium | Medium | Medium |
| Heavy precipitation and flooding | High | High | High |

| Climate hazard | Risk rating (Exposure x Sensitivity) | | |
|---|---|---|---|
| | Agricultural land | Water users (including farmers) | Ecological receptors |
| Drought and increased water stress | Low | Low | Medium |
| Erosion | Low | Low | Medium |

*Step Five: Identification of recommended climate resilience measures*

For the purpose of this assessment, risks identified as "High" are considered material and, accordingly, resilience measures are identified to reduce the materiality of these risks.

Reservoir, dam and spillway

To mitigate potential impacts of heat on reservoir and dam structures, construction materials should be selected that have a proven track record in performing under high temperature conditions. During operation, inspections should also be completed more regularly during and immediately after heat wave events to identify and resolve any issues associated heat induced expansion and other impacts.

In addition, the Artik reservoir should incorporate consideration of the impacts of climate change on reducing river flows as has been reported for the other reservoirs.

As with the other reservoirs, undertake a risk-based approach to determining the safety check flood including Probable Maximum flood analysis and sensitivity testing to determine how downstream consequences are affected by the occurrence of floods with a greater magnitude as a result of climate change. Expert judgement should then be applied to determine if an allowance is required for climate change in determining the Safety Check Flood.

Downstream receptors

In relation to extreme high temperatures and ecological receptors, this reflects a conservative approach undertaken in the absence of knowledge of the ecological species located in proximity to the reservoir. This risk should therefore be re-evaluated following ecological surveys and assessment to determine whether it remains material and if so, what resilience measures should be implemented.

The measures outlined above would address the risks posed to downstream receptors by heavy precipitation and flooding.

Climate change mitigation: CO2e impact analysis

The data inputs to the G-res tool relied on the design document for the reservoir, from which the key information is summarised in **Table 8-7**. The reservoir site and catchment area were delineated in Google Earth Engine for the assessment of upstream catchment and reservoir datasets.

**Table 8-7. G-res data inputs for the Artik reservoir**

| Upstream catchment | | | | | |
|---|---|---|---|---|---|
| **Catchment area** | | 62 | | km2 | |
| **Population in catchment** | | 1000 | | persons | |
| **Catchment annual runoff** | | 12 | | mm. yr | |
| **Landcover and mineral soils** | | | | | |
| **Bare areas** | 0% | **Croplands** | 23% | **Forest** | 0% |
| **Grassland/ shrubland** | 32% | **Settlements** | 8% | **Waterbodies** | 0% |

| | | | |
|---|---|---|---|
| **River area before impoundment** | 22 | km | |
| **Area to be inundated by reservoir** | | | |
| **Climate zone** | | Temperate | |
| **Reservoir area** | | 30 | ha |
| **Reservoir volume** | | 1.25 | MCM |
| **Water level** | | 1670 | masl |
| **Maximum depth** | | 13 | m |
| **Annual wind speed** | | 3.95 | m/s |
| **Mean air temperature** | | 3.7 | °C |
| **Reservoir** | | | |
| **Primary service** | | Irrigation | |
| **Secondary service** | | Flood control | Environmental flow |
| **Earth removed** | | (none included)[115] | $m^3$ |

The outputs indicate the post-impoundment emissions rate of $CH_4$ as 25 $tCO_2e/yr$ and no pre-impoundment emissions rate of $CO_2$. The reservoir emission over 50 years is 16.5 $tCO_2e/yr$ (**Table 8-8**).

**Table 8-8. G-res outputs for the Artik reservoir**

| | | |
|---|---|---|
| **Total net GHG footprint** | | |
| **Total reservoir emissions per year** | 0 | $tCO_2e/yr$ |
| **Total reservoir emissions at year 1** | 81.6 | $tCO_2e/yr$ |
| **Total reservoir emissions at year 50** | 16.5 | $tCO_2e/yr$ |
| **Reservoir net GHG footprint by pathway** | | |
| **Emission rate of which $CO_2$** | 0 | $tCO_2e/yr$ |
| **Emission rate of which $CH_4$** | 25 | $tCO_2e/yr$ |

GET assessment

**Table 8-9** outlines the GET outcomes anticipated for the Artik reservoir.

**Table 8-9. GET CROs for the Artik reservoir**

| GET Outcome | Valorisation of GET CRO[116] | CRO ratio (CRO/Capex) |
|---|---|---|
| **Increased agricultural potential (€/year)** | €1270703<br>Excluding consideration of Capex | 15.9% |
| **Increased water availability (€/year)** | €895845 | 11.2% |

It is considered that there is double counting between the increased agricultural potential and the increased water availability outcomes. Therefore, it is proposed that only the highest of these two figures is reported, i.e. 15.9% for the Artik reservoir.

At an earlier stage of the Project, potential was identified for the Project to reduce damage from flooding as a result of improving control of floodwaters. Through further review, it has been identified that whilst the Artik Reservoir will be designed to attenuate flows to an extent it is not anticipated that this will have any measurable impact on flood risk receptors downstream.

[115]No information available on amount of earth removed
[116]Cumulative Results Overview

No GET outcomes were identified under the "Other environmental benefits" category at this stage.

### 8.2.3 GHG Emissions

The CO2e impact analysis relied on the use of the GHG Reservoir Tool (G-res Tool), which is based on principles agreed upon by the IPCC[117] for assessing net reservoir emissions. When calculating CO2e for a reservoir, a whole-catchment approach was followed to account for terrestrial areas that act as net carbon sinks. Net GHG emissions caused by a reservoir are defined as the difference between the total CO2e emissions fluxes in the river basin before and after the reservoir's creation. The G-res tool is built on this principle of estimating net anthropogenic GHG emissions, i.e., what the atmosphere "sees" when a new, man-made reservoir is introduced into the landscape.

This assessment calculates the net GHG footprint using the following formula:

$$\textit{Net GHG Footprint} = \frac{\textit{Post-impoundment GHG balance from catchment after introduction of reservoir}}{\textit{Pre-impoundment GHG balance of catchment before introduction of reservoir}}$$

The pre-impoundment GHG balance relied on an assessment of the landscape. The G-res tool assesses the overall pre-impoundment GHG balance by multiplying the surface area of each land cover sub-unit with a specific emission factor appropriate for both CO2 and CH4. These are then summed over a 100-year assessment period and averaged to obtain a mean rate over the entire surface area to be occupied by the reservoir.

The post-impoundment GHG balance relies on an analysis of semi-empirical models based on existing datasets. These relate to annual CH4 diffusive emission, predicted gross annual emission and estimating the CO2 emissions rightfully attributed to the reservoir. The post-impoundment emissions are expressed in the G-res as areal emissions (gCO2e/m2/yr) and as reservoir wide emissions (tCO2e/yr) merged as GHG emissions, but also separately as CO2 and CH4. A global warming potential for 100 years was used to obtain CH4 emissions as CO2e.

The outputs of the G-res calculations indicate the post-impoundment emissions rate of CH4 as 25 tCO2e/yr with no post-impoundment emissions rate of CO2. The total GHG emissions from the planned reservoir at year 1 are estimated 81.6 tCO2e/yr, while at year 50 - 16.5 tCO2e/yr (**Table 8-8**).

### 8.2.4 Impact on Air Quality

*Construction phase*

During the construction phase, the following activities and operations are identified as potential sources of air emissions (both stationary and mobile):

- Site clearance (no tree cutting is required within the Project area),
- Construction of access roads and installation of temporary facilities,
- Excavation of the reservoir basin and spillway channels,
- Dam construction, including backfilling and concrete works,
- Grading and compaction of soil,
- Loading, transportation, and unloading of friable materials,
- Drilling works for the installation of OTL pillars,
- Welding and painting activities,

[117] Intergovernmental Panel on Climate Change

- Operation of construction equipment and machinery.

Air emissions expected during the Project's construction phase from both stationary and mobile sources, along with their estimated volumes, were calculated and presented in the national EIA report. The calculations were based on the CORINAIR methodology[118] for vehicles and construction machinery, and the guide for calculating unorganized air emissions from the construction industry for dust emissions. The calculated air emissions (in ton/year) from the planned reservoir construction activities are provided in **Table 8-10**.

**Table 8-10. Calculated volumes of air emissions**

| № | Name of emitted substance | Emissions, ton/year |
|---|---|---|
| 1 | Dust | 313.2 |
| 2 | Nitrogen dioxide | 9.16 |
| 3 | Carbon oxide | 7.86 |
| 4 | Hydrocarbons | 1.82 |
| 5 | Solid particles | 0.93 |
| 6 | Sulphur anhydride | 0.86 |
| **Total** | | **333.83** |

Around 90% of the overall air emissions from the construction activities consist of dust (PM2.5 and PM10). The maximum dust emission rate of 1.05 g/sec expected during the construction phase is unlikely to have a significant impact on dust levels in the ground-level atmosphere. A similar conclusion can be drawn for gaseous emissions, which are also expected to remain below the acceptable limits and pose minimal risk to ambient air quality. Moreover, the calculated levels of air emissions can be further reduced through the implementation of appropriate mitigation measures (see **Table 8-12**).

*Operation phase*

The potential sources, causes and environmental impacts from the operated reservoir are outlined in **Table 8-11**.

**Table 8-11. Sources, causes and impacts from the reservoirs**

| Source | Cause | Impact |
|---|---|---|
| **AIR POLLUTANTS** | | |
| **Volatile Organic Compounds (VOCs)** | | |
| Volatile organic compounds are emitted in small amounts from reservoirs, particularly if the water is affected by pollutants or chemicals in the surrounding environment. | VOCs can be released from aquatic plants, algae, or even from chemicals used in water treatment, runoff, or industrial activities near the reservoir. | VOCs can contribute to local air pollution, causing smog formation and having potential health impacts. They also contribute to the formation of ground-level ozone and other secondary pollutants. |
| **Ammonia ($NH_3$)** | | |
| Ammonia can be emitted from water reservoirs, especially if | Ammonia is often released as a result of the breakdown of | Ammonia can be toxic to aquatic life at high |

[118]The methodology is based on the classification of vehicles in accordance with the "Core Inventory of Emissions in Europe" (hereinafter referred to as CORINAIR), which is part of the "Base Inventory of Atmospheric Emissions in Europe" methodology

| Source | Cause | Impact |
|---|---|---|
| the water quality is influenced by agricultural runoff or other sources of nitrogenous compounds. | organic nitrogen in the water. It can also evaporate from surface waters where nitrogen-rich fertilizers or waste runoff have been deposited. | concentrations and, when released into the atmosphere, can contribute to the formation of fine particulate matter. |
| **Dust and Particulate Matter** | | |
| Dust and particulate matter can be emitted from areas surrounding the reservoir, especially in arid or semi-arid regions. | Even wind erosion can cause particulate matter to be emitted from the reservoir's surrounding landscape. | Dust can affect local air quality, contribute to respiratory problems in humans, and have ecological impacts. |
| **Sulphur Compounds (e.g., $H_2S$)** | | |
| In reservoirs with high organic material and low oxygen (anaerobic conditions), sulphur compounds like hydrogen sulphide ($H_2S$) can form. | Sulphate-reducing bacteria in the water may produce hydrogen sulphide when they break down organic matter in low-oxygen conditions. It may also occur in sediments at the bottom of the reservoir. | Hydrogen sulphide has a foul odor and can be toxic at high concentrations. It may also contribute to the formation of other sulphur-related compounds that can impact air and water quality. |
| **Phosphorus Compounds** | | |
| Although phosphorus is typically considered a water pollutant, in some cases, phosphorus compounds can be emitted to the air, particularly in the form of aerosols or particulates. | Phosphorus compounds may volatilize or become airborne when sediment is disturbed or if water quality management practices like aeration are implemented. | Phosphorus itself isn't a greenhouse gas, but it can contribute to nutrient pollution, leading to eutrophication, algal blooms, and subsequent methane emissions. |
| **GHG EMISSIONS** (discussed in **Section 8.2.3**) | | |
| **Methane ($CH_4$)** | | |
| Methane is one of the most significant greenhouse gases emitted from water reservoirs. It is produced through the anaerobic (oxygen-free) decomposition of organic matter at the bottom of the reservoir, where conditions are conducive to methane production. | Organic matter like plants, algae, and other organic material decomposes in the absence of oxygen, producing methane as a byproduct. This is most common in deeper, more eutrophic (nutrient-rich) reservoirs. | Methane is a potent greenhouse gas, with a global warming potential many times higher than carbon dioxide ($CO_2$). Its release into the atmosphere contributes significantly to climate change. |
| **Nitrous Oxide ($N_2O$)** | | |
| Nitrous oxide is a trace greenhouse gas that can be emitted from reservoirs, typically in areas where nitrogen compounds are present. | $N_2O$ emissions can result from the nitrification and denitrification processes, where nitrogen from agricultural runoff or wastewater undergoes biological transformations. This process often occurs under anaerobic conditions in | Nitrous oxide is a potent greenhouse gas, with a global warming potential over 250 times that of $CO_2$. Although it is typically released in smaller amounts than methane, it still plays a role in climate change. |

| Source | Cause | Impact |
|---|---|---|
| | sediment or water, producing $N_2O$ as a byproduct. | |
| **Carbon Dioxide ($CO_2$)** | | |
| Carbon dioxide is another common emission from reservoirs, resulting from aerobic (oxygen-present) decomposition of organic material in the water. It can also be released through respiration by aquatic organisms. | When organic material in the water decomposes in the presence of oxygen, it breaks down into carbon dioxide. Additionally, photosynthesis by aquatic plants and algae can lead to $CO_2$ release. | While $CO_2$ is a less potent greenhouse gas than methane, it still contributes to the greenhouse effect and global warming. |

The volume of air emissions from the reservoir during the operational phase will be minimal and will primarily depend on the climatic conditions in the Project region. Theoretically, these emissions can be controlled solely through the implementation of a defined operational regime and the application of technical measures; however, given the small quantities of air emissions, such measures are often considered unfeasible. Nevertheless, a set of technical measures that could potentially be considered in the Project design documentation is outlined in **Table 8-12**.

Some minor air emissions may occur during the maintenance activities of the operated reservoir. The types of emissions will be similar to those generated during the construction phase; however, their quantities will be significantly lower and can be considered negligible.

*Impact assessment and mitigation measures*

Assessment and mitigation of impacts on air quality during the reservoir construction and operation phases are summarised in **Table 8-12**.

**Table 8-12. Summary of air emissions impact and mitigation measures for the Project construction and operation phases**

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| CONSTRUCTION PHASE | | | |
| Workers, nearby population, soil and water resources, flora and fauna | Moderate | 1) Use modern construction machinery equipped with engines compliant with at least Euro IV standards, with emission control and minimal noise characteristics,<br>2) Perform regular technical maintenance of used construction machinery and heavy vehicles,<br>3) Cover friable materials with tarpaulin during the transportation,<br>4) Minimise dust from open area sources, including storage piles and top-soil storage areas, by using control measures such as installing enclosures and covers, and increasing the moisture content,<br>5) Restrict excavation and earthworks during the periods of strong winds, | Low |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| | | 6) Select the sites for construction facilities and construction machinery taking into consideration prevailing wind directions,<br>7) Apply regular watering to on-site and off-site dirt roads, especially during the excavation and other earthworks,<br>8) Minimise the period between excavation and backfilling works,<br>9) Prohibit construction materials and waste burning. | |
| *Monitoring:* According to the Air, water and soil quality monitoring plan | | | |
| OPERATION PHASE | | | |
| Nearby population, soil and water resources, flora and fauna | Low | ***Maintenance works***<br>1) Use modern construction machinery equipped with engines that comply with at least Euro IV standards, featuring emission control systems and low-noise characteristics,<br>2) Perform regular technical maintenance of all construction machinery,<br>3) If maintenance services are outsourced, contractors will be required to use modern, well-maintained equipment that complies with all applicable technical requirements.<br>***The following cost-efficient and technically feasible measures should be included in tender specifications, the Project design documentation and operation and maintenance plans:***<br>1) Installing aeration systems to oxygenate water and suppress anaerobic methane production,<br>2) Installing surface aerators or diffused air systems to increase dissolved oxygen,<br>3) Removing decaying vegetation, crop residues, or debris from the reservoir and inflows,<br>4) Keeping banks and inflow channels clear to reduce organic loading,<br>5) Establishing buffer zones with vegetation to absorb nutrients before they reach the reservoir. | Negligible |

### 8.2.5 Impacts on Landscape and Visual Amenity

*Construction phase*

The area designated for the construction of the Artik Reservoir is situated within a shallow depression (see **Figure 8-1**). As a result, the Project site is currently not visible from the H21 "H75-Horom-Alagyaz" road.

**Figure 8-1. Locations of the construction facilities**

During the construction phase, however, certain components of the construction site, such as material stockpiles, construction equipment, and vehicle movements, are expected to become visible to travelers and drivers along this route. The exact locations of the borrow pits have not yet been determined; therefore, their potential visibility from nearby sensitive receptors cannot be evaluated at this stage.

The nearest settlements are Artik town and Nor Kyanq village, both located at a significant distance from the Project area. Given this distance and the topographical setting, it is unlikely that residents of these communities will have direct views of the Project site, even during the construction phase.

Shepherds using the surrounding areas for livestock grazing, as well as occasional visitors to the area, are considered the primary receptors potentially affected by changes in the visual landscape.

Visual impacts during the construction phase will primarily result from the presence and operation of construction machinery, heavy vehicles and temporary storage areas for construction materials. These activities are expected to temporarily alter the visual character of the landscape and cause short-term visual disturbance. Although this impact is unavoidable, it will be temporary and limited to the construction period, and its magnitude is expected to remain low, provided that the mitigation measures outlined in **Table 8-13** are effectively implemented.

*Operation phase*

During the operation phase the landscape of the Project area will experience a permanent transformation due to the formation of the reservoir and the presence of supportive infrastructure. Main impacts include:

**1) Permanent change in land cover**

The original mountainous terrain, river flow and vegetation will be replaced by a standing water body, altering the natural character and visual identity of the area.

**2) New visual elements**

The reservoir, dam structure, and supportive facilities will become dominant and permanent features in the landscape.

**3) Potential aesthetic value**

The reservoir will enhance the visual appeal of the area, depending on how well it integrates with the surrounding environment.

**4) Landscape alteration**

Natural regeneration and vegetation growth around the reservoir perimeter may gradually soften visual contrasts and help the area blend with the surrounding environment.

Overall, the visual impact during the operation phase is long-term and permanent, but generally more stable and potentially less intrusive than during the construction phase. Effective landscaping and environmental integration can help mitigate negative visual effects.

Over time, the Project's visual impact may even become positive. The irrigation of currently uncultivated land plots using reservoir water is also expected to have an indirect positive effect on the visual amenity of the Project region, by promoting greener and more cultivated landscapes.

The implementation of the Project, through the provision of reliable irrigation water, is expected to enhance agricultural productivity and support the expansion of areas cultivated with potatoes, vegetables, and wheat. Consequently, the newly developed farmlands may display features of both designed and organically evolved cultural landscapes, reflecting a gradual transformation of traditional land-use patterns. Overall, the Project's impact on the cultural landscape is assessed as neutral to positive, considering the anticipated increase in cultivated green areas and the improvement of land productivity.

*Impact assessment and mitigation measures*

Assessment and mitigation of visual impacts during the reservoir construction and operation phases are summarised in **Table 8-13**.

**Table 8-13. Summary of visual impact and mitigation measures for the Project construction and operation phases**

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| CONSTRUCTION PHASE | | | |
| Shepards, occasional visitors | Moderate | ***Construction phase***<br>1) Limit the spatial footprint of construction areas and stockpiles to the extent practicable,<br>2) Store construction materials and fuel in designated, screened areas,<br>3) Avoid unnecessary night-time lighting and ensure that any required lighting is directed downward and shielded to reduce light spill,<br>4) Rehabilitate disturbed areas and remove temporary facilities and equipment promptly after completion of works. | Low |
| OPERATION PHASE | | | |
| Population, visitors | Moderate | *Over time, natural regeneration and vegetation growth along the reservoir's perimeter may reduce visual contrasts and facilitate the integration of the area into the surrounding landscape.*<br>*If well integrated with the natural landscape, the reservoir may contribute positively to the area's overall visual character.* | Can be positive (after 3-5 years) |
| Population, landowners, visitors, tourists | Neutral | ***Cultural Landscape***<br>Consult with the heads of affected settlements and landowners who will gain access to irrigation water as a result of Project implementation, to discuss and agree on design solutions for establishing potato and | Positive |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| | | vegetable cultivation based on modern agricultural and irrigation technologies.<br>*This may transform the organically evolved cultural landscape into a designed cultural landscape.* | |

### 8.2.6 Impact on Geology

*Construction phase*

The main impacts on the geological structure within the Project area are associated with the following construction activities:

1) Vegetation clearance and removal of topsoil,
2) Excavation and earthworks,
3) Soil erosion in the construction site, topsoil temporary and spoil disposal areas.

According to the national EIA study, the Project area was used as a reservoir until 1994 (see **Sub-section 2.7.1**). Consequently, the topsoil had previously been removed and no significant topsoil layer was reported to remain. However, site visits conducted by the Consultant indicated the presence of some vegetation cover within the planned reservoir area, suggesting that a limited topsoil layer may have re-formed over time. This is likely attributable to natural soil formation process driven by the interaction of physical, chemical, and biological factors, such as:

- Weathering of parent material,
- Deposition of sediments,
- Colonization by vegetation,
- Biological activity,
- Erosion and deposition balance.

Vegetation and topsoil will be removed from approximately 39.6 ha of land, including 30 ha within the reservoir and dam area, 4.2 ha within the feeding channel area, and 5.4 ha within the irrigation channel area (see **Sub-section 2.7.5**). Assuming a minimum topsoil thickness of 0.1 m, it is estimated that approximately 39,600 $m^3$ of topsoil will be stripped, collected and stored in designated temporary storage areas.

The specific locations for topsoil storage have not been defined in the current Project design documentation or in the national EIA study. Prior to the commencement of construction, the Construction Contractor will be required to coordinate with the Head of the Artik Community to identify suitable sites for temporary topsoil storage and to determine its potential reuse or reinstatement options (see also **Sub-section 8.2.8.1**).

The potential impact associated with vegetation clearance and topsoil removal is assessed as minor, provided that appropriate mitigation and management measures are implemented (refer to **Table 8-16**).

Excavation and earthworks will involve the movement of a certain amount of soil (including topsoil and excavated subsoil), which may potentially trigger landslides, mass movements, and other erosion processes. Improper practices in the storage and disposal of topsoil and spoil, particularly: (i) excessive height of stockpiles and steep slope gradients, (ii) location of storage sites near

watercourses and roads, and (iii) open storage without vegetation cover or protective sheeting, can negatively affect the geology of the Project site and surrounding areas. These aspects and the relevant mitigation measures are discussed in detail in **Section 8.2.8**.

Another potential impact of the Project on geological erosion is the temporary destabilization of disturbed soils due to precipitation and surface runoff. These effects on the soil, along with resulting changes in topography, may create conditions that lead to temporary but harmful erosion and sedimentation. The proposed mitigation measures are presented in **Table 8-14**.

*Operation phase*

During the operation phase, impacts on the geological conditions of the Project area may result from:

1) Water infiltration from the reservoir body and the dam base, potentially affecting groundwater,
2) Coastal erosion around the entire perimeter of the reservoir due to water encroachment during the initial years of operation.

Water infiltration aspects were assessed as part of the Project's engineering–geological study (see **Section 2.6**). This study included an analysis of the infiltration characteristics of the upper soil layer within the planned reservoir area. The total water infiltration from the reservoir body was estimated at approximately 2,272,504 $m^3$/year, indicating the necessity for appropriate anti-infiltration measures. These measures are detailed in the Project design documentation. Implementation of the proposed anti-infiltration measures is expected to reduce water infiltration losses from the reservoir to an acceptable level of approximately 7,197 $m^3$/year.

The management and mitigation of the second impact also require technical and technological solutions. Some of these are likely addressed in the Project design documentation; however, additional mitigation measures may be recommended by the Consultant to minimize embankment erosion during the early years of reservoir operation. These measures (**Table 8-14**) can be discussed with the Client and the EPC contractor and incorporated into the Project design documentation, if deemed relevant:

1. **Bioengineering / Vegetative Measures**
   - **Revegetation of embankment:** Planting native grasses, shrubs, and trees to stabilize soil through root systems and reduce erosion,
   - **Use of geotextiles:** Biodegradable or synthetic mats that support vegetation growth while preventing initial soil loss.
2. **Embankment Stabilization Measures**
   - **Riprap (rock armoring):** Placing layers of large, durable stones along vulnerable embankments to dissipate wave energy and prevent erosion,
   - **Revetments:** Sloped structures placed on banks to absorb and deflect the energy of incoming water.
3. **Reservoir Operation Management**
   - **Controlled filling rates:** Gradually filling the reservoir to allow embankment soils to stabilize and minimize sudden saturation that can lead to collapse,
   - **Water level fluctuation control:** Avoiding large, rapid fluctuations in water level during early years to reduce destabilization of new embankments.
4. **Erosion Monitoring and Adaptive Management**

- **Regular monitoring:** Using drones, surveys, or satellite imagery to detect early signs of erosion and assess the effectiveness of mitigation measures,
- **Adaptive management plans:** Revising and enhancing embankment protection measures based on ongoing monitoring results,
- **Erosion-sensitive zoning:** Identifying high-risk areas and applying stricter protection or engineering controls there.

*Impact assessment and mitigation measures*

Assessment and mitigation of impacts on geological conditions during the reservoir construction and operation phases are summarised in **Table 8-14**.

**Table 8-14. Summary of geological impacts and mitigation measures for the Project construction and operation phases**

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| CONSTRUCTION PHASE | | | |
| Soil resources | Moderate | ***Pre-construction phase***<br>1) In consultation with the Head of the Artik Community, identify suitable location(s) for the temporary storage of topsoil and determine options for its future use, preferably for the remediation of the borrow pit located in the Nor Kyanq settlement,<br>*See also mitigation measures proposed in **Table 8-16**.*<br>***Construction phase***<br>1) Diversion ditches or berms: redirect surface runoff away from disturbed areas,<br>2) Proper grading: ensures slopes are stable and directs water flow in controlled paths,<br>3) Slope breakers: break long slopes into smaller segments to reduce erosion potential,<br>4) Phased construction: limits the area of exposed soil at any one time,<br>5) Avoidance of earthworks during rainy seasons, where feasible, to reduce erosion risk. | Low |
| *Monitoring:*<br>- Regular site inspections, including topsoil storage areas and SDAs: Especially after rainfall, to check for erosion signs and repair damaged controls,<br>- Maintenance of sediment control measures: Ensure ditches, berms and drains are functioning properly. | | | |
| OPERATION PHASE | | | |
| Soil resources | Moderate | 1) Bioengineering / Vegetative Measures<br>- Planting native grasses, shrubs, and trees to stabilize soil through root systems and reduce erosion,<br>- Biodegradable or synthetic mats that support vegetation growth while preventing initial soil loss.<br>2) Embankment Stabilization Measures | Low<br>Negligible (after 3-5 years of operation) |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| | | - Placing layers of large, durable stones along vulnerable embankments to dissipate wave energy and prevent erosion,<br>- Sloped structures placed on banks to absorb and deflect the energy of incoming water.<br>3) Reservoir Operation Management<br>- Gradually filling the reservoir to allow embankment soils to stabilize and minimize sudden saturation that can lead to collapse,<br>- Avoiding large, rapid fluctuations in water level during early years to reduce destabilization of new shorelines.<br>4) Erosion Monitoring and Adaptive Management | |
| *Monitoring:*<br>- Using drones, surveys, or satellite imagery to detect early signs of erosion and assess the effectiveness of mitigation measures,<br>- Revising and enhancing embankment protection measures based on ongoing monitoring results,<br>- Identifying high-risk areas and applying stricter protection or engineering controls there. | | | |

### 8.2.7 Impact on Water Resources

The potential impacts of the Project on surface water resources during the construction and operation phases are described in **Subsection 8.2.7.1-8.2.7.3**.

#### *8.2.7.1 Water Quality / Water Contamination*

*Construction phase*

It is reported that a water flow of approximately 120-150 l/sec in the Artik River is affected by communal wastewater discharges from Artik town (see **Sub-section 6.1.5**). However, the water quality of the Artik River has not been systematically analysed, neither by the Hydrometeorology and Monitoring Center under the Ministry of Environment nor within the Project design documentation or the national EIA study. Therefore, the Consultant recommends conducting water quality monitoring of the Artik River upstream and downstream of Artik town to assess the contribution of communal wastewater discharges and their potential impact on the water entering the planned Artik Reservoir prior to the start of construction works.

During the construction phase, contamination of the Artik River is expected due to the deposition of dust and exhaust gas emissions (from construction machinery and heavy trucks), spills of hazardous materials, and improper management of storage areas. Surface water quality may also deteriorate as a result of soil erosion and runoff caused by rainfall or snowmelt.

Earth and excavation works and improper transportation or storage of topsoil, spoil, friable construction materials, and oil products, as well as loading/unloading operations, can lead to pollutants partially settling into nearby surface watercourses and/or potentially infiltrating into groundwater, thereby degrading overall water quality. Additionally, potential spills or leakages of oil and lubricants from construction machinery may be carried by runoff and discharged into downstream surface waters.

The removal of topsoil, excavation, and other earthworks will disturb the soil and vegetation cover within the Project area, potentially triggering or intensifying soil erosion. This erosion may cause soil to migrate into waterways via surface runoff, increasing turbidity and silting of water bodies, ultimately leading to further deterioration in surface water quality.

In can be concluded that the implementation of mitigation measures presented in **Sections 8.2.4**, **8.2.6** and **8.2.8**, supplemented by the measures proposed in **Table 8-15** will significantly minimise the impact of the construction works on water quality.

*Operation phase*

During the operation phase, the water quality of the Artikjur River upstream of the reservoir is not expected to change, as the reservoir operation will not cause contamination of upstream watercourses.

Within the reservoir, several natural processes contribute to the self-purification of water. These include sedimentation of suspended solids, adsorption and precipitation of nutrients and metals, microbial degradation of organic matter, and nutrient uptake by aquatic vegetation. Together, these ongoing processes help to maintain and improve water quality, supporting the long-term sustainability of irrigation activities. As a result, the quality of water downstream of the reservoir, including both environmental flow and irrigation water, is expected to improve due to the implementation of the Project.

However, one important precondition must be considered: soil erosion along the perimeter (shoreline) of the reservoir, particularly during the early years of operation, as well as stormwater and agricultural runoff entering the Artik River and reservoir, should be minimized (see **Section 8.2.6**).

#### *8.2.7.2 Changes to Hydrological Regime*

The following parameters are characterizing the hydrological regime of the reservoir:

**1) Flow Regulation**

Before the construction the river flows naturally with seasonal variations, high flows during snowmelt or rainy seasons, and low flows during dry periods. After construction the reservoir regulates flow, reducing peak discharges during floods and augmenting flow during dry periods. Therefore, the regulation of the water flow may benefit irrigation, but affect the natural water flow seasonal fluctuations downstream.

**2) Alteration of Flow Timing**

Reservoir operation often changes the timing of downstream flows, releasing water based on demand rather than natural cycles. This can shift peak flows from spring (due to snowmelt) to summer or autumn (due to irrigation needs), disrupting ecological processes.

**3) Reduction in Peak Flows and Flood Frequency**

Controlled releases from the reservoir reduce peak flood events downstream. This can lower the risk of flood damage but also impact floodplain ecosystems that depend on periodic flooding for nutrient cycling and habitat renewal.

**4) Evaporation Losses**

Large surface areas of reservoirs increase evaporation, especially in arid or semi-arid climates. This can lead to reduced downstream water availability compared to pre-reservoir conditions.

**5) Environmental Flow Modification**

Without proper planning, minimum environmental flows downstream may not be maintained. Therefore, environmental flow requirements must be included in the reservoir operation plan to support aquatic ecosystems and community needs.

In can be concluded that particularly the operation phase of the Project will significantly alter the hydrological regime of the Artik River. These changes include the regulation of natural flow variability, reduction of peak discharges, changes in flow timing, and sediment retention. While these changes support improved water availability for irrigation, they may also impact downstream ecosystems and groundwater dynamics. To mitigate adverse effects, the implementation of irrigation water and environmental flow releases management plan is recommended.

#### *8.2.7.3 Water losses*

*Construction phase*

No changes in water losses compared to the baseline situation are expected during the construction phase.

*Operation phase*

Water losses can occur from the reservoir body, the dam, the water irrigation outlet, and the main pipeline. Calculations of water infiltration from the reservoir body and the dam, along with proposed anti-infiltration, are presented in the Project design document and summarised in **Section 2.6** of this ESIA report. It can be assumed that the proposed mitigation measures will reduce water infiltration rate to the acceptable level (7,197 m³/year).

The feeding and irrigation channel will be constructed using steel pipes. Therefore, water losses from the irrigation outlet and main pipeline are unlikely to occur, except in cases of incidents or technological breakdowns, which would require regular technical maintenance of the reservoir's supporting infrastructure in accordance with the Reservoir Operation and Maintenance Plan (see also **Section 8.4**).

*Impact assessment and mitigation measures*

Assessment and mitigation of impacts on water resources during the reservoir construction and operation phases are summarised in **Table 8-15**.

**Table 8-15. Summary of impacts on water resources and mitigation measures for the Project construction and operation phases**

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| CONSTRUCTION PHASE | | | |
| Water resources | Moderate | ***Pre-construction phase - Water Contamination***<br>1) Conduct water quality monitoring of the Artik River upstream and downstream of Artik town during high and low water periods to assess the contribution of communal wastewater discharges and their potential impact on the water entering the planned Artik Reservoir prior to the start of construction works,<br>2) Use the water quality monitoring data to calculate and model the reservoir water quality and determine its compliance with the irrigation water standards | Low |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| | | established by RA Government Decree №75-N dated 27.01.2011,<br>3) Consider constructing an artificial wetland upstream of the reservoir to naturally treat and purify wastewater inflows, thereby improving the quality of water entering the reservoir (if water quality modelling indicates non-compliance with the irrigation water standards).<br>***Construction phase - Water Contamination***<br>1) Construct intermediate collection pools between runoff-generating surfaces and downstream watercourses to regulate flow to water bodies. These pools will allow soil particles to settle at the bottom, thereby reducing the turbidity of the runoff,<br>2) Limit excavation and other earthworks near the Artikjur River during the rainy season,<br>3) Prohibit the discharge of any untreated wastewater effluent into surface water bodies,<br>4) Where practical, construct local perimeter drains around working areas (e.g., storage and parking areas) to collect suspended runoff and prevent its discharge into surface water resources. | |
| *Monitoring:* According to the Air, water and soil quality monitoring plan | | | |
| OPERATION PHASE | | | |
| Water resources | Low | ***Operation phase - Water Contamination***<br>1) Minimize potential stormwater and agricultural runoff release to the Artik River,<br>2) Eliminate manmade inflows from domestic or industrial activities into the reservoir. | Positive |
| Water resources, irrigation water users, ecosystems downstream the reservoir | Significant | ***Pre-operation phase - Hydrological Regime***<br>Develop irrigation water and environmental flow releases management plan to:<br>- Ensure reliable and efficient delivery of irrigation water to agricultural areas,<br>- Maintain minimum environmental flows to support the health of downstream aquatic and riparian ecosystems,<br>- Prevent over-extraction and degradation of water resources,<br>- Comply with national water use regulations and environmental protection standards.<br>***Operation phase - Hydrological Regime***<br>1) Review the irrigation water and environmental flow releases management plan annually, or after major hydrological events, to incorporate new data, regulatory changes, and operational experience, | From moderate to low |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| | | 2) In the event of low reservoir levels or critical drought conditions, implement a prioritization protocol that protects environmental flows up to a predefined minimum threshold before allocating water for irrigation. | |
| *Monitoring:*<br>- Real-time monitoring to adjust schedules based on demand and supply conditions,<br>- Monthly reports on water releases for irrigation and environmental purposes must be submitted to the Water Committee,<br>- Regular ecological monitoring downstream to evaluate the adequacy of flow for habitat maintenance. | | | |
| Water resources, irrigation water users, | Low | ***Pre-operation phase - Water losses***<br>Develop Reservoir Operation and Maintenance Plan,<br>***Operation phase - Water losses***<br>Carry out technical maintenance of the reservoir's supporting infrastructure to eliminate incidents and breakdown in accordance with the Reservoir Maintenance Plan. | Negligible |

### 8.2.8 Impact on Soil

#### *8.2.8.1 Topsoil Management*

*Construction phase*

Construction activities will commence with vegetation clearance and topsoil removal. As outlined in **Sub-section 8.2.6** of this ESIA report, approximately 39,600 m³ of topsoil will be stripped, collected, and stored in designated temporary storage areas.

If not properly managed, the removed topsoil may be degraded through mixing with subsoil (spoil) or other construction materials. In addition, the physical and biological properties of the topsoil can deteriorate due to compaction by heavy machinery, both within and outside the construction site. Further losses may occur during transportation to storage areas, as well as through wind or water erosion while in stockpiles. The quality of stored topsoil may also decline if stockpiles are not adequately maintained and protected during the storage period.

According to the national legislation, topsoil management shall be regulated by the *Procedure for Topsoil Use*, approved by the RA Government Decree №1396-N, and the *Requirements for Determining Topsoil Stripping Norms and for the Preservation and Use of Stripped Topsoil*, approved by the RA Government Decree №1404-N. These documents define:

- Organizational aspects, including the procedure for permit issuance for soil removal, transportation and storage,
- Technical aspects, such as the prescribed norms (thickness) of topsoil to be stripped and removed,
- Technological and environmental aspects, including conditions and specifications for topsoil storage, preservation and use.

Topsoil removal, transportation, storage, and reuse operations shall be carried out by the Construction Contractor in accordance with the requirements of the above-referenced documents and the supplementary mitigation measures outlined in **Table 8-17**. Provisions related to the selection of temporary topsoil storage areas are presented in **Sub-section 8.2.5**. In addition, the Construction Contractor shall develop and implement a Topsoil Management Plan (TsMP) to ensure the proper handling, protection and reuse of topsoil throughout the construction phase.

*Operation phase*

No impacts on topsoil are expected during the Project operation phase.

#### *8.2.8.2 Soil Excavation and Disposal*

*Construction phase*

According to the RA Law on Waste, and in particular the *List of Wastes Generated in the Republic of Armenia*, approved by Order №342-N of the RA Minister of Environment, excavated material (subsoil or spoil) is classified as non-hazardous waste. Therefore, the main impacts related to soil excavation and disposal in the designated spoil disposal areas are discussed in **Section 8.2.9**.

*Operation phase*

No impacts associated with soil excavation and disposal are anticipated during the reservoir operation phase.

#### *8.2.8.3 Management of Hazardous Materials*

*Construction phase*

The list of hazardous materials that may potentially be used during the construction of the reservoir and its infrastructure, along with their associated hazards, is presented in **Table 8-16**.

**Table 8-16. Hazardous materials to be used during the reservoir construction, their uses and associated hazards**

| № | Materials | Use | Hazards |
|---|---|---|---|
| 1 | Fuels (diesel, petrol) | Powering construction machinery, generators, and heavy trucks. | Flammable, risk of spills leading to soil and water contamination. |
| 2 | Lubricants and oils | Machinery operation and maintenance (e.g., excavators, loaders, vehicles). | Toxic to aquatic life, potential for soil contamination. |
| 3 | Concrete and additives | Enhancing performance of concrete (e.g., accelerators, retarders). | May contain hazardous chemicals (e.g., formates, chlorides), skin and eye irritants. |
| 4 | Paints and coatings | Corrosion protection of metal structures, tanks, and pipelines. | May contain solvents and heavy metals; volatile organic compounds (VOCs). |

Leakages and accidental spills of hazardous materials, along with their management measures, are discussed in **Sub-section 8.2.8.4**. The impacts of hazardous materials on health and safety, as well as fire risks, are outlined in **Section 8.3.6**. Before the commencement of construction works, the

construction contractor shall develop a Hazardous Materials Management Plan (HMMP). Additional mitigation measures are presented in **Table 8-17**.

*Operation phase*

Only a few types of hazardous materials, and in small quantities, will be used during the maintenance of the reservoir and its infrastructure. Their potential impacts are negligible; therefore, they do not require mitigation measures.

#### *8.2.8.4 Soil Contamination*

*Construction phase*

The quality of soil within the area allocated for the reservoir construction and its vicinity is currently unknown. Therefore, prior to the commencement of construction works, soil samples shall be collected from the surface (0-20 cm) and underlying layers (20-50 cm), analysed by a licensed laboratory, and the results compared with the Admissible Concentration Limits (ACLs) for chemical elements in soil as established by Sanitary Rules and Norms №2.1.7.003-10, *'Hygienic Requirements for Soil Quality'*.

Accidental spills of friable materials, leakages of oil, fuel, and other liquid chemicals during the field works within the construction site as well as their transportation, storage, and use, may inevitably occur and lead to soil contamination. Improper waste management can also result in littering and further soil pollution (see **Section 8.2.9**). Therefore, the handling of hazardous materials, including their transportation, storage, and use, must be carefully managed.

The use of old or technically outdated construction machinery and heavy trucks for the Project shall be strictly prohibited. Friable materials shall be transported using trucks fitted with waterproof canvas covers. Oil products and chemicals must be stored separately in clearly marked drums or tanks, placed on secondary containment systems or spill trays. During refuelling or the transfer of oil, fuel, or other chemicals, protective berms shall be used (**Figure 8-2**). Excavated spoil and topsoil shall be stored and managed in accordance with the procedures outlined in **Subsections 8.2.8.1 - 8.2.8.2**.

Facilities designated for the storage of oil and chemicals, as well as heavy trucks used to transport such materials, shall be equipped with appropriate spill kits (**Figure 8-2**). Construction and other friable materials shall be stored in separately allocated, fenced areas covered with waterproof sheeting. In addition, it is recommended to regularly monitor soil quality near potentially contaminated areas, in accordance with the Air, Water, and Soil Quality Monitoring Plan. All of the specified measures, along with others, shall be consolidated into the Spill Prevention and Management Plan (SPMP).

**Figure 8-2. Recommended tools and kits for prevention or mitigation of spillages and leakages**

*a) Secondary containments or trays for storage and refilling of oil products and chemicals*


*b) Spill kits for oil products and chemicals*

Provided that the measures recommended in **Table 8-17** are implemented, the Project's impact on soil contamination during the construction phase can be assessed as low.

*Operation phase*

Some small-scale accidental spills of oil products and friable materials can be expected during routine maintenance of the reservoir body, dam, and supporting infrastructure, as well as during regular cleaning of the irrigation channel. These leaks (spills) can be prevented or minimised through the implementation of some administrative and organizational measures, such as outsourcing of the maintenance works to the contractors equipped with modern and technically serviced equipment.

*Impact assessment and mitigation measures*

Assessment and mitigation of impacts on soil during the reservoir construction and operation phases are summarised in **Table 8-17**.

**Table 8-17. Summary of soil impacts and mitigation measures for the Project construction and operation phases**

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| CONSTRUCTION PHASE | | | |
| Soil and water resources, flora and fauna | Moderate | ***Pre-construction phase***<br>1) Develop Topsoil Management Plan (TsMP) and obtain approval from the Supervision engineer and the Client,<br>2) Obtain required permit for topsoil transportation and storage operations,<br>3) Take soil samples from the surface (0-20 cm) and deeper layers (20-50 cm) in the planned reservoir area and nearby areas. Analyse the samples in a licensed laboratory and compare the results with the Admissible Concentration Limits (ACLs) set by Sanitary Rules and Norms №2.1.7.003-10,<br>4) Develop Hazardous Materials Management Plan (HMMP) and obtain approval from the Supervision engineer and the Client,<br>5) Develop Spill Prevention and Management Plan (SPMP) and obtain approval from the Supervision engineer and the Client.<br>***Construction phase - Topsoil management*** | Low |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| | | 1) Carry out the removal, transportation, storage, and use of topsoil in accordance with RA Government Decrees №1396-N and №1404-N,<br>2) Store topsoil separately to prevent mixing with subsoil, maintaining it in a condition that preserves the natural seed bank, until construction works are completed,<br>3) Locate topsoil stockpiles at least 50 m away from watercourses to prevent water siltation,<br>4) Avoid placing topsoil stockpiles near planned excavation areas,<br>5) Limit the height of stockpiles to a maximum of 3 m, and ensure the slope gradient does not exceed 25º,<br>6) Clearly label all topsoil stockpiles to ensure easy identification,<br>7) Cover topsoil stockpiles to prevent soil erosion, where natural revegetation has not occurred,<br>8) Fence off topsoil stockpiles to prevent unauthorized access and compaction by Project vehicles,<br>9) Reuse the stored topsoil for landscaping the disturbed areas and/or tree planting within the Project area after the completion of reservoir and dam construction.<br>***Construction phase - Hazardous materials***<br>1) Store all hazardous materials in clearly labelled, secure, and ventilated areas,<br>2) Hazardous materials containers to be clearly labelled according to contents and hazards,<br>3) Equip sites with spill response kits and train workers on emergency response,<br>4) Maintain Material Safety Data Sheets (MSDS) for all hazardous materials on-site,<br>5) Incompatible hazardous materials must not be stored together,<br>6) Hazardous materials storage areas will be equipped with eye wash kits and fire extinguishers,<br>7) Use appropriate PPE.<br>***Construction phase - Soil contamination***<br>1) Transport friable materials using trucks equipped with waterproof canvas covers,<br>2) Store construction and other friable materials in separately designated areas that are fenced and covered with waterproof tents,<br>3) Store oil products and chemicals separately, in special drums or tanks placed on secondary containment systems or trays (110% of the volume of the container), | |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| | | 4) Carry out refuelling of oil, fuel, and other chemicals only in dedicated areas with impervious surface equipped with protective berms,<br>5) Equip storage facilities for oil and chemicals, as well as heavy trucks transporting these materials, with appropriate spill kits,<br>6) Immediately stop work in the event of uncontrolled spillage of fuel, engine oil, or chemicals. Contain the spill and remediate contaminated soil by removing the affected layer (to be treated as hazardous waste) and replacing it with clean soil,<br>7) Train all staff on the safe execution of construction works and on response procedures for environmental incidents such as spills and leaks,<br>8) Ensure spoil piles do not exceed 3 m in height, and maintain slope gradients not exceeding 25º. Manage spoil piles to prevent erosion and runoff. | |
| *Monitoring:* According to the Air, water and soil quality monitoring plan | | | |
| OPERATION PHASE | | | |
| Soil and water resources, flora and fauna | Low | Outsource the maintenance of the operated reservoirs to the contractors equipped with modern and technically serviced equipment. | Negligible |

### 8.2.9 Waste Generation and Management

*Construction phase*

Typically, the construction of the reservoir, dam and supporting components is accompanied by the generation of industrial and household wastes, including:

- Excavated material (spoil) from excavation and other earthworks,
- Construction waste (residues of concrete, sand, gravel, used wood materials, etc.),
- Used oil and lubricants,
- Oily rags and soil contaminated with oil products,
- Used tires,
- Used lead-acid batteries,
- Ferrous and non-ferrous metal scraps, welding electrode slag,
- Empty containers of fuel, oil products and chemicals,
- Used packaging materials (cardboard and paper),
- Household waste.

A portion of the materials excavated from the reservoir basin will consist of cobble-pebble aggregates, which are planned to be reused for the construction of the reservoir dam. However, the volume of spoil expected to be generated during excavation and associated earthworks has not been specified in the Project design documentation or the national EIA study.

As outlined in **Sub-section 2.7.6**, the number and locations of Spoil Disposal Areas (SDAs) have not been determined within the Project design. Therefore, the identification of suitable SDA sites will

be the responsibility of the Construction contractor, in consultation with the heads of affected communities and, where relevant, the respective private landowners.

A Spoil Disposal Management Plan (SDMP) shall be developed for the selected sites and approved prior to the commencement of construction activities, ensuring that spoil generation, handling, transportation and disposal are managed in accordance with good international practice and relevant regulatory requirements.

There are no information relating to the volumes of household waste to be generated during the construction provided in the design document. According to the World Bank Project - *Armenia SWM Sector Assessment and Reform Plan, Sector Assessment Report* (2024), the current household waste generation rate is 219 kg/capita/year (or 18.25 kg/capita/month) for Armenian settlements with populations under 40,000 residents. Taking into account that 100 workers (see **Section 2.7.6**) will be engaged in construction activities, it can be assumed that the monthly amount of household waste will be 18.25 × 100 = 1,825 kg (or approximately 1.83 tonnes). Over the entire reservoir construction period (33 months × 1.9 tonnes), around 60.39 tonnes of household waste will be generated. The volumes of other types of waste remain unknown.

The types, hazard classes and codes of industrial and household waste to be generated during the construction phase as well as recommended waste management actions as per waste hierarchy, are presented in **Table 8-18**.

**Table 8-18. Types, hazard classes and codes of wastes generated during the construction works**

| № | Types of waste | Hazard Class | Hazard Code[119] | Recommended management actions |
|---|---|---|---|---|
| 1 | Excavated material (spoil) | V (non-hazardous) | 31401101 01 00 5 | Use as a backfill material, the residual part will be disposed of in the SDA |
| 2 | Construction waste | IV | 91200601 01 00 4 | Use as a backfill material, the residual part will be disposed of in the landfill |
| 3 | Used oil and lubricants:<br>- Industrial oil<br>- Engine oil<br>- Hydraulic oil<br>- Diesel oil | III | 54100205 02 03 3<br>54100201 02 03 3<br>54100213 02 03 3<br>54100203 02 03 3 | Store under special conditions and transfer to the licensed companies specialised in oil refining |
| 4 | Oily rags | III | 58200600 01 01 4 | Store under special conditions and transfer to the licensed companies for the treatment |
| 5 | Soil contaminated with oil products | III | 31402303 01 03 4 | |
| 6 | Used tires | IV | 57500200 13 00 4 | Periodically transfer to the licensed companies for the treatment |
| 7 | Used lead-acid batteries | II | 92110100 13 01 2 | Store under special conditions and transfer to licensed companies for the recycling |
| 8 | Ferrous metal scrap, empty metallic containers | IV | 35131100 01 00 4 | |

[119]According to the list of waste generated in the Republic of Armenia (https://www.arlis.am/hy/acts/100155)

| № | Types of waste | Hazard Class | Hazard Code[119] | Recommended management actions |
|---|---|---|---|---|
| | of fuel, oil products and chemicals | | | Can be periodically transferred to specialised companies for the recycling |
| 9 | Welding electrode slag | IV | 31404800 01 99 4 | |
| 10 | Non-ferrous metal scrap:<br>- Copper scrap<br>- Aluminium scrap | III<br>V<br>(non-hazardous) | 35310301 01 01 3<br>35310105 01 99 5 | Can be transferred to specialised companies for the recycling |
| 11 | Used packaging materials:<br>- Cardboard<br>- Paper | V<br>(non-hazardous) | 18710202 01 00 5<br>18710300 01 00 5 | Can be transferred to specialised companies for the recycling |
| 12 | Household waste | IV | 91200400 01 00 4 | Shall be disposed of in the landfill |

Proper management of the waste streams to be generated during the construction phase will be ensured through a detailed Waste Management Plan (WMP), to be prepared by the appointed Construction contractor prior to the start of construction works. The WMP as a minimum shall include:

- Waste storage locations, containers and conditions,
- Environmental, fire, health and safety of the waste storage facilities,
- Actions to be implemented to ensure the provisions of waste management hierarchy (prevention, minimization, reuse, recycling, energy recovery and disposal, see also Table **8-18**),
- Safe transportation of waste,
- Response to the accidents (leakages of liquid waste, spills of friable materials, etc.) (see also **Section 8.2.8**),
- Requirements and responsibility of the engaged personnel,
- Waste inventory and records, etc.

All required permits and normative documents regulating waste management in Armenia shall be obtained by the construction contractor prior to the commencement of construction. These documents shall include, at a minimum: (i) hazardous waste passports, (ii) waste generation norms, and their disposal limits, (iii) waste generation register, etc., (iv) waste primary registration log-books, etc.

*Operation phase*

During the Artik Reservoir operation phase, the main types of waste generated will be associated with the maintenance of the reservoir, dam, and supporting infrastructure (e.g., irrigation channels, spillways, etc.), including:

- Debris and general litter,
- Metal scraps from repair works,
- Used oil and lubricants,
- Sludge (sediment) resulting from dredging operations,
- Household waste (including small quantities of oily rags, which can be collected together with household waste due to their minimal volume).

Currently, it is unclear whether the volume of sediment accumulated in the reservoir will periodically require removal from the reservoir bottom through dredging operations. However, if required, disposal at a landfill or the use of dredged sediment as fertilizer shall be considered.

Although only small volumes of waste are expected to be generated from maintenance operations, they should be properly managed by the operator of the Artik Reservoir, most likely "Jrar" CJSC under the MTAI. Taking into account that "Jrar" CJSC also manages other first and second category reservoirs[120] in Armenia, the company should have a corporate Waste Management Plan (WMP) in place for the maintenance of all reservoirs under its control.

All waste-related permits required for the construction phase are also applicable to the operation phase and must, therefore, be obtained by "Jrar" CJSC. These provisions will also be included in the Project's Environmental and Social Action Plan (ESAP).

*Impact assessment and mitigation measures*

Assessment and mitigation of the reservoir construction and operation related waste impacts are summarised in **Table 8-19**.

**Table 8-19. Summary of waste-related impact assessment and mitigation measures for the construction and operation phases**

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| CONSTRUCTION PHASE | | | |
| Workers, nearby population, soil and water resources, flora and fauna | Moderate | ***Pre-construction phase - Waste management***<br>1) Obtain all required permits and normative documents regulating waste management in Armenia, as a minimum including:<br>- hazardous waste passports,<br>- waste generation norms, and their disposal limits,<br>- waste generation register, etc.,<br>- waste primary registration log-books.<br>2) Prepare and put into effect the Waste Management Plan (WMP) for the Project,<br>3) Identify potential Spoil Disposal Areas and obtain agreement from Artik Municipality for the use of the SDAs, or propose an alternative SDA,<br>4) Develop Spoil Disposal Management Plan (SDMP) for the selected SDA and obtain approval from the Supervision engineer and the Client.<br>***Construction phase - General***<br>1) Train the workers engaged in waste management on provisions of the WMP,<br>2) Apply waste hierarchy approach (prevention, minimization, reuse, recycling, energy recovery, disposal) while implementing the construction activities, | Low |

[120] *Armenia Water Reservoirs - Technical, Economic and Green Due Diligence Gap Analysis, Draft Final Report*, 2023-2024, Ove Arup & Partners

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| | | 3) Elaborate and implement waste handling procedures for the construction operations,<br>4) Equip the construction site and construction camps with the waste separate collection / storage containers and locations,<br>5) Furnish the waste storage / collection facilities with fences, fire extinguishers, secondary containment trays, oil and chemicals spill clean-up kits, etc.,<br>6) Store liquid waste leak-proof, sealed containers.<br>7) Sign contracts with the licensed waste handling (recycling, treatment, disposal) companies to hand them over the generated wastes.<br>***Construction phase - Waste transportation***<br>1) Transport all types of wastes using adequate, sealed and covered trucks to avoid the leakage or dispersal of the waste on roads and surroundings,<br>2) Ban fly-tipping of waste and/or their disposal in unauthorized locations,<br>3) Identify and select lower risk routes for the transportation of waste from the area of its generation to its storage and recycling / disposal area,<br>4) Instruct the waste truck drivers on waste transportation safety rules.<br>***Construction phase - Household waste management***<br>1) Equip the construction site with properly labelled household collection containers / bins,<br>2) Sign a contract with the communal company for the regular removal of household waste from the construction site and construction camps. | |
| Workers of the construction contractor | Moderate | In addition to the measures listed above: enforce the use of PPE and in particular, the protective clothes, shoes, gloves, respirator / masks for the workers dealing with the waste. | Low |
| *Monitoring:* According to the Waste Management Plan and Spoil Disposal Management Plan | | | |
| OPERATION PHASE | | | |
| Workers of the reservoir operator | Low | 1) Obtain all required permits and normative documents relevant to the operation of reservoirs in Armenia, as required by local waste-related legislation (can be done at the corporate level),<br>2) Develop and implement WMP for the operation and maintenance of the reservoir (can be done at the corporate level),<br>3) Apply waste hierarchy approach (prevention, minimization, reuse, recycling, energy recovery, disposal) for the generated waste,<br>4) Equip the site with properly labelled waste collection and storage containers and areas, | Negligible |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| | | 5) Sign contracts with the licensed waste handling (recycling, treatment, disposal) companies to hand them over the generated wastes,<br>6) Sign a contract with the communal company for the regular removal of household waste from the reservoir site. | |
| *Monitoring:* According to the operation phase Waste Management Plan | | | |

### 8.2.10 Noise and Vibration Impact

*Construction phase*

The main sources of noise and vibration during the construction stage are:

1) Operation of construction machinery within the construction site,
2) Movement of heavy trucks along community and regional roads, as well as within the construction site,
3) Operation of the construction camps and borrow pits,
4) Noise-generating activities such as loading and unloading of soil and construction materials.

The dominant source of noise from most construction equipment is the diesel engine, which may operate without adequate muffling. In some cases, however, construction processes themselves can generate noise levels exceeding those produced by the equipment. Noise intensity during construction will vary depending on the type of activity, operating schedule, and combination of machinery in use.

There are no residential areas located in the immediate vicinity of the planned reservoir site. The nearest residential house is located approximately 700 m away, in Nor Kyanq village (see **Figure 2-3**). However, the irrigation pipeline will pass in proximity to Meghrashen village, where some temporary noise and vibration impacts on local residents may occur.

Minor noise impacts on residents of Nor Kyanq may also occur due to heavy vehicle traffic transporting construction materials along the H21 "H75-Horom-Alagyaz" road. Construction workers are expected to be exposed to occupational noise and vibration during routine activities. Additionally, construction noise may cause temporary disturbance to local wildlife and shepherds grazing livestock near the Project site.

Typical noise levels generated by construction equipment are expected to exceed the national hygienic standard of 80 dBA. Therefore, appropriate mitigation measures should be implemented, including the provision of Personal Protective Equipment (PPE) for workers (see **Table 8-20**). These measures, together with other noise management practices, will help reduce exposure for workers, local shepherds, and residents of nearby settlements.

According to BS 5228-2:2009+A1:2014 (“Vibration Limits”) and the Consultant’s professional experience, construction-related vibration impacts are typically localized and limited to within 100 m of the vibration source. Given that the nearest residential buildings in Nor Kyanq village are located approximately 700 m from the planned reservoir site, no significant vibration impacts are expected in this area.

In the case of Meghrashen village, where the irrigation channel will pass approximately 45 m from the nearest residential houses, vibration impacts are expected to be short-term and low, as no high-vibration equipment (e.g., vibratory rollers) will be used. Construction vibrations are not expected to affect the structural or seismic stability of existing buildings and infrastructure. Only equipment and machinery operators may experience limited exposure to vibration; therefore, they should be provided with appropriate PPE and work rotation arrangements as necessary.

*Operation phase*

No significant noise or vibration exposure is expected from the operation of the reservoir. Only periodic maintenance activities may generate noise, which is anticipated to be negligible.

*Impact assessment and mitigation measures*

The assessment and mitigation of noise and vibration impacts during the construction and operation phases of the reservoir are summarised in **Table 8-20**.

**Table 8-20. Summary of noise and vibration impacts and mitigation measures for the Project construction and operation phases**

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| CONSTRUCTION PHASE | | | |
| Workers, population of Nor Kyanq and Meghrashen villages, shepherds | Moderate *(in case of heavy trucks movement)*<br>Low *(in case of operation of construction machinery)* | 1) Regularly maintain all diesel-powered vehicles and equipment (such as generators and air compressors). This will particularly include the regular inspection and, if necessary, replacement of intake and exhaust silencers,<br>2) Shut down machinery/vehicles that are used intermittently or throttle it back will be during periods when not in use,<br>3) Whenever possible: enclose noisy equipment, restrict non-stop operation of noisy equipment, avoid simultaneous operation of noise generating equipment,<br>4) Avoid unnecessary idling times,<br>5) Minimise the need for equipment to reverse. This will reduce the frequency at which disturbing but necessary reverse warnings will occur,<br>6) Avoid unnecessary horn hooting from the used construction machinery,<br>7) Limit truck speeds - not to exceed 40 km/h, when driving through local community roads,<br>8) Inform the population of Nor Kyanq and Meghrashen rural settlements of the schedule and duration of construction activities, particularly where these are likely to generate high noise levels and before the blasting works,<br>9) Movement of heavy trucks along the communal roads will be strictly prohibited between 10 PM and 6 AM near residential areas. | Low |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| Workers of construction company | Moderate | In addition to the measures listed above:<br>1) Enforce the use of PPE and in particular, the protective devices capable to reduce the sound level at the ear to acceptable levels,<br>2) Provide employees engaged in 'noisy' operations with additional 15 minutes break per 2 hours. | Low |
| *Monitoring:* According to the noise and vibration monitoring plan | | | |

### 8.2.11 Traffic Impacts

*Construction phase*

Access to the planned reservoir site will be provided via earthen access roads connected to the H21 "H75-Horom-Alagyaz" road, without traversing nearby settlements. Consequently, no significant traffic-related impacts are anticipated within the settlements of the Artik enlarged community. However, Project-related traffic will contribute to increased traffic density along the H21 road and the M1 highway, both of which are already subject to heavy use by freight vehicles and construction trucks serving the ongoing North-South Road Corridor Project.

To manage potential traffic-related impacts and ensure road safety, the Construction Contractor shall develop a Traffic Management Plan (TMP). The TMP will be subject to approval by the Supervision Engineer, the Client, and the relevant regional authorities, including the Road Police.

The TMP shall also incorporate the provisions and mitigation measures outlined in **Sections 8.3.2**, **8.3.5** and **8.5.2** of this ESIA report, ensuring alignment with good international practice and relevant EBRD requirements.

*Operation phase*

No significant traffic impacts are expected during the reservoir operation phase.

*Impact assessment and mitigation measures*

The assessment and mitigation of traffic impacts during the construction and operation phases of the reservoir are summarised in **Table 8-21**.

**Table 8-21. Summary of traffic impacts and mitigation measures for the Project construction and operation phases**

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| CONSTRUCTION PHASE | | | |
| Population of project affected settlements | Significant | ***Pre-construction phase***<br>1) Develop a Traffic Management Plan, that will be approved by the Supervision engineer and agreed with the Client and EBRD as well as relevant regional authorities and road police.<br>2) Prior to the commencement of construction works, the condition of community roads to be used for project purposes shall be jointly inspected and documented with the participation of representatives from the | Low |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| | | affected community. In the event that significant damage is caused by the Project, the Construction Contractor shall restore the roads to at least their pre-construction condition.<br>*The TMP shall also cover measures outlined in Sections 8.3.2, 8.3.5 and 8.5.2.*<br>***Construction phase***<br>3) Construct the access roads as envisioned in the Project design document,<br>4) Implement the Traffic Management Plan,<br>5) Train drivers of heavy vehicles on the key requirements of the Traffic Management Plan,<br>6) Inform local residents of anticipated construction traffic impacts at least two weeks prior to the start of construction,<br>7) Equip roads used by Project vehicles with appropriate road safety signs and posters,<br>8) Provide additional crossings for cattle where necessary. | |

### 8.2.12 Impact on Biodiversity

This sub-section presents an assessment of the potential impacts on biodiversity resulting from the Project-related construction and operations activities.

Impacts of the Project will occur within the footprint areas (dam, reservoir), temporary roads and sites (access roads, camp, the spoil disposal area, borrow pits), and within a potential zone of influence of 500 m around the footprint areas.

The baseline biodiversity studies focused primarily on the footprint areas of the proposed dam and reservoir. For the purposes of this assessment, the scope has been expanded to include biodiversity within these areas and a 500-meter buffer zone surrounding them.

The impacts are considered and assessed taking into account EBRD's PR 6 (2019), and Guidance Notes to the EBRD PR 6 (2023), as well as applicable national legislation of the RA.

#### *8.2.12.1 Impacts of the Project*

As presented in the Baseline section, the Project will be implemented in an area of high biodiversity where valued (priority) habitats and species were identified.

The impacts of the Project on biodiversity will occur during both construction and operation phases. The construction phase includes construction of the dam and reservoir filling. The methodology of impact assessment, including identification of impact characteristics and matrix significance are detailed in **Section 5** "ESIA Methodology and Approach". Due to the species' varying responses to different impacts, the sensitivity of each species (receptors) was taken into account during the assessment.

Potential impacts on biodiversity (including priority biodiversity features and critical habitats) derive from activities during:

1. Construction phase, and include:
   - Destruction (loss) of habitats (excavation, top-soil removal and transportation, reservoir filling),
   - Flora species loss (excavation, top-soil removal and its transportation, reservoir filling),
   - Disturbance of fauna species by noise, vibration and light pollution (construction machinery, traffic, lighting of the building area),
   - Destruction of sedentary animals' habitats and a risk of their death (excavation, top-soil removal and its transportation, reservoir filling),
   - Loss of foraging habitats for medium mammals (excavation, top-soil removal and its transportation, reservoir filling),
   - Loss of breeding and foraging habitats for birds (excavation, top-soil removal and its transportation, reservoir filling),
   - Loss of habitats of invertebrates and a risk of partial death of their populations (excavation, removal of topsoil and its transportation, reservoir filling),
   - Destruction of the habitats of the aquatic species and risk of the species death
   - Impact on protected areas and internationally designated areas.
2. Operational phase, and include:
   - Emergence of new habitats (water, riparian areas),
   - Increased access to the area.

The negative impacts occur mainly during the construction phase; they are caused by the dam building and flooding of the reservoir footprint area.

Some positive impacts on biodiversity will occur during the operational phase, associated with the emergence of the new habitats, such as large water surface and coastal vegetation, which will attract various animal species.

The assessment was conducted for each predicted impact during the construction and operation phases and for each group of biodiversity receptors, which were grouped based on their ecological characteristics. Where possible, impacts on individual species were also assessed.

#### *8.2.12.2 Construction phase*

***Impact on habitats***

*Destruction (loss) of habitats*

Currently, the habitats are considerably disturbed (mainly impacted by grazing). Land clearance, excavation, and topsoil/soil removal will completely destruct the habitats within the dam and reservoir footprint (with a total area of 66.4 ha). Initially, habitats will be destructed during clearance of the dam footprint area, followed by topsoil/soil removal, and dam construction. Subsequently, habitats located in the flooded part will be lost during the reservoir filling.

Priority habitats of this area are the following: (names of habitats in accordance with Resolution 4 of the Bern Convention name and Annex 1 of the EU Habitats Directive, estimated lost area is indicated in brackets):

- C1.4 Permanent dystrophic lakes, ponds and pools = 3160 Natural dystrophic lakes and ponds (1.42 ha),

- E1.2 Perennial calcareous grasslands and basic steppes = 62C0* Ponto-Sarmatic steppes (28.54 ha).

The total lost area of the habitats is 29.96 ha.

The 62C0* habitat will be destructed by the reservoir filling. Regarding the water habitat 3160 (the existing pond), it should be studied to decide whether the new reservoir may be considered as similar habitat. One of the key features is that the pond is the habitat of the priority species Syrian spadefoot, *Pelobates syriacus* (see below).

***Impacts on terrestrial species***

*Flora species loss*

Land clearance, excavation, topsoil/soil removal will result in vegetation clearance in the same areas where habitats will be destructed (see above). But there are no trees at the site (see Baseline section). Thus, only herbaceous vegetation will be destroyed.

There are no protected plant species (nationally or internationally) registered in the Project area.

*Disturbance of fauna species*

Terrestrial animals can be divided in two groups in relation to their reaction to disturbance - those that run away, and those that hide where they live. Below, the identified mammals, birds, reptiles, and amphibians are analysed in terms of their reaction to disturbance.

According to the baseline study, the identified terrestrial mammals were classified into two groups based on lifestyle. The first group includes permanent residents of the area, such as small- and medium-sized species, mainly rodents, insectivores, and small predators. The second group includes temporary visitors that transit through the area and use it temporary for foraging, such as predators.

Small permanent residents (rodents, insectivores) usually hide (in burrows, for example) in response to disturbances, they do not run away from their homes. This behaviour in the context of the Project is dangerous because it results in death of the animals due to the destruction of their homes; potential impacts on this group of animals are considered in the sub-section below.

The second group of temporary visitors usually move away or avoid disturbance areas.

Identified birds are classified in three groups: i) breeding in the Project area, ii) breeding in proximity to the site and using the area as part of their foraging range, and iii) passing the area during the seasonal migration. They all will also move away or avoid disturbance zones.

Identified reptiles and amphibians are permanent residents; they would choose the same hiding strategy as the small sedentary mammals (see above), so they will be in danger of dying. Potential impacts on this group of animals are considered below.

Noise and soil vibration at the start of construction works will be the initial impacts in the Project area. Impact distance (for noise) can vary from about 100 m to 500 m and more, depending on species sensitivity[121, 122]. As the site area is flat, the noise will be heard far away. As a result, the dam and

[121]Senzaki, M., Yamaura, Y., Francis, C. et al. Traffic noise reduces foraging efficiency in wild owls. Sci Rep 6, 30602 (2016). https://doi.org/10.1038/srep30602
[122]Shilling, F.; Collins, A.; Louderback-Valenzuela, A.; Farman, P.; Guarnieri, M.; Longcore, T., et al. (2018). Wildlife-Crossing Mitigation Effectiveness with Traffic Noise and Light. UC Davis: National Center for Sustainable Transportation. Retrieved from https://escholarship.org/uc/item/8893d8zw

reservoir footprint area, as well as adjoined territories (about 500 m around) will be abandoned by most animals.

The next phase of the construction process will be the dam filling, during which impact factors such as vibration, noise, dust, and lighting will occur. These factors will scare away the animals who are still present around the dam area.

*Loss of sedentary animals' habitats and associated risk of mortality*

There are two groups of permanent residents which were identified - small mammals (rodents, insectivores), and reptiles and amphibians. Both groups of animals use certain type of shelters (e.g., holes, rocks, hollows, etc.) and hide there in case of danger or disturbance. Such impact as noise will make them hide. Intensive vibration can drive animals out of their shelters, but they will not run far away trying to find temporary shelter and come back when the impact disappears.

Thus, these two groups are mostly likely to be affected during the construction works at the dam footprint area.

A similar negative impact may occur during the filling of the reservoir, as shelters could be flooded, resulting in death of most animals.

The following eight biodiversity values were identified among sedentary species:

**Mammals**

- Schidlovsky's vole *Microtus schidlovskii*, PBF,
- Asia Minor ground squirrel *Spermophilus xanthoprymnus,* PBF.

**Reptilia**

- Sand lizard*, Lacerta agilis*, CH,
- Snake-eyed Lizard, *Ophisops elegans*, CH,
- Valentine's lizard, *Darevskia unisexualis*, PBF.

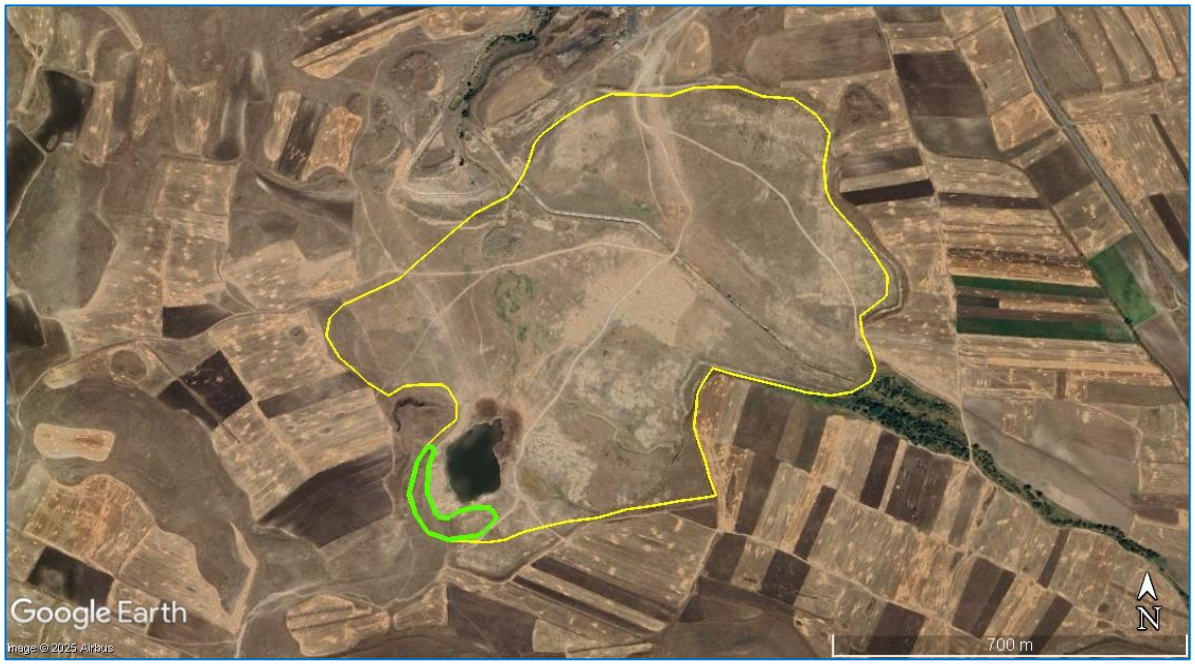
**Amphibia**

- Variable toad/ green toad *Bufo viridis*, CH (the flooded area will increase the periphery of the shoreline and thus, will increase the species habitat),
- Syrian spadefoot, *Pelobates syriacus,* PBF.

The flooding will decrease the habitats of the Asia Minor ground squirrel (*Spermophilus xanthoprymnus)* and Schidlovsky's vole (*Microtus schidlovskii*).

Overall, the number of Asia Minor ground squirrels is estimated to be 20-30 individuals, occupying about 1.1 ha (**Figure 8-3**).

**Figure 8-3. The area occupying by the Asia Minor ground squirrel, *Spermophilus xanthoprymnus*, in boundaries of the footprint area of the Artik site**




The number of Schidlovsky's vole can be estimated to be 670-710 individuals, concentrated in five clusters, with a total area of 6.49 ha; their spatial location is shown in **Figure 8-4**.

To compensate the loss of the habitats by Asia Minor ground squirrel and Schidlovsky's vole it is recommended to undertake the measures that can increase their density in the surrounding areas. Particularly, it is recommended to review the grazing practices in the surrounding areas, converting them into more sustainable ones. This will lead to the process of restoration of the degraded grassland habitats, thus increasing the density of these species, and compensating the proportional loss of the population.

**Figure 8-4. The plots occupying by the Schidlovsky's vole, *Microtus schidlovskii,* in boundaries of the footprint area**

The flooding will decrease the habitats of *Darevskia unisexualis*. Their number is estimated at 60-90 individuals, which occupy about 1.19 ha (**Figure 8-5**).

**Figure 8-5. Distribution area of *Darevskia unisexualis*, in boundaries of the footprint area**


To compensate for the habitat loss of *Darevskia unisexualis* it is recommended to provide them with alternative habitats of at least 1.19 ha. In particular, it is recommended to increase proportionally the area of rocky outcrops, maintaining the connectivity with the main habitat. It can also be worth to move the animals, which currently inhabit the reservoir area to the newly developed habitat.

As the first mitigation step regarding the two reptile species, Sand lizard and Snake-eyed Lizard, the quantitative survey of the species in the footprint area is suggested. Such survey allows to estimate an approximate number of individuals of each species and their locations.

To compensate the reduction of the habitats of these two species it is suggested to provide construction of the critical features of the species' habitats in the proximity of the flooded area. These features can include but not limited to additional rocky outcrops, increased number of planted herbaceous and bush species. The features should be large enough to support the species populations. Before the flooding as many individuals of the species as possible have to be caught and relocated to the prepared habitats.

Habitats of the Syrian spadefoot, *Pelobates syriacus* will be partly lost, but the main impact will occur on the species breeding area (and, evidently, mating area) - the pond located in the footprint area. This impact is considered below as an impact on aquatic species as tadpoles (the species larvae) develop in water.

The project is beneficial for other priority species, namely the Green Toad, as it increases the water surface and shoreline, thereby enhancing habitats and food supply. Therefore, none of the mitigation measures are required.

Permanent residents of the first group of mammals, such as the Badger and Least weasel, use burrows; however, they can leave them when disturbed and relocate to other habitats. To prevent

harm to these animals, it is necessary to survey their burrows before the construction works begin and monitor if the animals vacate them; if they do not, special measures to safely drive them away should be implemented.

*Loss of foraging habitats for medium mammals*

Animals of the second mammal group (namely, temporary visitors) will move away or avoid disturbance once the site clearance and construction work start. The main deterrent impact is noise and appearance of people.

The Marbled polecat, *Vormela peregusna*, was identified as the priority (CH) species. The species individuals may hunt in the area. There are no significant impacts predicted for the species, but only in the case if no shelters (dens) of the species are located in the area. To be sure of it, pre-construction survey is recommended.

*Loss of breeding and foraging habitats for birds*

From 78 identified species, 30 species are assessed as the Priority Biodiversity Features (PBF) according to the EBRD PR6 criterion 12: namely, 28 species are listed in the Resolution No. 6 of Bern Convention and Annex I of the EU Birds Directive, two species are considered "significant biodiversity features" by a broad set of stakeholders or governments (and listed in the RA Red Book, category "Vulnerable").

Due to the anticipated flooding of the territory, the loss of breeding habitats[123] is expected for the following numbers of the species (breeding pairs), protected under the Bern Convention (marked as Res 6):

1. Red-backed Shrike Lanius collurio 3-5 pairs (Res 6),
2. Ortolan Bunting Emberiza hortulana 2-3 pairs (Res 6).

The flooding will not affect the majority of the large ranged and colonial species, protected under Bern Convention and Red Book of Animals of Armenia:

1. Long-legged Buzzard Buteo rufinus,
2. Red-billed Chough Pyrrhocorax pyrrhocorax.

The area appears not to play a significant role as the grassland habitat because it is already degraded and therefore doesn’t provide a major food supply for these species.

Also, the flooding will not affect the migratory and wintering species, protected under the Bern Convention and the Red Book of Animals of Armenia, including those which make relatively high congregations during the migration:

1. European Honey-buzzard Pernis apivorus,
2. Black Kite Milvus migrans,
3. Short-toed Snake-eagle Circaetus gallicus,
4. Hen Harrier Circus cyaneus,
5. Montagu's Harrier Circus pygargus,
6. Pallid Harrier Circus macrourus,
7. Marsh Harrier Circus aeruginosus,
8. Egyptian Vulture Neophron percnopterus,

[123]Any activity of the Project has to be implemented before the breeding season or after, and thus we do not assume that any birds will die.

9. Steppe Eagle Aquila nipalensis,
10. Imperial Eagle Aquila heliacal,
11. Lesser Spotted Eagle Clanga pomarine,
12. Booted Eagle Hieraaetus pennatus,
13. Levant Sparrowhawk Tachyspiza brevipes,
14. Long-legged Buzzard Buteo rufinus,
15. Lesser Kestrel Falco naumanni,
16. Common Crane Grus grus,
17. Demoiselle Crane Anthropoides virgo,
18. European Roller Coracias garrulus,
19. Citrine Wagtail Motacilla citreola,
20. Lesser Grey Shrike Lanius minor.

The absence of impact can be explained by the fact that the species do not feed in the area and fly over it.

The following mitigation measures are suggested for the Priority Species:

1. Consider introduction of sustainable grazing practices in the Artik community, which can improve the quality of grassland habitat, increase the number and diversity of the herbaceous vegetation, invertebrates and rodents, and support the necessary food supply for the Red-backed Shrike and Ortolan Bunting, thus increasing their populations density,
2. Plant additional thorny bush species as breeding spots for the Red-backed Shrike, helping them to discover new breeding sites.

The individual breeding territories of the Red-backed Shrike range from 0.64 and 1.33 ha per pair. Considering the degraded conditions of the existing grassland habitats, it is reasonable to apply the upper value of 1.33 ha per pair. Therefore, restoration of approximately 6.65 ha of suitable habitat is recommended the support maximum five breeding pairs of the species.

The spatial distribution of breeding populations of Ortolan Bunting is more complex, which is why the individual breeding territories of the Ortolan Bunting are not fixed and depend on the local habitat structure.

The key characteristic for the Ortolan Bunting is the need for separate foraging and nesting sites, with males often leaving the nest territory for up to 27% of the day to forage at distances as far as 2.7 km away. Territories can vary depending on the local habitat, but they require a mosaic of bare ground, short vegetation, and areas with taller plants for song posts.

Considering that the breeding and foraging ranges of both species usually overlap, the proposed 6.65 ha of the grassland habitat to be restored for the Red-backed Shrike will serve for the Ortolan Bunting as well.

*Loss of habitats of invertebrates and a risk of partial death of their populations*

The flooding is supposed to affect the habitats of the following invertebrates (beetles and butterflies):

1. Carabus maurus,
2. Dailognatha caraboides,
3. Omophlus caucasicus,
4. Ultraaricia crassipuncta,

5. Neolysandra coelestina,
6. Pseudochazara geyeri,
7. Euphydryas aurinia.

If the construction works start in May-August, butterflies will leave the disturbance areas to look for other places for foraging and breeding; it is important that suitable habitats have been created in vicinity. But if the works start in October - April, overwintering stages of butterflies (caterpillar or pupa) present within the work area may be destroyed.

The similar measures suggested for compensating habitats for mammals, birds, and reptiles will also be beneficial for the mentioned invertebrate. It is recommended to:

1. Implement a study of the habitat requirements of the priority species and estimate areas of the habitats, which are lost by these species,
2. Develop the similar habitats in the surrounding grasslands, in close vicinity of the existing populations, no less area than the lost ones, securing habitat connectivity (primarily includes planting forage plants for the butterfly species and large stones for beetles),
3. Introduce sustainable grazing practices in Artik community that can improve habitats quality and diversity.

***Impacts on aquatic species***

*Destruction of the habitats of the aquatic species and a risk of the species death*

The fishless pond located in the footprint area is a favourable breeding area for the Syrian spadefoot, *Pelobates syriacus*, whose big tadpoles (38 individuals were counted there during ichthyological study) live and grow there. However, the reservoir will flood the pond.

The pond, which is a breeding ground for the Syrian spadefoot, needs to be further studied by amphibian experts to determine what impact the construction work to convert the pond into a reservoir may have and whether the reservoir will continue to be a breeding ground for the species after that.

*Impact on protected areas and internationally designated areas*

Due to large distances, there will be no negative impact on the nationally protected areas, Candidate Emerald sites or KBA/IBA areas.

***8.2.12.3 Operation phase***

*Emergence of new habitats (water, riparian)*

The flooding will be beneficial for the following priority breeding and migratory species as it creates additional water habitat for them:

1. Dalmatian Pelican Pelecanus crispus,
2. Great White Pelican Pelecanus onocrotalus,
3. Great Cormorant Phalacrocorax carbo,
4. Little Egret Egretta garzetta,
5. White Stork Ciconia ciconia,
6. Black Stork Ciconia nigra,
7. Ruddy Shelduck Tadorna ferruginea.

*Increased access to the area*

Increase in waterbird diversity and numbers can attract hunters; this is more likely because the Artik town is located in close vicinity to the Project site. Therefore, the biodiversity management plan should consider possible increase of illegal hunting in the area, which can affect not only game birds, but also priority bird and mammal species.

*Impact assessment and mitigation measures*

Assessment and mitigation of impacts on biodiversity during the construction and operation phases are summarized in **Table 8-22**. According to the mitigation hierarchy[124] four types of measures are applied – avoidance, minimization, restoration and offset. Excluding avoidance (as construction of the dam and reservoir at the footprint areas is already approved by the government), the measures are presented in the **Table 8-22**.

**Table 8-22. Summary of impacts on biodiversity and mitigation measures for the Project construction and operation phases**

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| **Overarching action:**<br>Develop a Biodiversity Action Plan (BAP)[125] during the pre-construction phase to cover mitigation activities of the pre-construction, construction, and operation phases. The BAP will outline and provide guidance for components such as the Biodiversity Management Plan (including monitoring) and Offset project. The mitigation and/or management measures listed below shall be incorporated into the BAP. | | | |
| PRE-CONSTRUCTION AND CONSTRUCTION PHASE | | | |
| 1. Habitats | Significant | ***Pre-construction phase***<br>1) Study the priority grasslands habitat (CH) in the Project area, its plant composition and ecological structure, level of disturbance and determine its precise extent,<br>2) Study areas around the construction area to define existing habitats similar to the following:<br>E1.2 Perennial calcareous grasslands and basic steppes = 62C0* Ponto-Sarmatic steppes,<br>3) Develop a habitat offset project aimed at conserving/restoring the habitat in areas most suitable for conservation,<br>4) Study the existing pond (including study of the tadpoles of Syrian spadefoot living there - see below) to decide whether the reservoir may be considered as similar to the priority habitat:<br>C1.4 Permanent dystrophic lakes, ponds and pools = 3160 Natural dystrophic lakes and ponds (1.42 ha),<br>5) If it is considered impossible to replace the pond by the reservoir, include construction of the similar pond in the vicinity of the reservoir in the offset project. | Moderate (after offset - no net loss / a net gain) |

[124]Guidance Notes to the EBRD PR 6 (March, 2023)
[125]Biodiversity Action Plan is developed and approved prior the tendering process for the Construction Contractor. Other Biodiversity plans developed by the Construction Contractor prior to construction. Some specified mitigation measures are implemented at the pre-construction phase and some - throughout construction.

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| | | *Preliminary quantitative assessment*<br>*The total lost area of the grasslands habitat E1.2/62C0* is 28.54 ha. The buffer/protection zone of the reservoir can't be considered for the grasslands habitat restoration because it is narrow (10 m) and riverine vegetation will appear there. Accordingly, the suitable area should be found and conserved/restored in the area around the reservoir.*<br>*The total lost area of the water habitat (the existing pond) is 1.42 ha. If it is considered impossible to replace the pond by the reservoir, the similar pond should be constructed in the vicinity of the reservoir.*<br>*Proposals for the construction and conservation of the habitats, including multipliers, should be finally developed in the BAP. It should be taken into account that the grasslands habitat is partly disturbed.* | |
| OPERATIONAL PHASE | | | |
| Habitats | No new impact, but the mitigation continues | Implement the offset project to conserve/restore the following habitat:<br>E1.2 Perennial calcareous grasslands and basic steppes = 62C0* Ponto-Sarmatic steppes,<br>and, possibly, to construct the water habitat:<br>C1.4 Permanent dystrophic lakes, ponds and pools = 3160 Natural dystrophic lakes and ponds. | - |
| *Monitoring:* according to the monitoring chapter of the offset project | | | |
| PRE-CONSTRUCTION AND CONSTRUCTION PHASE | | | |
| 2. Flora | Significant | ***Pre-construction phase***<br>1) Study plant composition and structure of the priority grasslands habitat,<br>2) Develop a Habitat Restoration/Construction Plan using indigenous plant species as the basis for habitat creation,<br>3) Construct the grassland habitat in the vicinity of the reservoir area.<br>***Construction phase***<br>4) Maintain the grasslands habitat based on indigenous plant species. | Moderate (after offset - no net loss / a net gain) |
| OPERATION PHASE | | | |
| Flora | No new impact, but the mitigation continues | Maintain the grasslands habitat based on indigenous plant species | Low |
| *Monitoring:* according to the monitoring chapter of the offset project | | | |
| PRE-CONSTRUCTION AND CONSTRUCTION PHASE | | | |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| 3. Fauna (other than those listed below) | Significant | ***Pre-construction phase***<br>1) Develop the Worker Code of Conduct for employees of the construction company to prevent poaching.<br>***Construction phase***<br>2) Plan and commence construction works starting from one edge of the reservoir/dam area; this approach will allow animals to leave the area,<br>3) Begin the construction works before or after the breeding season - prior to April or after August; this will protect lives of animals, including offspring,<br>4) Monitor compliance with the Worker Code of Conduct by the construction company workers to prevent poaching,<br>5) Develop the Worker Code of Conduct for the operator of the reservoir to prevent poaching. | Low |
| OPERATION PHASE | | | |
| Fauna | Moderate | Monitor compliance of the reservoir's operator with the Worker the Code of Conduct to prevent poaching during operations. | Negligible |
| *Monitoring:* according to the Biodiversity Management Plan | | | |
| PRE-CONSTRUCTION AND CONSTRUCTION PHASE | | | |
| 4. Sedentary animals | Significant | ***Pre-construction phase***<br>1) Survey the footprint area to map local habitats and estimate the number of individuals of lizards and snakes, and amphibians,<br>2) Identify existing habitats which are suitable for relocation of the animals in the vicinities of the flooded area,<br>3) Create additional rocky outcrops in the vicinity of the flooded area to increase the number of native shelters to enhance habitats for snakes and lizards,<br>4) Survey the area to map inhabited burrows of badger and other burrowing animals.<br>***Construction phase***<br>1) Before the reservoir construction starts, survey the construction area and capture found lizards and snakes, and amphibians, and relocate them to safe habitats identified during the pre-construction phase,<br>2) Before the reservoir construction starts take measures to scare away the priority species - Schidlovsky's vole and Asia Minor ground squirrel as well as other small mammals,<br>3) Before filling the reservoir, survey the site and capture as many individuals as possible, including snakes and lizards, and amphibians, and relocate them to the safe | Low |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| | | habitats identified and/or arranged during the pre-construction phase,<br>4) Before filling the reservoir, inspect the mapped residential burrows of badger and other animals; if any individuals remain, capture them and relocate to the safe habitats. | |
| OPERATION PHASE | | | |
| Sedentary animals | No new impact, but the mitigation continues | 1) Introduce or support sustainable grazing practices in the areas that surround the planned reservoir, as improved quality of the habitats can provide a more diverse food supply for small mammals, reptilians and Syrian spadefoot, thus supporting an increase in the population density of the species,<br>2) Maintain rocky habitats which are habitats for relocation snakes and lizards in the vicinities of the flooded area.<br>*Preliminary quantitative assessment*<br>*Areas calculated as minimum (multiplier 1, "no net loss" approach) compensation areas for the priority species (Asia Minor ground squirrel - 1.1 ha, Schidlovsky's vole - 6.49 ha, Valentin's lizard - 1.19 ha) can be compensated in the framework of the grassland habitat conservation/restoration of area 28.54 ha (see above).*<br>*Proposals for the construction and conservation of the habitats, including multipliers, should be developed in the BAP.* | Low |
| *Monitoring:* according to the Biodiversity Management Plan | | | |
| PRE-CONSTRUCTION AND CONSTRUCTION PHASE | | | |
| 5. Medium mammals | Moderate | ***Pre-construction phase***<br>Survey the footprint area to confirm/rule out presence of the den of Marbled Polecat; if den is found, take measures to scare away animals from the reservoir area.<br>*The survey should be conducted before or after the breeding season.* | Negligible |
| *Monitoring:* according to the Biodiversity Management Plan | | | |
| PRE-CONSTRUCTION AND CONSTRUCTION PHASE | | | |
| 6. Birds | Moderate | ***Pre-construction phase***<br>Provide conservation/restoration of grasslands (with planting thorny bush species) in the vicinity of the reservoir, to support the breeding habitats of the Red-backed Shrike and Ortolan Bunting.<br>*Preliminary quantitative assessment*<br>*The minimum area (multiplier = 1) for compensation of the lost habitats of the two bird species, based on a "no net loss" approach is 6.65 ha (see sub-section Loss of breeding and foraging habitats for birds - above).* | Low |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| | | *This area can be compensated in the framework of the grassland habitat conservation/restoration of area 28.54 ha (see above).*<br>*If sustainable grazing practices are applied in the grasslands surrounding the site area, they will help to maintain the necessary food supply for the two priority species (see Operation phase). In this case, these areas may be taken into account in the compensation.*<br>*Proposals for the use of restored and conserved habitats including multipliers and related calculation, should be developed as part of the BAP.*<br>***Construction phase***<br>Maintain the restored parts of grasslands. | |
| OPERATION PHASE | | | |
| Birds | No new negative impact, but the mitigation continues<br><br>Positive impact could manifest | 1) Introduce/support sustainable grazing practices in the Artik community to improve the quality of grassland habitat, increase the number and diversity of invertebrates, and support the necessary food supply for the Red-backed Shrike and Ortolan Bunting, thereby contributing to a potential increase in their population density,<br>2) Maintain the restored parts of grasslands. | Low |
| *Monitoring:* according to the Biodiversity Management Plan | | | |
| PRE-CONSTRUCTION AND CONSTRUCTION PHASES | | | |
| 7.Invertebrates | Significant | ***Pre-construction phase***<br>Study and quantify the lost habitats of the priority species, establish habitat features for this species in the surrounding grasslands (primarily planting forage plants for the butterfly species and large stones for beetles).<br>*These habitats may be included in the restored grassland habitats (see above) in areas located in the vicinity of the reservoir site.*<br>*If sustainable grazing practices are applied in the grasslands surrounding the site area, these areas may be taken into account in the compensation.*<br>***Construction phase***<br>Maintain developed habitats. | Low |
| OPERATION PHASE | | | |
| Invertebrates | Moderate | 1) Introduce/support sustainable grazing practices in the Artik community around the reservoir site, that can improve quality of grassland habitat,<br>2) Maintain developed habitats. | Low |
| *Monitoring:* according to the Biodiversity Management Plan | | | |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| PRE-CONSTRUCTION AND CONSTRUCTION PHASES | | | |
| 8.Aquatic species | Significant (potentially) | ***Pre-construction phase***<br>1) Conduct a specialized assessment of the existing pond by amphibian experts to evaluate the potential impacts of its conversion into a reservoir, and to determine whether the reservoir will remain a viable breeding and possibly mating habitat for the Syrian spadefoot (*Pelobates syriacus*),<br>2) If it is considered impossible to replace the pond by the reservoir, construct the similar pond in the vicinity of the reservoir.<br>*Preliminary quantitative assessment*<br>*The total lost area of the water habitat (the existing pond) is 1.42 ha. Final area of the compensated water habitats should be calculated after the study.*<br>***Construction phase***<br>1) Before the reservoir construction starts, capture tadpoles of the Syrian spadefoot and relocate them to the newly created pond,<br>2) Maintain developed habitat and monitor the species being. | Low |
| OPERATION PHASE | | | |
| | Moderate | Maintain developed habitat and monitor the species being. | Low |
| *Monitoring:* according to the Biodiversity Management Plan | | | |

## 8.3 Social Impacts and Benefits, Mitigation Measures

### 8.3.1 Impacts on the Local/Regional Economic Growth, Employment and Business / Investment Opportunities

*Construction phase*

The residents of the Artik community might be positively impacted by the new employment opportunities during the Project construction stage, thereof increasing the households' income. Also, local and regional businesses may join the project supply chain - in areas including transportation, and provision of goods and services.

All local employment and procurement matters shall be managed through a Local Employment and Procurement Plan (LEPP). At a minimum, the LEPP shall include: (i) local employment targets and commitments; (ii) provisions for the procurement of goods, works, and services from local suppliers where feasible; (iii) requirements for labour standards and social safeguards in accordance with applicable EBRD PR2; (iv) monitoring and reporting procedures; and (v) measures for integrating these requirements into procurement and contractual documentation.

An influx of construction workers can also increase the risks of Gender Based Violence and Harassment (GBVH). Women, young people and economically disadvantaged residents are most vulnerable, particularly in rural communities with limited health infrastructure. However, given the

traditional, family-oriented lifestyle that characterizes rural settlements in Armenia, the incidence of STDs among the local population is expected to be negligible (see also **Sub-section 8.3.5**).

*Operation phase*

According to economic and financial analysis[126] the Artik Reservoir likely justifies investment on the basis of the preliminary financial and economic assessment. However, the analysis should be updated once the detailed design is finalised and costs are confirmed.

The Project's implementation will lead to the increased irrigation of the region's agricultural lands, directly benefiting the socio-economic well-being of the local population. The residents of Artik enlarged community, including impacted settlements are predominantly involved in agricultural activities, including cultivation of wheat, barley, potatoes, vegetables, and animal husbandry. Therefore, ensuring the availability and protection of irrigated lands, grasslands, and pastures is crucial, given their vital role in supporting the livelihoods of the community population.

### 8.3.2 Impacts on Public Facilities and Infrastructure

*Construction phase*

An additional pressure on local infrastructure including power lines, roads, and healthcare facilities might occur due to the Project construction activities.

It is necessary to identify sensitive receptors (schools, hospitals, residential areas, other social infrastructure) along the transportation routes and develop mitigation measures where necessary (including avoidance, timing adjustments, additional traffic signs, reinforcement of the speed limit etc.). Therefore, a Traffic Management Plan should be developed, and transportation routes should be disclosed to the public.

Regarding the healthcare facilities, the medical centers in the rural settlements have limited capacities, both in terms of the personnel and equipment, to serve the Project workforce. Therefore, Artik Medical Center, located in Artik town, should be considered for emergency situations.

*Operation phase*

Reservoir operation will have mixed impacts on public infrastructure: some positive impacts, such as improved water security and irrigation infrastructure upgrades, and some negative namely increased load on local roads, power and waste management systems.

*Impact assessment and mitigation measures*

The assessment and mitigation of impact on public facilities and infrastructure during the Project construction phase is summarised in **Table 8-23**.

[126]Armenia Water Reservoirs - Technical, Economic and Green Due Diligence Gap Analysis, Draft Final Report, 2023-2024, Ove Arup & Partners.

**Table 8-23. Summary of impact assessment on and mitigation measures for public facilities and infrastructure**

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| CONSTRUCTION PHASE | | | |
| Local and regional public facilities and infrastructure | Moderate | 1) Develop a Traffic Management Plan aiming to minimise pressure on the reginal and local road infrastructure and avoiding as much as possible sensitive receptors,<br>2) Oblige the construction contractor to set up a medical post at least at one of the labour accommodation camps. | Low |
| OPERATION PHASE | | | |
| Local and regional public facilities and infrastructure | Positive Low to Moderate | 1) Ensure equitable allocation of water to all beneficiaries, preventing conflicts and enhancing trust in the system.<br>2) Hire local labour for reservoir maintenance, canal management, and monitoring activities to create permanent jobs.<br>3) Train local staff and farmers in irrigation management, water-saving techniques, and maintenance of associated infrastructure. | Moderate |
| | Negative Low to Moderate | 4) Conduct regular inspections and maintenance of access roads and bridges exposed to heavy transport or increased traffic for reservoir operations.<br>5) Design alternative routes or strengthen existing infrastructure to handle maintenance vehicles and community traffic.<br>6) Maintain embankments, spillways, and outlet structures to ensure controlled water releases and avoid downstream flooding that could damage public infrastructure. | Low |

### 8.3.3 Land Tenure Impacts

The Artik Reservoir is expected to affect around 130 land plots with the area of 96,065 $m^2$ in Nor Kyanq, Anushavan, Panik, Artik, Tufashen, and Pemzashen settlements to construct the feeding and irrigation channels. Of these, 85 are community-owned, 17 are state owned, and 28 are privately owned land plots. The private plots are mainly agricultural lands and cover 6,090 $m^2$. Most private landowners are engaged in agriculture activities; during the EIA consultations they stressed the shortage of water and thus limited crops. Yet, impact on crops is expected. Due compensation and livelihood restoration activities have been outlined in the Resettlement Framework (to be further detailed in the Resettlement Plan).

*Impact assessment and mitigation measures*

The assessment and mitigation of land tenure impact during the construction phase of the reservoir is summarised in **Table 8-24**.

**Table 8-24. Summary of land tenure impact assessment and mitigation measures**

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| CONSTRUCTION PHASE | | | |
| Residents of the affected villages | High | ***Pre-construction phase***<br>1) Develop a Resettlement Plan (RP) for the Project based on the Resettlement Framework (RF), ensure that necessary mitigation measures for all affected settlements, including vulnerable households are included and implemented,<br>2) Ensure that public consultations with AHs are conducted in all affected settlements as per the RP to present the Project's aims, stages of land acquisition and compensation process, a concept of "cut-off date", basic eligibility and entitlements, survey timelines, resettlement timelines,<br>3) Establish a Grievance Mechanism to deal with the Project-related concerns. | Low |
| Community land | Moderate | 4) Develop and implement the Resettlement Plan to ensure that the compensation for community land is fully provided prior to any construction works on site. | Low |

### 8.3.4 Impact on Vulnerable Groups

The Project's implementation will allow irrigation of approximately 300 ha of agricultural lands, positively impacting the socio-economic conditions of the local population. The reservoir reconstruction and enhancement of irrigation water supply are expected to elevate living standards in the area, thereby contributing to a reduction in poverty rates among the local residents.

Furthermore, stable availability of water will benefit women who play an essential role in the provision, use and management of water in the households. However, women can face barriers in the access to the irrigation infrastructure due to their limited involvement in the decision-making processes. Therefore, it is important to regulate and ensure equal access to the Project benefits for women. Equal employment opportunities for men and women should also be ensured during the Project construction stage.

**Table 8-25. Summary of impact assessment on vulnerable groups and mitigation measures**

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| CONSTRUCTION PHASE | | | |
| Vulnerable households of the affected villages | Moderate | 1) Implement the SEP to ensure that information about the Project and its opportunities is widely available and communicated to vulnerable households, including the female-headed and elderly households engaged in agricultural activities, households below the poverty line. | Low |
| Women | Low | 2) Equal employment opportunities and payment for men and women should also be ensured during the Project construction stage. | Low |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| OPERATION PHASE | | | |
| Vulnerable households of the affected villages | Moderate | 3) Implement subsidies or reduced fees for low-income households to access irrigation water or reservoir-related services,<br>4) Ensure transparent and equitable allocation of water to all farmers, prioritizing smallholders and disadvantaged users,<br>5) Facilitate access to financial or technical support for low-income farmers to maximize the benefits of irrigation,<br>6) Ensure emergency response plans explicitly consider vulnerable groups, including designated evacuation routes and assistance during floods or dam releases,<br>7) Prioritize participation of vulnerable groups in water user associations or community decision-making on irrigation schedules and reservoir management. | Low |

### 8.3.5 Impact on Community Health and Safety

*Construction Phase*

During the construction of the reservoir, community health and safety may be affected by increased heavy vehicle movement and machinery use, which can raise the risk of road accidents. Noise and dust from excavation and transportation activities may cause respiratory discomfort and disturb daily life for nearby residents, including vulnerable groups such as children and the elderly. Open excavation sites, heavy machinery, and unsecured construction areas pose physical safety risks such as falls, injuries, or unauthorized entry by residents. There is also the potential for water and soil contamination if fuels, oils, or construction materials are mishandled, which could affect drinking water sources.

Furthermore, an influx of construction workers can increase the risks of GBVH. Women, young people and economically disadvantaged residents are most vulnerable, particularly in rural communities with limited health infrastructure. However, given the traditional, family-oriented lifestyle that characterizes rural settlements in Armenia, the incidence of STDs among the local population is expected to be negligible.

*Operation stage*

Once operational, the reservoir will bring long-term benefits through improved irrigation, food security, and economic development; however, new health and safety risks will also emerge. The most significant hazard is drowning, particularly for children, due to the presence of deep open water. Stagnant water areas may create breeding grounds for mosquitoes and other vectors, potentially increasing the risk of vector-borne diseases. Poor management of agricultural inputs such as fertilizers and pesticides can lead to runoff into the reservoir, contaminating water quality and indirectly affecting community health. The reservoir and associated infrastructure, if not properly designed and maintained, could also pose risks of flooding or failure. Nevertheless, with strong monitoring, safety systems, and emergency preparedness, these risks can be minimized, while the improved irrigation will enhance local livelihoods and nutrition.

*Impact assessment and mitigation measures*

The assessment and mitigation of impacts on community health and safety during the construction and operation phases of the reservoir is summarised in **Table 8-26**.

**Table 8-26. Summary of community health and safety impact assessment and mitigation measures**

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| CONSTRUCTION PHASE | | | |
| Residents of the villages | Moderate | ***Pre-construction phase***<br>1) Develop and implement the Traffic Management Plan (TMP) that will contain at least:<br>- Avoiding community access roads if possible and documenting quality of roads prior to their use,<br>- Optimise routes and times of the day for transporting materials to site, especially bulky equipment parts (e.g., pipes) agreed with the traffic police and local administrations,<br>- Identify sensitive receptors (schools, hospitals, residential areas, other social infrastructure) along the transportation routes and develop mitigation measures where necessary,<br>2) Maintain machinery to reduce noise and limit work to daytime hours,<br>3) Screen worker influx for communicable disease and provide treatment, as appropriate, to reduce exposure to local population,<br>4) Secure construction zones with fencing, barriers, and warning signage,<br>5) Develop and implement Emergency preparedness and response plan covering whole project lifecycle (see **Chapter 8.4**),<br>6) Inform local residents about construction schedules, risks, and safety precautions. | Low |
| OPERATION PHASE | | | |
| Residents of the villages | Moderate | 1) Monitor the technical conditions of the reservoir, provide timely maintenance,<br>2) Conduct community awareness campaigns on drowning risks, especially targeting children,<br>3) Develop a Traffic Management Plan to address impacts of the use of heavy machinery or large number of vehicles for the performance of the maintenance works, ,<br>4) Develop an Emergency Response Plan (see **Chapter 8.4**). | Low |

### 8.3.6 Health and Safety Impact

*Construction phase*

The main health and safety risks during the Project construction are associated with earthworks and excavation activities, use of the construction machinery and equipment, and delivery of construction materials to the site (see **Chapter 2.7.6** for the detailed description of the construction activities).

Some of the major physical hazards include: falls from heights when working on scaffolding, or steep slopes around the dam site; trips and slips on wet, uneven, or muddy surfaces; entrapment or impact from the operation of the construction machinery, such as cranes, bulldozers, concrete mixers, etc; exposure to increased noise levels due to machinery and blasting operations. Additional risk to workers laying water pipes is posed by the presence of other underground services such as electric cables or gas pipes. Inadequate human resource practises and isolation from family can contribute to mental strain, causing fatigue and stress and should also be considered by the workforce managers. Among natural hazards are extreme weather events, contact with the wildlife (snakes, insects).

Workers may face accidents from heavy machinery, vehicles, and elevated work areas, including falls, crush injuries, and entrapment. Exposure to dust, noise, and vibration can lead to respiratory issues, hearing loss, and musculoskeletal strain. Handling construction materials, fuels, and chemicals carries risks of burns, poisoning, or skin irritation. Open excavations and trenches present fall and entrapment hazards, while long hours, harsh weather, and inadequate hydration increase the likelihood of heat stress or fatigue.

To prevent accidents at the construction site, an OHS Management Plan (OHSMP) should be developed by the construction contractor and should at least cover the following:

- Allocation of OHS roles and responsibilities,
- Identification of OHS risks relevant to the Project,
- Development of OHS procedures for different types of work / professions,
- Workers' regular OHS briefing / training,
- Performance of the high-hazard activities, inter alia: earthworks, works at height, with high voltage etc.,
- Provision of workers (including sub-contractors) with Personal Protective Equipment (PPE),
- Initial and periodic medical examination of workers, including the staff of sub-contractors,
- Recording and investigation of safety accidents.

Additionally, the contractor must define proper management procedures for the following activities:

- Storage and handling of materials and chemicals, including hazardous ones,
- Fire prevention and the maintenance of the firefighting equipment,
- Provision of the first aid,
- Heat stress management,
- Prohibition of drugs use and alcohol consumption,
- Site safety signs, posters and registers,
- Monitoring of construction noise, vibration and air emissions.

Regular monitoring of the safety performance of the construction workers should be conducted. It should cover both monitoring of work practises, and the working environment.

*Operation Phase*

OHS risks during the Project operation stage are associated with the workers performing maintenance and repair works. The OHS maintenance and repair works procedure/instruction should be developed and followed. The procedure should be based on the applicable risks, and lessons learned from the OHS performance during the construction activities.

*Impact assessment and mitigation measures*

The assessment and mitigation of the OHS impacts during the construction and operation phases of the reservoir are summarised in **Table 8-27**.

**Table 8-27. Summary of occupational health and safety impact assessment and mitigation measures**

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| CONSTRUCTION PHASE | | | |
| Project workforce | Moderate | ***Pre-construction phase***<br>1) Develop an Occupational Health and Safety Management Plan (OHSMP), covering the key elements of the OHS performance management during the construction stage, including:<br>- Allocation of OHS roles and responsibilities<br>- Identification of OHS risks and hazards,<br>- Briefing, training and knowledge check,<br>- OHS procedures and regulations,<br>- Medical examination,<br>- Emergency response,<br>- Management of hazardous materials, chemicals and oil / fuel,<br>- Fire safety and emergency response,<br>- Performance of high hazard tasks<br>- Use of PPE,<br>- Supervision of sub-contractors,<br>- Investigation of safety accidents,<br>- Responsibilities for non-compliance, etc.<br>***Construction phase***<br>1) Implement the provisions of the Occupational Health and Safety Management Plan,<br>2) Conduct regular audits of the construction site to monitor the OHS performance of the contractors. | Low |
| Monitoring: *OHS daily, weekly and monthly inspections and monitoring as per the OHSMP (to be performed by the Construction contractor, the Supervision engineer, the Client and invited external consultants[127]).* | | | |
| OPERATION PHASE | | | |
| Workers performing | Moderate | 1) Develop an OHS procedure/instruction for the maintenance and repair works, | Low |

[127]at least two independent public health and safety (H&S) and OHS audits are recommended during the construction phase (before the start of construction and during the peak of the construction) to verify that the Project complies with the EBRD's OHS requirements. These measure is included in the Project's ESAP.

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| technical maintenance | | 2) Comply with the requirements of the relevant national OHS legislation. | |

### 8.3.7 Workers' Rights and Working Conditions Related Impacts

*Construction stage*

The compliance with the national labour regulations and EBRD PR2 should be required from the contractors via contractual clauses. Monitoring of the HR practises should be performed among the workers on site (work schedule and shift duration, full rest days, provision of paid sick leave, payments above the minimum required level etc.), and in the labour accommodation camp (freedom of movement, availability and conditions of sanitary facilities, sufficient private space, dining facilities etc.).

The contractor should be obliged to maintain the workers grievances mechanism, including an opportunity to submit anonymous complaints. In case of doubt, the PIA should extend their grievance mechanism to contractors' workers (the responsibility for responding to the grievances in this case stays with the direct employer).

*Operation stage*

During the operation phase, workers' rights may be affected by insecure or informal employment, unfair wages, and long or irregular working hours. Insufficient occupational health and safety protections, limited access to training, and inadequate PPE can increase the risk of accidents and exposure to hazards. Workers may also face restricted opportunities for grievance reporting, union participation, or career advancement, while gender bias or exclusion of people with disabilities could limit equitable access to employment. By implementing formal employment contracts, regulated working hours, safety measures, grievance mechanisms, equal opportunities, and training programs, the reservoir operation can protect workers' rights, ensure safety, and enhance workforce well-being and productivity

*Impact assessment and mitigation measures*

The assessment and mitigation of the impacts on workers' rights and working conditions during the construction and operation of the reservoir are summarised in **Table 8-28**.

**Table 8-28. Summary of assessment of impacts on workers' rights and working conditions and mitigation measures**

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| CONSTRUCTION PHASE | | | |
| Project workforce | Moderate | ***Pre-construction phase***<br>1) Include requirements related to the compliance with the national labour regulations and EBRD PR2 in the contractual clauses with the Construction contractor.<br>2) Develop a Labour and Working Conditions Management Plan (at least a month before the construction) and implement it, | Low |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| | | 3) Develop and implement a Construction Camp Management Plan, including sub-plans for Camp Code of Conduct and Camp Management, with requirements for worker accommodation in compliance with the Armenian labour, sanitary and health standards, EBRD PR 2 requirements, EBRD/IFC guidance on worker accommodation (2009), ILO Workers' Housing Recommendation 1961 (№115), and gender-specific provisions,<br>4) Prepare a Local Employment and Procurement Plan (LEPP), which shall at a minimum include:<br>- local employment targets and commitments,<br>- provisions for the procurement of goods, works, and services from local suppliers where feasible,<br>- requirements for labour standards and social safeguards in accordance with applicable EBRD PR2,<br>- monitoring and reporting procedures,<br>- measures for integrating these requirements into procurement and contractual documentation.<br>***Construction phase***<br>5) Set up and maintain grievance mechanisms available to all project workforce, including the opportunity for anonymous complaints,<br>6) If a large-scale maintenance is planned, oblige the Maintenance Contractor to develop a Labour and Working Conditions Management Plan and Worker Code of Conduct (if needed) in line with Armenian labour laws and EBRD PR2 at least a month before any maintenance works, and implement it. | |
| *Monitoring: Daily, weekly and monthly inspections and monitoring of the human resource practises, as well as working and living conditions at the construction site and construction camp (to be performed by the Construction contractor, the Client and invited consultants). Points to be monitored should include, among others: work schedule and shift duration, full rest days and shift breaks, provision of payments above the minimum required level, availability and conditions of sanitary facilities, as well as living conditions in the labour accommodation camp (freedom of movement, sufficient private space, dining facilities etc.).* | | | |
| OPERATION PHASE | | | |
| Operation phase staff | Moderate | 1) Ensure formal contracts for all workers specifying wages, roles, and duration of employment,<br>2) Implement regulated working hours with adequate breaks and rest periods,<br>3) Establish transparent grievance and complaint mechanisms for all staff,<br>4) Promote gender equality and inclusivity of persons with disabilities in recruitment, training, and promotion, | Low |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| | | 5) Provide regular training on operational procedures, safety, and skills development. | |

### 8.3.8 Gender-Based Violence and Harassment

*Construction phase*

The influx of non-local male workers may increase the risk of gender-based violence and harassment (GBVH), including sexual harassment, exploitation, and domestic violence, particularly affecting women and girls. Women engaged in small businesses, agriculture, or service provision around the construction area may face risks of harassment or coercion.

A Worker Code of Conduct and Gender-Based Violence and Harassment (GBVH) Policy should be developed and conveyed to all construction workers and contractors. A grievance mechanism with a specific mandate on GBVH should be developed and disclosed, a dedicated person to manage / oversee it should be appointed.

*Operation phase*

As discussed in **Chapter 8.3.4**, women (especially single women headed households) can face obstacles in the access to the irrigation infrastructure due to their limited involvement in the decision-making processes. Related GBVH cases might occur, and therefore the Project's implementing agency and the local governing authorities should employ appropriate measures to monitor and prevent such cases.

*Impact assessment and mitigation measures*

The assessment and mitigation of the GBVH impact during the construction and operation phases of the reservoir are summarised in **Table 8-29**.

**Table 8-29. Summary of GBVH impact assessment and mitigation measures**

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| CONSTRUCTION PHASE | | | |
| Female residents of the settlements | Moderate | ***Pre-construction phase***<br>Develop GBVH Policy and assign focal points responsible for handling GBVH incidents within the workforce and beyond.<br>***Construction phase***<br>1) Conduct mandatory and regular training for workers on required lawful conduct in local community, the Code of Conduct and GBVH Policy and consequences for failure to comply with the above,<br>2) Maintain a grievance mechanism, which includes a specific mandate on GBVH,<br>3) Organize information and awareness raising campaigns for community members, specifically women and girls, | Low |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| | | 4) Provide information to communities on how to use the grievance mechanism to report GBVH issues. | |
| OPERATION PHASE | | | |
| Female residents of communities | Moderate | 1) Monitor access to the irrigation infrastructure following the Project completion.<br>2) Maintain the grievance mechanism during the Project operation, including the GBVH cases. | Low |

## 8.4 Emergency Situations and Response

*Construction stage*

During reservoir construction, emergencies can result from natural hazards, hazardous material use, or other man-made accidents. Potential emergency situations during the reservoir and dam construction include flooding of the construction site, landslides, accidents with heavy machinery, hazardous materials spills, fire or electrocution. Thus, construction emergencies are mainly linked to accidents, floods, slope collapses, and hazardous materials, affecting primarily workers and nearby residents.

*Operation stage*

Even though a not-high dam has a lower probability of catastrophic failure than a large dam, operation-phase risks include both rare but severe emergencies (dam breach, overtopping, seismic events) and more frequent, moderate impacts (spillway malfunctions, water quality deterioration, sedimentation, and OHS hazards for staff). These require continuous monitoring, preventive maintenance, and emergency preparedness to protect both workers and surrounding communities.

*Impact assessment and mitigation measures*

The assessment and mitigation of the emergency situations during the construction and operation phases of the reservoir are summarised in **Table 8-30**.

**Table 8-30. Summary of emergency situations impact assessment and mitigation measures**

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| CONSTRUCTION PHASE | | | |
| Construction workers | Moderate | 1) Prepare site-specific emergency response procedures for incidents such as landslides, machinery accidents, or hazardous material spills,<br>2) Firefighting equipment and first aid kits should be available and maintained at all construction sites and project-related delivery vehicles. Selected workers should be trained on their usage. | Low |
| Residents of the downstream settlements | Moderate | 1) Conduct Dam Integrity Risk Assessment,<br>2) After completion of the dam integrity risk assessment and flood safety check, consider the need of an early-warning system and provision of the life-saving equipment in the local communities, with the | Low |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| | | requirement of regular maintenance and emergency evacuation drills,<br>3) Establish traffic and access management plans to reduce accident risks for workers and local residents. | |
| Monitoring: *According to the Emergency Preparedness and Response Plan* | | | |
| OPERATION PHASE | | | |
| Operation phase staff | Moderate | 1) Carry out preventive maintenance of gates, valves, and pumps, and ensure staff are trained in emergency response.<br>2) Protect workers by enforcing PPE use, confined space entry protocols, and safety training on electrical and mechanical hazards.<br>3) Develop and implement an Emergency Action Plan, including early warning systems, evacuation routes, and periodic drills with local authorities and communities (both for staff and local residents). | Low |
| Residents of the downstream settlements | Moderate | 1) Enhance community safety with fencing, signage, and awareness programs on drowning risks.<br>2) Engage with local communities and provide grievance mechanisms to address concerns. | Low |

## 8.5 Cultural Heritage Impact

### 8.5.1 Impact on Tangible Cultural Heritage

*Construction phase*

As outlined in **Sub-section 6.4.1**, four cultural heritage assets have been identified in the vicinity of the planned reservoir area and supporting infrastructure. Two of these assets are located within the Project's direct impact zone, approximately 6 m and 20 m from the irrigation channel, respectively. Another monument is situated at a distance of approximately 75 m from the irrigation channel.

According to the conclusion of the Historical and Cultural Reserves-Museums and Historical Environment Preservation Service SNCO, the construction works associated with the irrigation channel are of limited scale, involving a relatively small land area. Therefore, the potential impact on these cultural heritage sites is assessed as moderate, provided that appropriate mitigation measures are implemented.

Prior to the commencement of construction activities, it is recommended that a detailed field archaeological investigation be carried out within the planned reservoir and dam areas, as well as along the proposed feeding and irrigation channels. Based on the results of this investigation, and if deemed necessary, a site-specific Cultural Heritage Management Plan (CHMP) shall be developed by the Construction Contractor. The CHMP will be reviewed and approved by the Supervision Engineer, the Client, and the Authorized State Body (Ministry of Education, Science, Culture and Sport).

Implementation of the CHMP will be supervised by a qualified cultural heritage expert engaged by the Construction Contractor. This expert shall be present on-site during all earthworks and ensure the effective application of mitigation and monitoring measures specified in the CHMP.

At this stage, the Project's overall impact on cultural heritage is assessed as moderate. The residual impact is expected to be low, provided that the mitigation measures outlined in **Table 8-29** are fully implemented.

*Operation phase*

No adverse impacts on tangible cultural heritage sites/units are anticipated during the Project's operation phase. On the contrary, the presence of the reservoir may generate positive synergistic effects by enhancing the attractiveness of the area and potentially increasing visitor interest in the historical monuments located within Artik enlarged community.

*Impact assessment and mitigation measures*

The assessment and mitigation of the tangible cultural heritage impacts during the construction and operation phases of the reservoir are summarised in **Table 8-31**.

**Table 8-31. Summary of tangible cultural heritage impact assessment and mitigation measures**

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| CONSTRUCTION PHASE | | | |
| Local communities and site visitors | Low | ***Pre-construction phase***<br>1) Develop a Chance Finds Procedure (CFP) for the Project prior to the commencement of construction works,<br>2) Hire a qualified cultural heritage expert to be present during the construction works and implement archaeological surveillance for all construction sites and help implement all heritage focused mitigations, if required,<br>3) Conduct detailed field archaeological investigation within the planned reservoir and dam areas and buffer zone, as well as along the proposed feeding and irrigation channels. If necessary, protective (safeguard) excavations shall be carried out by the construction contractor under the supervision of qualified specialists,<br>4) Prepare a site-specific Cultural Heritage Management Plan (CHMP) that shall be reviewed and approved by the Supervision engineer, the Client, and the Authorized State Body (Ministry of Education, Science, Culture and Sport).<br>***Construction phase***<br>Train relevant personnel in the implementation of the CFP to ensure that workers are able to identify potential chance finds, suspend work in the affected area, and notify site management promptly. Maintain an up-to-date | Negligible |

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| | | training log and include relevant information in regular monitoring reports. | |
| OPERATION PHASE | | | |
| Local communities and site visitors | Neutral | The presence of the reservoir may generate positive synergistic effects by enhancing the attractiveness of the area and potentially increasing visitor interest in the historical monuments. | Positive |

### 8.5.2 Impact on Intangible Cultural Heritage

*Construction and operation phase*

The implementation of the Project is not expected to result in any adverse impacts on intangible cultural heritage elements registered on either the UNESCO or national lists of Intangible Cultural Heritage.

During the construction phase, local residents will need to plan community celebrations, such as Christmas, New Year, Easter and Trndez, as well as family events including weddings and baptisms, with consideration for increased traffic along the H21 "H75-Horom-Alagyaz" road. This road connects the villages within the Project command area to the town of Artik and via the M1 highway, to the regional centre of Gyumri and the capital city, Yerevan. These impacts are expected to be temporary and low, provided that the provisions of the Traffic Management Plan (TMP) are effectively communicated and implemented in coordination with the affected communities.

No impacts are anticipated on sacred, religious, or spiritual sites that are regularly visited by local residents as a result of Project implementation.

Certain intangible cultural heritage practices traditionally observed in the Project-affected settlements, such as lacemaking and the traditional preparation of "chechil" cheese, are gradually declining due to ongoing urbanization and socio-economic changes in rural areas. Consequently, the Project is not expected to have a direct negative or positive influence on the preservation or promotion of these cultural traditions.

At the same time, the Ghapama[128] Festival 2025, held in October 2025 in the village of Nor Kyanq, brought together enthusiasts of Armenian culinary and cultural traditions[129]. The event demonstrates potential to become an annual festival. If institutionalized as a recurring celebration, it could contribute to local socio-economic development by positioning the Artik Reservoir area as an emerging cultural and tourism destination within Shirak Marz and beyond.

In this context, the Project impact on the local intangible cultural heritage is assessed as positive, provided that it can contribute to the development of tourism in the Project region. To support this potential, discussions should be held with the heads of Artik community and Nor Kyanq settlement, as well as with local cultural NGOs, tourism organizations, organizer of the Ghapama Festival, and other relevant stakeholders.

[128]Ghapama is a beloved traditional Armenian dish typically prepared during festive occasions. It is a stuffed pumpkin dish. A small to medium-sized pumpkin is hollowed out, filled with a mixture of rice, dried fruits, nuts, honey, and spices, then baked until tender.
[129]https://armenpress.am/hy/article/1232516

The assessment of the Project impact on cultural landscapes is embedded in **Section 8.2.5** 'Impacts on Landscape and Visual Amenity'.

*Impact assessment and mitigation measures*

The assessment and mitigation of the intangible cultural heritage impacts during the construction and operation phases of the reservoir are summarised in **Table 8-32**.

**Table 8-32. Summary of intangible cultural heritage impact assessment and mitigation measures**

| Receptor | Assessed Impact | Mitigation / management measures | Residual impact |
|---|---|---|---|
| CONSTRUCTION PHASE | | | |
| Local residents | Low | Communicate the provisions of the Traffic Management Plan to the population of rural settlements within the Project command area to help them plan Christmas, New Year, Easter, Trndez, weddings, and other celebrations and to avoid additional nuisance. | Negligible |
| OPERATION PHASE | | | |
| Local residents, tourists and visitors, cultural NGOs, tourism organizations | Neutral | Engage with local cultural NGOs, tourism organizations, the heads of the Artik community and Nor Kyanq settlement, the organizers of the Ghapama Festival, and other relevant stakeholders to explore opportunities for promoting and institutionalizing the Ghapama Festival as a recurring cultural event. | Positive |

## 8.6 Cumulative Impact Assessment

### 8.6.1 Introduction

This section summarizes the results of the Cumulative Impact Assessment (CIA), which examines the combined environmental and social impacts of the Project together with other existing or planned developments within its area of influence. The CIA includes activities for which sufficient publicly available information exists to identify potential temporal or spatial overlaps with the Project and to evaluate the resulting cumulative effects.

The CIA methodology follows the step-by-step process outlined in the *IFC Cumulative Impact Assessment and Management - Guidelines for the Private Sector in Emerging Markets* (2013)[130], and is aligned with the requirements of the EIA Directive. In accordance with these guidelines, the CIA is conducted in six steps:

Step 1 - Identification of Valued Environmental and Social Components (VEC)[131], establishment of spatial and temporal assessment boundaries,

Step 2 - Identification of other projects / activities affecting VECs included into the assessment,

Step 3 - Collecting data on and establishment of the baseline conditions of the identified VECs (this information is presented in Chapter 6 and is not repeated in the current section,

Step 4 - Assessment of the cumulative impacts on the identified VECs,

[130] https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/publications_handbook_cumulativeimpactassessment.
[131] VECs may include: a) physical features, habitats, wildlife populations, b) ecosystem services, natural processes (e.g., water flow, microclimate), c) social conditions (e.g., health, income), or d) cultural aspects (e.g., recreation habits, local traditions).

Step 5 - Assessment of significance for the predicted cumulative impacts,

Step 6 - Management of the cumulative impacts.

### 8.6.2 Step 1 - Identification of VECs, and Establishing Spatial and Temporal Assessment Boundaries

Valued Environmental and Social Components (VECs) are environmental and social features, processes, or components whose viability or sustainability may be affected by the Project. The focus of the CIA is on 'ultimate recipients of impacts' (IFC, 2013). For this assessment, the VECs correspond to the environmental and social receptors of Project's impacts identified in **Chapter 8**. Only VECs associated with adverse residual impacts of low to moderate significance, as well as those with positive residual impacts, are considered likely to be affected by cumulative effects and therefore are included in the CIA.

The VECs identified for consideration in the CIA include:

- **Local population**:
  - Residents of Nor Kyanq settlement affected by increased road safety risks related to Project-related traffic crossing through the settlement, as well as by the emissions and noise from these vehicles (mainly, during construction phase).
  - Communities affected by the increased risk of exposure to diseases including socially significant diseases related to migrant worker influx during the construction phase,
  - Occasional visitors (namely, shepherds and farmers) of the vicinities of the Project sites affected by noise and vibration and visual effects of the construction works,
  - Female residents of the villages exposed to security risks related to male migrant worker influx during the construction phase,
  - Downstream communities exposed to the risk of dam collapse and accidental flow release which will threaten their lives and property
- **Irrigation water users** in Nor Kyanq, Vardaqar, Panik, Meghrashen and Anushavan villages, who would be positively impacted by the sustainable supply of irrigation water for agriculture production.
- **Private land owners and users of communal land plots** to be acquired for the Project needs.
- **Users of M1 highway and H21 communal road** affected by the increased traffic density and increased risks of traffic accidents during the construction phase.
- **Construction workers** exposed to occupational health and safety risks associated with:
  - Performing high-hazardous works at the construction sites (earthworks, works at height, with high voltage, outdoors works in extremely hot weather conditions, works on or close to the open waterbodies, works with pressurized systems),
  - Handling of chemical and materials at the construction sites,
  - Traffic accidents,
  - Dust and ICE emissions and air pollution in the work zone,
  - Noise and vibration from operation of the construction machinery and equipment,

  - Potential spread of waterborne diseases (if construction activities disrupt the river and result in areas of stagnation water that favour the growth of bacterial pathogens),
  - Potentially insufficient sanitation at the construction sites / construction camps.

- **Operation and maintenance workers** during the reservoir operation phase
- **Local workforce** that would benefit from Project-related new employment opportunities for skilled, semi-skilled, and unskilled construction workers during the construction phase,
- **Wildlife** within the Project sites that will either be relocated to safe areas (sedentary species) or forced to migrate from the Project sites and their vicinities (large mammals and birds) because of construction activities.
- **Vegetation cover and flora** within the Project sites that will be destructed and lost because of construction works.
- **Habitats** at the Project sites that will be destructed or lost due to construction works. Compensation and offsetting measures will be implemented to ensure that the Project achieves “no net loss” or “net gain” status.
- **Natural landscape** of the Project area, which will be modified by the clearance of trees and occurrence of the temporary landscape forms (stockpiling of topsoil, clay and gravel, borrow pit) – during construction phase, and permanent change in land cover with new visual elements during operation.
- **Surface water resources** (the Artikjur River) in terms of:
  - Potential negative impact on the river water quality from contaminated surface runoff, dust, and waste from the construction sites,
  - Change of the river’s hydrological regime once the reservoir is completed.
  - Positive impact on the river water quality downstream of the reservoir due to natural self-purification process during the operation phase,
- **Soil resources** due to soil disturbance and risk of soil contaminations at construction sites.
- **Local and regional infrastructure facilities** will be exposed to additional load related to the Project activities during the construction phase, namely:
  - Power supply lines - by temporary increase in electricity consumption during Project construction,
  - Local healthcare facilities - by potential increase in demand for medical services generated by the temporary construction workers,
  - Regional waste management infrastructure – by increase in the volumes of household waste, hazardous waste (including waste collection, transportation, and utilization),
  - Roads comprising the main Project transportation route - M1 highway and H21 road - by increased heavy vehicle traffic for transporting construction materials and equipment, which may result in road deterioration.
- **Local and regional economies** that would benefit from:
  - Increased demand for certain goods and services, enabling some local and regional businesses to become Project suppliers during the construction phase (e.g. providing meal preparation and delivery, housekeeping services at the construction camps,

construction machinery maintenance and repair, and construction waste transportation, etc.),

- Reliable irrigation water supply, enabling farmers to cultivate additional land, diversify crops, and increase agricultural production, thereby enhancing economic opportunities for local communities.

The following VECs **were excluded from the CIA**, as the residual significance of the Project's impacts on them is predicted to be negligible or low to negligible:

- Local communities during the Project operation phase,
- Wildlife / flora of the Project site during operation phase,
- Soil resources during operation phase,
- Tangible and intangible cultural heritage.

The CIA **spatial boundaries** are assumed to coincide with the boundaries of Shirak Marz.

The CIA **temporal boundaries** are assumed to include Project construction and operation phases. The estimated duration of the construction phase is 33 months, while the operation phase is assumed to last at least 50 years.

### 8.6.3 Step 2 - Identification of Other Activities/Projects for the Inclusion in the CIA

The current CIA examines the interactions between the Project and other existing or planned activities that overlap with it spatially and temporally and can impact the same VECs. The following projects and programmes have been identified and reviewed:

1. **Local and regional development plans/programmes:**
   - 1.1. Artik Community Five-Year Development Plan for 2022–2026.
2. **Concurrent projects in the Project area:**
   - 2.1. Construction of the Kaps reservoir - irrigation and water-management project north of Gyumri, located on the Akhuryan River, and resettlement of the partly submerged village of Jradzor (ongoing in 2025).
   - 2.2. Construction of Lanjik-Gyumri section within the «North-South Road Corridor Investment Program – the section is passing around 6 km from planned reservour in a straight line (ongoing in 2025).
   - 2.3. Construction of the Shirak Dry Port / Industrial Park - multimodal logistics and industrial hub in Gyumri (feasibility study completed as of beginning of 2025)
   - 2.4. The Artik Community Development Plan until 2026 includes plans for the implementation of the following projects: i) reconstruction of potable water supply network in 6 settlements (not specified), ii) construction of irrigation network in Nor Kyanq settlement, iii) reconstruction of House of culture in Horom settlement, reconstruction of muzical school in Nor Kyanq settlement, iv) (re-)construction of kindergarten in Artik town and Nor Kyanq settlement, v) asphalt pavement works in Artik town, vi) extension of street lighting in Artik and Vardaqar settlements, and vii) rehabilitation of two parks in Artik town.

Implementation of the above-mentioned development programmes and projects may have both spatial and temporal overlaps with the Project. While the temporal overlap is likely, the spatial overlap can only be foreseen to certain Project components, such as the main delivery roads.

### 8.6.4 Step 3 - Collecting data on and establishment of the baseline conditions of the identified VECs

This information is provided in **Chapter 6** and is therefore not repeated in the current section.

### 8.6.5 Steps 4 and 5 - Assessment and Evaluation of the Key Cumulative Impacts

*Construction phase*

During construction phase, cumulative impacts may result from the overlap between Project activities and concurrent projects in the Project area.

The current CIA indicates that many of the Project's impacts are not significantly amplified by those of other activities or projects. As a result, the cumulative impacts are expected to remain at a similar level of significance as the Project's own residual impacts, including:

- Impacts of low significance:
    - Cumulative OHS risks for construction workers, except for those related to road safety.
    - Cumulative adverse impacts on fauna, including invertebrates, sedentary animals, birds and aquatic species resulting from disturbance, destruction of foraging and/or breeding habitats as a result of construction works,
    - Cumulative adverse impact on the water quality of the the Artikjur River due to surface runoff and waste from the construction sites,
    - Cumulative adverse impacts on soil resources in the community due to multiple construction activities,
    - Cumulative visual impacts due to temporary (during construction) and permanent (during Project operation) landscape transformation by new visual elements including the planned transmission line,
    - Impacts on public infrastructure due to aggregated needs of the Project and concurrent construction activities in case of significant temporal overlap.
- Impacts of moderate significance:
    - Cumulative impact on habitats during Project construction, in particular fragmentation of natural habitats,
    - Loss of flora species as a result of construction works at the Project sites and along planned power line route.

  Note: "No net biodiversity loss" status, and when possible "net biodiversity gain" is expected to be achieved.

However, there are cumulative impacts that will amplify Project-related impacts. The significance of these cumulative impacts is assessed as low to moderate. These impacts include:

- Cumulative risk of traffic accidents affecting construction workers, residents, and other road users on roads designated as primary transportation routes for the Project and concurrent activities.
- The cumulative impact on road conditions resulting from Project traffic and concurrent construction activities along same transportation routes.
- Positive cumulative impact on the local workforce through the creation of new employment opportunities, and development of new skills among construction workers.

- Positive aggregated impact on local and regional economic development, driven by increased demand for goods and services provided by local and regional businesses (e.g., meal preparation and delivery, maintenance and repair of construction machinery, removal of construction waste, etc.).

*Operation phase*

There are no long-term plans or programs available publicly to assess potential cumulative impacts during project operation phase.

### 8.6.6 Step 6 - Cumulative Impacts Management

As discussed above, the potential cumulative impacts on the VECs considered in this CIA are expected to remain largely unchanged or show only minor increases in the significance of the Project's residual impacts. Overall, the assessment did not identify any cumulative impacts of moderate or high adverse significance.

***Recommended Impact Prevention / Mitigation Measures to Reduce Adverse Cumulative Impacts:***

- Develop a Construction Traffic Management Plan, that accounts for the traffic flows of concurrent activities to minimize overlaps. The Plan should aim to reduce cumulative impacts on local communities and sensitive receptors (schools, hospitals, residential areas, other social infrastructure facilities), through measures including avoidance, scheduling adjustments, additional traffic signs, driver training etc.
- Conduct timely equipment maintenance, limit noisy operations to the daytime, and implement appropriate dust control measures to reduce potential cumulative noise and dust impacts on local communities. In addition, execution of blasting operation that may be required both for the reservoir and road (tunnels) construction, should be coordinated.
- Constantly engage with local communities and disclose relevant information, including on planned transportation routes.

The implementation of these measures **will reduce the significance of adverse cumulative impacts related to construction traffic to minor**.

## 8.7 Summary of E&S Impacts, Benefits and Opportunities

1) The Artikjur is a river in Armenia that flows through the Artik town, Shirak Marz. It originates from the northwestern slope of Mount Aragats and flows for 26 km before joining the Karkachan River, which is a tributary of the Akhuryan[132] River. The Artik River is known for its role in supplying water to the planned Artik Reservoir and for the potential flood risks it presents during snowmelt and heavy rainfall.
2) A conservative evaluation of the planned reservoir' impacts downstream of the reservoir has been made possible through basic hydrological modelling (SWAT+) and expert judgment. The assessment indicates that the Artik reservoir is unlikely to cause significant impacts. This conclusion is primarily based on the upstream positions relative to existing lakes or reservoirs, and the relatively small size of the rivers they impound.

[132]Arpacay River in Turkey

3) The Project is assessed as aligned with the goals of the Paris Agreement and is included on the aligned list under the water supply and wastewater category. No project activities have been identified on the 'non-aligned list'. The Project is also assessed as aligned with the mitigation goals of the Paris Agreement (BB1 aligned).

   The Project does align with some of the targets outlined in Armenia's draft LT-LEDS and, therefore, the country's NDC in that it is designed to improve water supply and efficiency in irrigation. However, it is noted that GHG emission estimates at this stage show net positive carbon emissions for reservoir over 100 years. The total GHG emissions from the planned reservoir at year 1 are estimated 81.6 tCO2e/year, while at year 50 - 16.5 tCO2e/year.

4) Approximately 90% of the total air emissions from construction activities are expected to consist of dust (PM2.5 and PM10). According to air emissions calculations, the maximum dust emission rate during the construction phase is estimated at 1.05 g/sec, which is unlikely to have a significant impact on ground-level atmospheric dust concentrations. A similar conclusion applies to gaseous emissions, which are also expected to remain below acceptable limits and pose minimal risk to ambient air quality. There are no residential houses in the immediate vicinity of the construction site, construction camps and borrow-pits. Therefore, air pollutants, as well as noise and vibration from construction machinery and operations, are not expected to affect the local population, although some negative impact on workers employed by the contractors may occur.

   The air emissions from the operated reservoir will be minimal and will primarily depend on the climatic conditions in the Project region. The noise and vibration impact during the Project operation phase is negligible.

5) Due to the topographical characteristics of the Project area, the construction site will not be visible from the H21 "H75-Horom-Alagyaz" road, nor from Artik town and Nor Kyanq village, which are the nearest settlements to the reservoir area. However, during the construction phase, certain elements of the site, such as material stockpiles, construction equipment and vehicle movements, may become visible to travelers and drivers along the H21 road. The exact locations of the borrow pits have not yet been determined; therefore, their potential visibility from nearby sensitive receptors cannot be evaluated at this stage. This impact is unavoidable; however, it is short-term (limited to the construction period).

   As a result of the Project implementation, the landscape of the Project area will undergo a permanent transformation due to the formation of the reservoir and the presence of associated infrastructure. Overall, the visual impact during the operation phase is long-term and permanent. However, effective landscaping and environmental integration measures can help mitigate negative visual effects. Over time, the Project's visual impact may even become positive.

   Project implementation may also have a positive impact on the cultural landscape. The irrigation of currently uncultivated land plots using reservoir water is also expected to have an indirect positive effect on the visual amenity of the Project region, by promoting greener and more cultivated landscapes.

6) Excavation and earthworks involve the movement of certain amount of soil, including topsoil and excavated subsoil. These activities can potentially trigger landslides, mass movements, and other erosion processes. Additionally, disturbed soils may become temporarily destabilized due to precipitation and surface runoff, increasing the risk of geological erosion. The combined effects on soil stability and changes in topography can create conditions that lead to temporary but harmful erosion and sedimentation.

7) According to the results of the engineering-geological study, the estimated annual water infiltration from the reservoir body is significant, indicating the need for anti-infiltration measures, which are described in detail in the project design documentation. Implementation of the proposed measures is expected to reduce water infiltration from the reservoir to an acceptable level of 7,197 m³ per year.

8) During the construction phase, contamination of the Artikjur River may occur due to dust deposition, exhaust gas emissions from construction machinery and heavy trucks, spills of hazardous materials and improper management of storage areas. The construction of the reservoir may also alter the hydrological regime of the Artikjur River.

9) A portion of the materials excavated from the reservoir basin will consist of cobble-pebble aggregates, which are planned to be reused for the construction of the reservoir dam. However, the volume of spoil expected to be generated during excavation and associated earthworks has not been specified in the Project design documentation or the national EIA study. The number and locations of Spoil Disposal Areas (SDAs) have not been determined within the Project design stage and therefore will be identified and agreed with the heads of affected communities and, where relevant, the respective private landowners. Proper management of waste streams generated during the construction phase will be ensured through a detailed Waste Management Plan.

10) The impacts of the Project on biodiversity will occur during both construction and operation phases. The construction phase includes construction of the dam, feeding and irrigation channels and reservoir filling. Due to the species' varying responses to different impacts, the sensitivity of each species (receptors) was taken into account during the assessment.

11) The negative impacts occur mainly during the construction phase; they are caused by the dam building and flooding of the reservoir footprint area. Some positive impacts on biodiversity will occur during the operational phase, associated with the emergence of the new habitats, such as large water surface and coastal vegetation, which will attract various animal species.

12) Priority habitats of this area are the following: C1.4 Permanent dystrophic lakes, ponds and pools = 3160 Natural dystrophic lakes and ponds (1.42 ha) and E1.2 Perennial calcareous grasslands and basic steppes = 62C0* Ponto-Sarmatic steppes (28.54 ha). The total lost area of the habitats is 29.96 ha.

    The 62C0* habitat will be destructed by the reservoir filling. Regarding the water habitat 3160 (the existing pond), it should be studied to decide whether the new reservoir may be considered as similar habitat. One of the key features is that the pond is the habitat of the priority species Syrian spadefoot, *Pelobates syriacus*.

13) The fishless pond located in the footprint area is a favourable breeding area for the Syrian spadefoot, *Pelobates syriacus*, whose big tadpoles (38 individuals were counted there during ichthyological study) live and grow there. However, the reservoir will flood the pond. The pond, which is a breeding ground for the Syrian spadefoot, needs to be further studied by amphibian experts to determine what impact the construction work to convert the pond into a reservoir may have and whether the reservoir will continue to be a breeding ground for the species after that.

14) Due to large distances, there will be no negative impact on the nationally protected areas, Candidate Emerald sites or KBA/IBA areas.

15) However, the movement of Project-related construction machinery and vehicles will contribute to increased traffic density along the H21 road and the M1 highway, both of which

are already subject to heavy use by freight vehicles and construction trucks serving the ongoing North-South Road Corridor Project. A Traffic Management Plan shall be developed for the Project.

16) The Project impacts on the socio-economic receptors of the Project area are mostly positive during both construction and operation phases. The residents of impacted communities might be positively impacted by the new employment opportunities during the Project construction stage, thereof increasing the households' income. Also, local and regional businesses may join the project supply chain - in areas including transportation, and provision of goods and services.

17) The Project's implementation will lead to the increased irrigation of the region's agricultural lands, directly benefiting the socio-economic well-being of the local population. The residents of Artik enlarged community, including impacted settlements are predominantly involved in agricultural activities, including cultivation of wheat, barley, potatoes, vegetables, and animal husbandry. Therefore, ensuring the availability and protection of irrigated lands, grasslands, and pastures is crucial, given their vital role in supporting the livelihoods of the community population.

18) The Project's implementation will allow irrigation of approximately 300 ha of agricultural lands, positively impacting the socio-economic conditions of the local population. The reservoir reconstruction and enhancement of irrigation water supply are expected to elevate living standards in the area, thereby contributing to a reduction in poverty rates among the local residents.

19) Artik Reservoir is planned within the existing 1992 year's boundaries (though the dam is planned to be placed 400 m away from the old facilities) with land acquisition required only for the feeding and irrigation channels. It will require around 96,065 $m^2$ of private, communal and state land in Nor Kyanq, Anushavan, Panik, Artik, Tufashen, and Pemzashen settlements.

20) Physical factors such as air and noise emissions, soil contamination, and wastewater discharge are unlikely to affect the health and safety of residents in Artik enlarged community. Labour influx might increase the risk of the local community exposure to diseases, including socially significant diseases, as well as safety and security risks. Emergency situations pose risks to the community both during construction and operation stages. The construction works must be performed in accordance with an Occupational Health and Safety Management Plan.

21) The Project Implementation Unit (PIU) should require compliance with the national labour regulations from the contractors via contractual clauses. Monitoring of the human resources practises should be performed among the workers on site (work schedule and shift duration, full rest days, provision of paid sick leave, payments above the minimum required level etc.), and in the labour accommodation camps (freedom of movement, availability and conditions of sanitary facilities, sufficient private space, dining facilities etc.).

22) A Worker Code of Conduct, Local Employment and Procurement Plan and Gender-Based Violence and Harassment (GBVH) Policy should be developed and conveyed to all construction workers and contractors. A grievance mechanism with a specific mandate on GBVH should be developed and disclosed, a dedicated person to manage / oversee it should be appointed.

23) Four cultural heritage assets have been identified in the vicinity of the proposed reservoir area and associated infrastructure. Two of these assets are located within the Project's

direct impact zone, approximately 6 m and 20 m from the irrigation channel, respectively. Another monument is situated at an approximate distance of 75 m from the irrigation channel. A detailed field-based archaeological investigation shall be undertaken within the planned reservoir and dam areas, as well as along the proposed feeding and irrigation channels. Based on the findings of this investigation, a site-specific Cultural Heritage Management Plan (CHMP) shall be developed and implemented.

No adverse impacts on tangible cultural heritage sites/units are anticipated during the Project's operation phase. On the contrary, the presence of the reservoir may generate positive synergistic effects by enhancing the attractiveness of the area and potentially increasing visitor interest in the historical monuments located within Artik enlarged community.

24) The implementation of the Project is not expected to have any adverse impact on Intangible Cultural Heritage (ICH) elements registered in either the UNESCO or national ICH lists. Furthermore, the Project will not negatively affect local traditions or rituals. On the contrary, the Artik Reservoir has the potential to serve as an additional point of interest and contribute to the tourism appeal of the Artik enlarged community.

25) The Cumulative Impact Assessment prepared for the Project did not identify any major negative cumulative impacts.

26) E&S Monitoring Plans for construction and operation phases will be developed, agreed with the Supervision engineer and Lenders, and implemented by the Construction contractor (during construction phase) and the Client (during the operation phase). Both observational and instrumental monitoring will be conducted as per the Monitoring Plans. Appropriate human and material resources for their implementation will be allocated.

# 9. Environmental and Social Management and Monitoring

## 9.1 Introduction

The Project's Environmental and Social Management Plan (ESMP) is a standalone document associated with this ESIA Report. It comprises a set of mitigation and management measures, criteria for their effective implementation, and institutional arrangements to be undertaken throughout the Project's life cycle to prevent, reduce and compensate adverse E&S impacts to acceptable levels. The ESMP has been prepared based on the findings of this E&S appraisal to ensure that the Project is implemented in compliance with applicable national E&S laws and regulations, the EBRD ESP (2019), relevant EU directives, and Good International Practices (GIP).

The ESMP is a key document that outlines the E&S requirements, including those related to cultural heritage (both tangible and intangible), land tenure, emergency situations, and community and occupational health and safety risks, and specifies the operational procedures necessary to manage significant issues that may arise during Project implementation.

The ESMP will be implemented during the construction (including pre-construction) and operation (including maintenance) phases of the Project. As such, it can be used as a standalone document throughout the different phases of the Project by key stakeholders, including:

- **Construction contractor(s)** - during the pre-construction and construction phases,
- **The Supervision engineer** - during the construction phase,
- **The Client (Water Committee with its PIU)**, in its capacity as Project owner and developer - throughout the Project construction phase,
- **"Jrar" CJSC**, in its capacity as reservoir operator - throughout the Project operation phase,
- **The Contractors** engaged by the Client or reservoir operator ("Jrar CJSC" under the MTAI) - during the maintenance phase,
- **EBRD** - during the active period of the loan agreement,
- **Other governmental authorities** (MTAI, ME) and inspection bodies,
- **Local self-governmental bodies** – Municipality of Artik enlarged community.

The Client holds the overall responsibility for the implementation and supervision of the E&S management and mitigation measures outlined in the Project's ESMP. The further development and effective implementation of these measures prior to and during the construction phase will be delegated to the Construction contractor(s) and supervised by the Supervision engineer, who will be appointed by the Client. The Client or the water reservoir operator - "Jrar" CJSC, will be responsible for and take ownership of the measures relevant to the operation and maintenance phase of the Project.

This chapter outlines the key objectives and fundamental principles of the ESMP, as well as its structure and content.

## 9.2 Objectives of Environmental and Social Management

E&S management and monitoring measures represent the primary outputs of the Project's ESIA process. They are intended to address identified E&S impacts and risks and to reduce them to acceptable levels in line with national regulatory and EBRD ESP requirements. The key objectives of the E&S management/monitoring are to:

- **Integrate environmental and social considerations** into all phases of Project design, construction and operation (maintenance),
- **Ensure compliance** with national legal requirements, EBRD PRs, and other applicable international standards,
- **Avoid, minimize, or mitigate adverse impacts** on the environment, workers, and affected communities through effective planning and implementation of mitigation measures,
- **Establish clear roles, responsibilities, and procedures** for the implementation of E&S mitigation and monitoring measures, as outlined in the Project's ESMP,
- **Promote continuous improvement** in E&S performance through adaptive management, regular monitoring, and corrective actions,
- **Enhance transparency and accountability** by ensuring timely reporting to the Client, EBRD, competent authorities, and other relevant stakeholders,
- **Facilitate stakeholder engagement** by ensuring that the concerns and expectations of affected communities and other stakeholders are considered and addressed throughout the Project life cycle.

## 9.3 Principles of Environmental and Social Management across the Project Life Cycle

*Pre-construction Phase*

Any requirement arising from the process of obtaining specific Project-related decisions (such as approvals, permits, or consents) from national and/or local self-governmental bodies (e.g., ministries, communities, inspection bodies, agencies) and/or the Client and EBRD during the pre-construction stage will be incorporated into the final construction documentation.

*Construction Phase*

In principle, the implementation of the key E&S mitigation measures related to the construction phase will be delegated to the Construction contractor(s). This delegation will be governed by the ESMP, which will form part of the tender documents, procurement process, and the Construction contractor's contract.

The Construction contractor(s) will develop their own Construction Environmental and Social Management Plans (CESMP), which must be aligned with this ESIA Report and the associated ESMP. The CESMP will include Site-Specific Environmental and Social Management and Monitoring Plans (SSESMPs) or procedures to address E&S issues during the construction period. The Supervision engineer, appointed by the Client, shall review and approve these documents.

It will be the responsibility of the appointed construction contractor(s) to further elaborate on the issues addressed in the ESMP as the Project planning progresses, both prior to and during construction. This includes, but is not limited to, the establishment of construction zones, temporary facilities for the workforce, details for storing construction and other materials, traffic and transport management, environmental protection and waste management, labour management, occupational and community health and safety, emergency preparedness, and other relevant matters.

*Operational Phase*

The operation phase will commence following the full commissioning of the reservoir and supporting infrastructure. At that stage, all works will have been handed over by the Construction contractor to the reservoir operator ("Jrar" CJSC), who will be responsible for implementing the majority of E&S

management measures to ensure continued compliance with the Project's mitigation strategy. These measures will be managed through "Jrar" CJSC's Environmental and Social Management System (ESMS), in alignment with applicable regulations and guidelines.

In addition, the implementation of key E&S mitigation measures related to maintenance activities may be delegated to a designated contractor (i.e. the reservoir maintenance contractor). Such delegation will be governed by specific contractual arrangements.

## 9.4 Site-Specific Environmental and Social Management and Monitoring Plans

The Consultant recommends a set of specific operational, management, and monitoring plans that should be prepared by the construction contractor in line with the Project's ESMP and implemented during the pre-construction and construction phases to effectively manage E&S impacts. At a minimum, the proposed SSESMPs shall include:

- Traffic Management Plan,
- Topsoil Management Plan,
- Borrow Pit Management Plan,
- Spoil Disposal Management Plan,
- Hazardous Materials Management Plan,
- Spill Prevention and Management Plan,
- Waste Management Plan,
- Occupational Health and Safety Management Plan,
- Construction Camp Management Plan, including sub-plans for Camp Code of Conduct and Camp Management,
- Local Employment and Procurement Plan,
- Cultural Heritage Management Plan,
- Chance Find Procedure,
- Riverine Habitat Construction Plan,
- Air, Water, and Soil Quality Monitoring Plan,
- Noise and Vibration Monitoring Plan,
- Stakeholder Management Plan (that shall be updated at least once a year).

## 9.5 Organizational Structure of Environmental and Social Management

The organizational structure of the Project's E&S management is presented in the **Figure 9-1**.

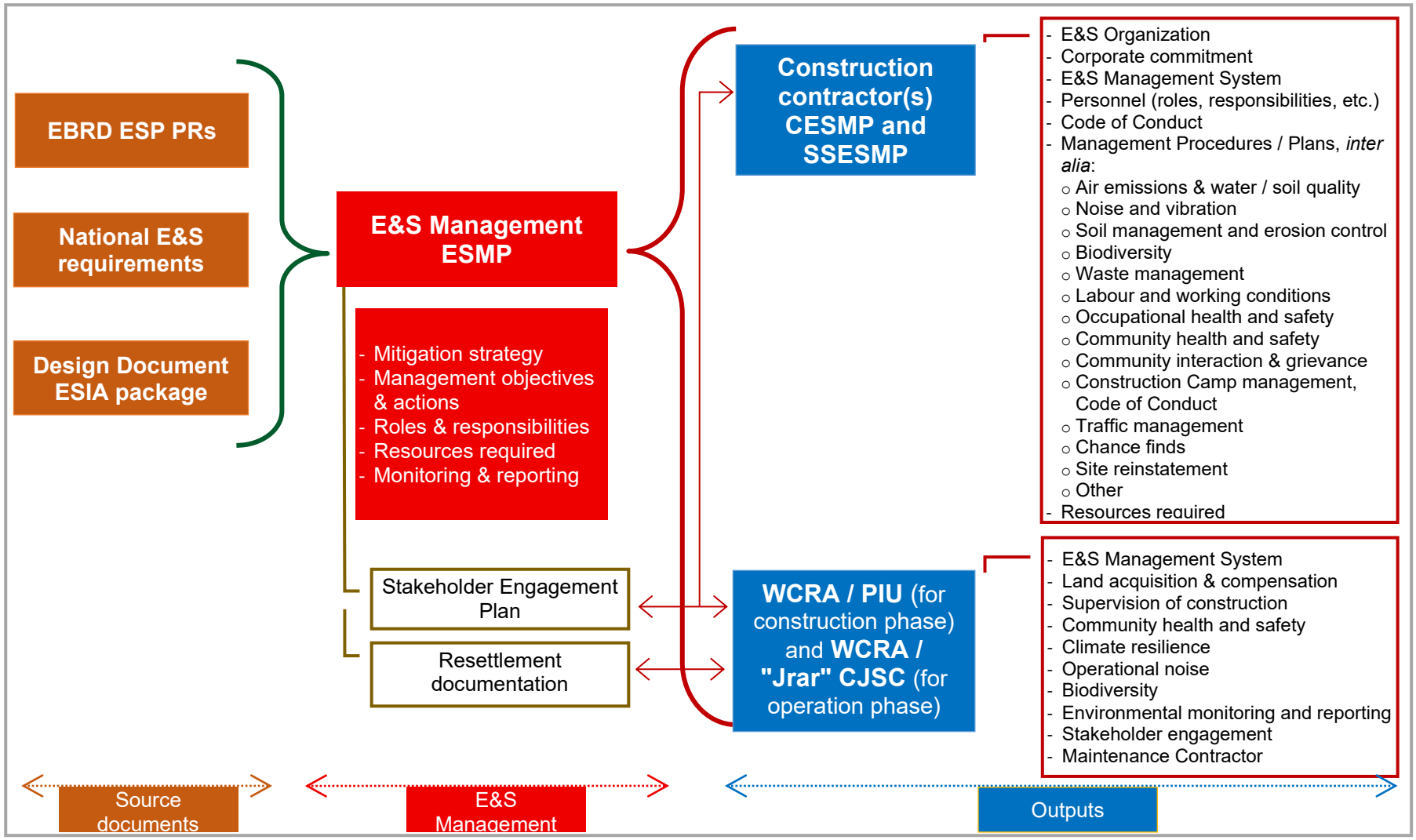
The source documents include:

- National legal act and regulations,
- EBRD ESP, applicable EU directives and GIPs,
- Design documents - to be prepared to meet national regulations as well as the best international practice,
- ESIA report (this document) and the accompanying documents (ESIA package), and upcoming updates.

The output documents are:

- The CESMP and SSESMPs to be prepared by the Construction contractor(s) to achieve the E&S performance objectives during the Project's construction phase,
- The Client's or PIU's ESMS, required to implement and monitor the management actions described in the ESMP,
- Detailed E&S management procedures necessary to address the mitigation and compensation measures identified through this E&S assessment, and
- Various documents to be produced and disclosed during Project implementation to provide information on construction and operation activities, as well as the results of E&S monitoring.

**Figure 9-1. Structure and organization of the Project's Environmental and Social Management**



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Annex 1

ՀԱՍՏԱՏՈՒՄ ԵՄ՝
Շրջակա միջավայրի նախարար
Հակոբ Սիմիդյան
«13» 12. 2024թ.

# ՊԵՏԱԿԱՆ ՓՈՐՁԱՔՆՆԱԿԱՆ ԵԶՐԱԿԱՑՈՒԹՅՈՒՆ

## ՇՐՋԱԿԱ ՄԻՋԱՎԱՅՐԻ ՎՐԱ ԱԶԴԵՑՈՒԹՅԱՆ ՓՈՐՁԱՔՆՆՈՒԹՅԱՆ

**ԲՓ N 278 - 24**

**Նախաձեռնող՝** «Ակադեմիկոս Ի.Վ. Եղիազարովի անվան ջրային հիմնահարցերի և հիդրոտեխնիկայի ինստիտուտ» ՓԲԸ
ք.. Երևան Արմենակյան 125/3

**Գործունեությունը՝** Արթիկ համայնքի Արթիկի ջրամբարի վերակառուցում
Շիրակի մարզ

**Առդիր՝ 9 թերթ**

**ՊԵՏԱԿԱՆ ՓՈՐՁԱՔՆՆԱԿԱՆ ԵԶՐԱԿԱՑՈՒԹՅՈՒՆ**
**ՇՐՋԱԿԱ ՄԻՋԱՎԱՅՐԻ ՎՐԱ ԱԶԴԵՑՈՒԹՅԱՆ ՓՈՐՁԱՔՆՆՈՒԹՅԱՆ**

**ԲՓ №** 278 - 24

«13» դեկտեմբերի **2024թ.**

**Շիրակի մարզի Արթիկի ջրամբարի վերակառուցման աշխատանքների շրջակա միջավայրի վրա ազդեցության գնահատման հաշվետվություն**

| | |
|---|---|
| Նախաձեռնող՝ | «Ակադեմիկոս Ի.Վ. Եղիազարովի անվան ջրային հիմնահարցերի և հիդրոտեխնիկայի ինստիտուտ» |
| Փաստաթղթի տեսակը՝ | Շրջակա միջավայրի վրա ազդեցության գնահատման ՇՄԱԳ հաշվետվություն/նախագիծ |
| Գործունեության տեսակը՝ | «Բ» կատեգորիա |
| Գտնվելու վայրը | Շիրակի մարզ Արթիկ համայնք Նոր Կյանք, Վարդաքար, Փանիկ, Մեղրաշեն և Անուշավան բնակավայրեր |

***Ներածական մաս.*** Փորձաքննության ներկայացված ՇՄԱԳ հաշվետվությամբ նախատեսվող գործունեությունն իրականացվելու է Շիրակի մարզ Արթիկ համայնքի Նոր Կյանք բնակավայրի վարչական տարածքում: Համաձայն «Շրջակա միջավայրի վրա ազդեցության գնահատման և փորձաքննության մասին» օրենքի 12-րդ հոդվածի 4-րդ մասի 3)-րդ կետի «ա» ենթակետի և 18-րդ հոդվածի՝ շրջակա միջավայրի վրա ազդեցության գնահատման և փորձաքննության է ենթակա նաև նախատեսվող գործունեության տեսակների վերակառուցում կամ ընդլայնում կամ տեխնիկական կամ տեխնոլոգիական վերազինում կամ վերապրոֆիլավորում կամ կոնսերվացում կամ տեղափոխում կամ դադարեցում կամ փակում կամ քանդում կամ նախագծային փոփոխությունը:

Նախագծով նախատեսվում է Արթիկի պատվարի և ջրամբարի վերակառուցում, որի հիմնական նպատակն է նպաստել Արթիկջուր գետի երկայնքով սակավ ջրային ռեսուրսների կայուն օգտագործմանը՝ հաշվի առնելով տարբեր մրցակցող ջրօգտագործողների շահերը: Ծրագիրը նպատակ ունի բարձրացնել գյուղատնտեսական արտադրողականությունը, նպաստել պարենային անվտանգության ապահովմանը, խթանել գյուղական զարգացումը և բնակչության կենսապայմանների բարելավումը, ինչպես նաև նվազեցնել թիրախային խմբի խոցելիությունը կլիմայի փոփոխության ազդեցությունների նկատմամբ, պաշտպանել տարածաշրջանում էկոհամակարգերն ու կենսաբազմազանությունը, ինչպես նաև նվազեցնել ռիսկը անավարտ Արթիկի պատվարի և ջրամբարից ներքև գտնվող բնակչության համար: Ծրագիրը միտված է Շիրակի մարզի Կարկաչուն գետի ոռոգման համակարգի ընդլայնմանն ու արդիականացմանը:

Ծրագիրն ընդգրկվելու է ջրային ռեսուրսների համապարփակ կառավարման

շրջանակում՝ Արթիկջուր գետի ավազանում և ջրօգտագործող խմբերի համար ջրային ռեսուրսների ավելի կայուն կառավարում ապահովելու համար: Արթիկի ջրամբարն ունենալու է 1.2 մլն.մ$^3$ պահեստավորման հզորություն,

Նախատեսվող գործունեության իրականացման համար հիմք են հանդիսացել նախագծային փաստաթղթերը՝

- նախկին ջրամբարի տարածքը ընդգրկող տեղամասի ինժեներաերկրաբանական հետազոտությունների եզրակացությունը,
- համապատասխան համաձայնությունները և թույլտվությունները,
- ճարտարապետահատակագծային առաջադրանքը՝ N 128ա/24 տրված 30.08.2024թ., հողամասի նպատակային և գործառնական նշանակությունն է՝ հիդրոտեխնիկական կառույցների հողեր:

***Նկարագրական մաս.*** Արթիկի ջրամբարը գտնվում է Շիրակի մարզի Արթիկի տարածաշրջանում՝ Կարկաչուն գետի ջրավազանում, Արթիկ քաղաքից հյուսիս-արևմուտք, Արթիկջուր գետի վրա: Արթիկի տարածաշրջանն ունի բազմաճյուղ ճանապարհային ցանց, տարածքով է անցնում Երևան-Գյումրի ավտոմայրուղին և երկաթուղին: Արթիկի ջրամբարը շահագործման է հանձնվել 1992 թվականին՝ տարածքի 5 համայնքներին պատկանող 300 հա գյուղատնտեսական հողատեսքերը ոռոգելու նպատակով: Արթիկի ջրամբարի պատվարի փլուզման հետ կապված պարզաբանվել են Արթիկջուր գետի բոլոր մորֆոմետրիկ տվյալները, ինչպես նաև Կարկաչուն գետի ձախափնյա երկու ձորակների տվյալները, որոնցից նախատեսվում է ջրի տեղափոխումը ջրամբարում կուտակման համար: Ելնելով վերը նշված ճշգրտումներից, իրականացվել են բոլոր հիդրոլոգիական բնութագրերի վերահաշվարկներ:
Արթիկի ջրամբարի վերակառուցման նախագծում որպես հեղեղային առավելագույն ելք ընդունվել է 0.1% ապահովածության՝ 23.4 մ3/վ: Իրիգացիոն ջրթողի թողունակությունը նեռարյալ բնապահպանական թողքերը ընդունվում է 320լ/վրկ: Մեռյալ ծավալը համաձայն ջրաբերուկների հոսքի մեծության 100 տարվա համար կազմում է 0.13 մլն մ$^3$:

Հիդրոլոգիական հաշվարկներում ուսումնասիրվել են Արթիկի ջրամբարի կառուցումից հետո նրա ազդեցությունը Վարդաքարի ջրամբարի վրա: Իրականացվել է ջրային հաշվեկշիռ Վարդաքարի ջրամբարի ուղղահատավածքում: Համաձայն հաշվարկների Վարդաքարի ջրամբարի ուղղահատավածքում ջրի տարեկան հոսքը կազմում է 28.78 մլն.մ$^3$, որի հոսքը ամբողջությամբ բավարարում է Վարդաքարի ջրամբարի շահագործման պայմաններին: Արթիկի ջրամբարի կառուցումը բացասական ազդեցություն չի թողնելու Վարդաքարի ջրամբարի վրա:

Կատարվել է ջրի ելքերի վրա կլիմայի փոփոխության ազդեցության գնահատումը, համաձայն որի վերջին 20 տարիների ընթացքում ջրի ծախսը կտրուկ նվազել է ՝ 1998-2011թթ. 28.5% -ով, 2012-2022թթ. ՝ 30% -ով: Գեոդեզիական հետազննական աշխատանքները իրականցվել են Արթիկի ջրամբարի թասի, պատվարային հանգույցի, հանքատեղիների, մոտեցնող (դոտացիոն) և ոռոգման ջրանցքների տարածքներում:

Արթիկի ջրամբարի ծավալի ապահովման համար հարկավոր է Պեմզաշեն բնակավայրով անցնող երկու ձորակներով եկող ջրերն ուղղել դեպի ջրամբար: Այդ իրականացնելու համար ուսումնասիրվել է տեղանքը և ընտրվել է օպտիմալ մոտեցնող ջրանցքի առանցքը: Գլխամասից մինչև Արթիկջուր գետը ջրանցքի երկարությունը կկազմի մոտ 5600մ: Մոտեցնող ջրանցքից հետո Արթիկջուր գետով ջուրը կտեղափոխվի մինչև ջրամբար մոտ

2400մ: Արթիկի ջրամբարն օգտագործվելու է Նոր Կյանք, Վարդաքար, Փանիկ,Մեղրաշեն և Անուշավան բնակավայրերին պատկանող 300 հա գյուղատնտեսական հողատեսքերը ոռոգելու նպատակով: Այդ իրականացնելու համար պետք է կառուցվի մոտ 7.0 կմ ոռոգման ջրանցք, որն անցնելու է Նոր Կյանք , Փանիկ, Մեղրաշեն և Անուշավան բնակավայրերի տարածքով: Ջրատնտեսական հիմնվորումները ջրամբարի ծավալի որոշման համար իրականացվել են ելնելով Արթիկջուր գետի և Կարկաչուն գետի ձախափնյա հեղեղատարներից ջրամբար մուտք գործող ամսական 50% և 75% ապահովածության հոսքերի մեծություններից, 300 հա ամսական ոռոգման ջրապահանջարկի, ջրամբարից կորուստների (գոլորշիացում և ֆիլտրացիա), բնապահպանական ամսական թողքերի չափերից:

300 հա ոռոգման ջրապահանջարկի 50% ապահովածության համար հարկավոր է կառուցել ջրամբար՝ 1.112 մլն մ$^3$ օգտակար ծավալով: 75% ապահովածությամբ ջրամբարի կառուցման դեպքում հնարավոր չի ապահովել 300 հա ոռոգման ջրապահանջարկը:

Արթիկի ջրամբարը բաղկացած է լինելու՝

պատվարային հանգույցից՝

ա. Հողային պատվար,

բ. Գոյութուն ունեցող շինարարական ելքերի հեռացման ջրանցք,

գ. Ոռոգման ջրթող,

դ. Ջրընդունիչ ջրանցք,

ե. Հեղեղային ջրհեռ,

ջրամբարի թասից՝

ա. Պահակային-շահագործման տնակից,

բ. Մոտեցնող ջրանցքից,

գ. Ոռոգման ջրանցքից:

դ.Պատվարային հանգույց՝

հողային պատվարից՝

Պատվարի մարմինը նախատեսվում է իրականացնել տեղական շինարարական նյութերով՝ ճալաքարա-կոպճային գրունտներով, որպես հակաֆիլտրացիոն միջոցառում նախատեսվում է իրականացնել ավազակավե էկրանի և պանուրի կառուցում:

- Պատվարի առավելագույն բարձրությունը՝ 10.0 մ է նախատեսվում,
- Կատարի երկարությունը՝ 610 մ,
- Կատարի լայնությունը՝ 6 մ,
- Շեպերի թեքությունները՝ վերին բիեֆում - 1:3.5; 1:4.0; ներքին բիեֆում - 1:2.5,
- Կատարի նիշը՝ 1670.0 մ:

Վերին շեպը նախատեսվում է ամրացնել քարե շարվածքով: Պատվարի հակադարձ ֆիլտրը նախատեսվում է իրականացնել m=3.0 թեքությամբ, էկրանը՝m=3.0, իսկ անցումային շերտը ճալաքարա-կոպճային գրունտներից՝ m=2.0: Պատվարի նեքին բիեֆում նախատեսվում է քարային ցամաքուրդ: Պատվարի կատարի վերին և ներքին շեպերի եզրերում նախատեսվում է բետոնե եզրաքար: Պատվարի վերին շեպի ամբողջ

սահմանագծով նախատեսվում են՝ լուսավորության սյուներ 26մ քայլով, մետաղական բազրիք, մայթ 60սմ լայնությամբ և կատարից բարձր 20սմ-ով ասֆալտե ծածկույթով:

Պատվարի կատարում ամբողջ լայնքով (ներառյալ մայթը 0.60մ լայնքով) նախատեսվում է ասֆալտե ծածկույթ 8սմ, որից 5սմ-ը՝ խոշորահատիկ, իսկ 3սմ-ը մանրահատիկ շերտով: Պատվարի կատարն ունի թեքություն i=0.015 դեպի վերին շեպը: Յուրաքանչյուր 26.0 մետրը մեկ նախատեսվում է մետաղական D=102x4մմ խողովակներ L=2.5մ երկարությամբ, անձրևաջրերը հեռացնելու համար: Միաժամանակ նախատեսվում է կատարի երկարությամբ մետաղական D=325x6մմ կիսախողովակաշար անձրևաջրերի հավաքման հեռացման համար: Շինարարության ժամանակ գետի ելքերը հեռացնելու նպատակով օգտագործվելու հին ջրամբարի համար կառուցած Գ-20 տիպի ե/բ բլոկներով և ե/բ հատակով ջրանցքը: Ջրանցքը գտնվում է բարվոք վիճակում և այն շահագործման վիճակի բերելու համար նախատեսվում է իրականացնել՝

- ջրամբարի հատակի մաքրում բուսականությունից և բերվածքներից, հատակի խոռոչների լցափակում,
- մոտ 60մ հատվածի քանդված բլոկների փոխարինում նոր բլոկներով,
- Գ-20 տիպի հողմահարված բլոկների սվաղում:

Ոռոգման ջրթողը բաղկացած է լինելու՝

1. ջրընդունիչ աշտարակից՝ 3.3մ բարձրությամբ և 2.9x.4.4մ արտաքին չափերով,
2. ե/բ միաձուլ ջրթողից՝ 300մմ դատարկող և 700մմ ոռոգման խողովակներից ե/բ պատյանով 85մ երկարությամբ,
3. ջրթողման փականային խուց՝ կահավորվելու է 2 հատ 700մմ սողնակներով, 2 հատ 300մմ սողնակներով և 1 հատ 700մ ու 1 հատ 300մմ ուլտրաձայնային ջրաչափով,
4. ջրթողի ոռոգման ջրատար՝ D=700մմ պողպատե թաղված խողովակաշար 500մ երկարությամբ,
5. դատարկման փականային խուց՝ կահավորվելու է 1 հատ 300մմ սողնակով,
6. մարիչ հոր՝ 6.4x5.5մ արտաքին չափերով ե/բ հոր, որը միացնելու է ոռոգման ջրթողի 700մմ տրամագծով խողովակաշարը ԼՌ-80 տիպի ե/բ հավաքովի վաքերով ոռոգման ջրանցքին:

Ջրընդունիչ ջրանցքը տեղակայված է Արթիկջուր գետի և ջրամբարի թասի միացման հանգույցում: Այն բաղկացած է հետևյալ մասերից՝

1. Ջրընդունիչ գլխամաս՝ ե/բ հոր, որի լայնությունը նեղանալու է 20.0մ-ից 10.0մ և 5.0մ երկարությամբ,
2. Ուղղանկյուն կտրվածքով Գ-20 տիպի ե/բ բլոկներով և 10.0մ լայնությամբ ե/բ հատակով ջրանցքից, որի երկարությունը 290.0մ:
3. Ե/բ թեք հարթակ, որը բաղկացած է՝

ա. ջրընդունիչ ե/բ հորից 10.0մ լայնությամբ և 2.0մ երկարությամբ,

բ. ե/բ ուղանկյուն կտրվածքով թեք ջրանցքից 10.0մ լայնությամբ և 33.0մ երկարությամբ,

գ. մարիչ հորից 11.0x2.5մ արտաքին չափերով:

Հեղեղային ջրհեռը տեղակայված է պատվարի աջ կողմում: Այն բաղկացած է հետևյալ մասերից՝

1. ջրընդունիչ մաս, որը բաղկացած է լինելու ե/բ հորից 20.0մ լայնությամբ և 7.0մ երկարությամբ,

2. պատվարային հանգույց՝ 20.0մ լայնությամբ և 0.7-1.0մ բարձրությամբ ե/բ պատվարից,

3. ե/բ մարիչ հանգույց՝ ե/բ հորից 20.0մ լայնությամբ և 10.0մ երկարությամբ և նեղացող հատվածից 10.0մ լայնությամբ և 5.0մ երկարությամբ,

4. արագահոսային մաս՝ ե/բ մարիչ հանգույցից հետո 112.0մ երկարությամբ և 10.0մ լայնությամբ ուղղանկյուն կտրվածքով ջրանցք կահավործ Գ-20 տիպի ե/բ բլոկներով և ե/բ հատակով, որը միանալու է գոյություն ունեցող շինարարական ելքերի հեռացման ջրանցքի հետ:

Ջրամբարի թասից ֆիլտրացիայից խուսափելու համար նախատեսվում է՝ իրականացնել հակաֆիլտրացիոն միջոցառումներ և թասի 22.0 հա տարածքը ծածկել բենտոմատով:

Արթիկի ջրամբարի նախագծով նախատեսվող պատվարից մոտ 100մ հեռավորության վրա գոյություն ունեցող կառույցն օգտագործվել է որպես պահակային-շահագործման տնակ: Արթիկի ջրամբարի ծավալի ապահովման համար հարկավոր է Պեմզաշեն բնակավայրով անցնող երկու ձորակներով եկող ջրերը ուղղել դեպի ջրամբար:

Ընտրված դոտացիոն ջրանցքի առանցքը սկիզբ է առնելու Մարալիկ-Արթիկ ավտոճանապարհի տակով գոյություն ունեցող երկու անցքով թունելից՝ հետո N3 ուղղեհատվածքի վրա I գլխամասի կառուցումով: Նախատեսվող գլխամասից հետո Պեմզաշեն-Տուֆաշեն ավտոճանապարհին զուգահեռ ԼՌ-40 տիպի ե/բ հավաքովի վաքերով 950մ երկարությամբ ջրանցքով ջուրը կտեղափոխվի մինչև գոյություն ունեցող N2 ուղղեհատվածքի ձորակի վրա ինքնակամ ստեղծած հողային պատվարի ջրավազանի մեջ և կկառուցվի II գլխամասը: Գլխամասից սկիզբ կառնի դյուկեր D=500մմ պողպատե խողովակներով, որի երկարությունը կազմի 2300մ: Դյուկերի մեջ կուտակված երկու ձորակների ջուրը կանցկացվի Պեմզաշեն-Տուֆաշեն ավտոճանապարհին ուղղահայաց դեպի շահագործվող տուֆի քարհանքի ճանապարհի տակով, գոյություն ունեցող թունելի հարևանությամբ, որից հետո կշարունակվի դոտացիոն ջրանցքը N2 ուղղեհատվածքի ձորակին զուգահետ մինչև Տուֆաշեն բնակավայրը: Տուֆաշեն բնակավայրի և շահագործվող քարհանքի տարածքների միջև կշարունակվի խողովակաշարը, որից հետո զուգահեռ կշարժվի գոյություն ունեցող գրունտային ճանապարհի (Հ-2 և Տուֆաշեն միացնող հին ճանապարհ) կողքով մինչև բացված խրամուղի, որը նախկինում նախատեսված էր մոտեցնող ջրանցքի անցկացման համար: Վերջին նշված կետից հետո դյուկերը լցնելու է դաշտերի միջև բացված խրամուղիով, որտեղ կհատվի դաշտամիջյան ճանապարհի հետ: Հատման կետում դյուկերը կավարտվի և ջրանցքը կկահավորվի ԼՌ-60 տիպի ե/բ հավաքովի բաքերով 2400մ և կմիանա Արթիկջուր գետին, որով էլ ջուրը կտեղափոխվի դեպի Արթիկի ջրամբար:

Առաջին գլխամասից մինչև Արթիկջուր գետը ջրանցքի երկարությունը կկազմի 5650մ: Արթիկջուր գետով ջուրը կտեղափոխվի մինչև ջրամբար մոտ 2400մ:

Ոռոգման ջրթողի փականային խուցից հետո նախատեսվում ԼՌ-80 տիպի ե/բ հավաքովի վաքերով ջրատար, որի երկարությունը կազմում է 460մ: Ջրանցքը անցնելու է լքված

քարհանքի, իսկ ներկայումս Արթիկի աղբավայրի տարածքով և կավարտվի աղբավայրից 190մ հետո նախկինում բացված խրամուղիով: Այս խրամուղում ջրագիծը նույնպես կառուցվելու է ԼՌ-80 տիպի ե/բ հավաքովի վաքերով, որտեղ ջրատարի երկարությունը կկազմի 490մ, որից հետո վաքերով ջրատարը միանալու է Արթիկ- Հոռոմ ավտոմայրուղու տակով գոյութուն ունեցող D=1000մմ ե/բ խողովակներին: Ավտոմայրուղուց հետո կառուցվելու է 4030մ երկարությամբ դյուկեր D=700մմ պողպատե խողովակներով, որն անցնելու է Նոր Կյանք բնակավայրի բնակելի տարածքների հարևանությամբ և կշարունակվի Նոր Կյանքի, Անուշավանի և Փանիկի բնակավայրերի տարածքներով և կավարտվի Մեղրաշեն բնակավայրի սահմանի մոտ: Դյուկերի ավարտման տեղում նախատեսվում է միանալ գոյություն ունեցող սեղանաձև 70սմ խորությամբ բետոնե ջրանցքին, որը ենթակա է վերականգման: Բետոնե ջրանցքը շարունակվելու է 590մ, որտեղից հետո այն կշարունակվի նոր տեղադրվող ԼՌ-60 տիպի ե/բ հավաքովի բաքերով 1130մ: Նախատեսվող 6.7կմ երկարությամբ ջրանցքը կապահովի Նոր Կյանք, Վարդաքար, Փանիկ, Մեղրաշեն և Անուշավան բնակավայրերի 300 հա հողերի ինքնահոս համակարգով ոռոգումը: Նախագծով նախատեսվում է իրականացնել 1.479 մլն.մ3 ծավալով, 22.0հա մակերեսով (ՆԴՀ-ի դեպքում), հոսքի սեզոնային կարգավորմամբ, 10.0մ բարձրությամբ հողային, ավազակավային էկրանով պատվարով կիսաթաղված (փորվածքային) նախկին ջրամբարի թասի հարավային մասում, որտեղ իրականացվել են երկրաբանական ուսումնասիրություններ:

Արթիկի ջրամբարի վերակառուցումն իրականացվելու է նշված տարբերակով, որն ունի հետևյալ առավելությունները՝

1. Քանի որ նախագծով նախատեսվող ջրամբարը փորվածքային է, իսկ պատվարը 10.0մ բարձրություն ունի, ապա թասի բացման համար փորված գրունտները կարելի է օգտագործել պատվարի մարմնի կառուցման համար:

2. Նախագծով նախատեսված թասը զբաղեցնելու է 33.0 հա-ով ավելի քիչ տարածք քան նախկինում զբաղեցնող փլուզված ջրամբարը, որտեղ չզբաղեցրած տարածքները կարելի է օգտագործել օրինակ՝ գյուղատնտեսական կամ էներգետիկ (արևային վահանակների տեղադրման) նպատակով:

3. Ոռոգման մայր ջրանցքի հիմնական մասը նախատեսված է խողովակով, որի շնորհիվ ՕԳԳ 85-87% է, ելնելով այն հանգամանքից, որ ոռոգման ցանցը կարելի է իրականացնել նոր տեխնոլոգիաներով (կաթիլային համակարգ և այլն), ապա նախանական նախագծով նախատեսվող 300հա-ի փոխարեն կարելի է ոռոգել 420հա հողատարածքներ:

4. Ելնելով հիդրոլոգիական հաշվարկներից՝ Արթիկջուր գետի հոսքի վերջին 10 տարվա շարքի դեպքում ջուրը պակասել է մոտ 30%-ով, այդ պատճառով թասի լցման պայմանից ելնելով՝ նախագծով նախատեսվող ջրամբարը քիչ ռիսկային է:

***Պատճառաբանական մաս.*** Փորձաքննության շրջանակներում կատարվել է գործունեությանն առնչվող գոյություն ունեցող բնապահպանական և սոցիալական ելակետային պայմանների ուսումնասիրություն: Նախատեսվել է գործունեության իրականացման արդյունքում հնարավոր բնապահպանական և սոցիալական վնասակար ազդեցությունների կանխատեսումը և դրանց կանխարգելմանը, նվազեցմանը կամ բացառմանն ուղղված համապատասխան միջոցառումներ, դրանց արդյունավետ

իրականացման մեխանիզմներ: Շրջակա միջավայրի վրա հնարավոր ազդեցությունները հիմնականում կապված են լինելու՝

- շինարարության ընթացքում մարդու առողջության և աշխատանքի անվտանգության հետ,
- օդային ավազան արտանետումների՝ պայմանավորված շինտեխնիկայի աշխատանքի արդյունքում արտանետումների, հողային աշխատանքների հետ,
- հողային, ջրային ռեսուրսների օգտագործմամբ,
- արտակարգ իրավիճակների առաջացման հետ,
- թափոնների կառավարման հետ:

Օդային ավազան արտանետումները կավելանան տեղանքի և ջրամբարի մաքրումից, հորատման տարածքների աշխատանքներից, պատվարի շինարարությունից և այլ հողային աշխատանքներից, շին.տեխնիկայի շարժից, ինչպես նաև մոտեցման ճանապարհներից:

Հատկապես, եթե անհրաժեշտություն առաջանա իրականացնել պայթեցման աշխատանքներ, որի ընթացքում կառաջանան NO2, CO և NO արտանետումներ: Ուստի անհրաժեշտ է հաշվի առնել պայթեցման աշխատանքների համար հնարավոր այլընտրանքները: Փոշու արտանետումները փորման աշխատանքների ընթացքում պետք է վերահսկվեն փոշեկլանիչների միջոցով կամ թաց փոշեորսիչներով և ջրցանման գործողություններով:

Շինաշխատանքների մեկնարկից առաջ պատվարի տարածքում առկա թափոնները պետք է պատշաճ կերպով առանձնացվեն և հեռացվեն: Շինարարության ընթացքում առաջացող հիմնական թափոններն են՝ բանվորների կողմից առաջացող կենցաղային թափոնները շինհրապարակի և ջրամբարի տարածքի մաքրումից՝ բուսականության մնացորդներ, նյութերը, որոնք օգտագործվելու են պատվարի կառուցման համար:

Թվարկված աշխատանքների ազդեցությունը նվազեցնելու նպատակով նախատեսված են բնապահպանական միջոցառումներ, որոնք ներառված են բնապահպանական կառավարման պլանում:

Նախագծվող պատվարի մարմնի և հիմնատակի գրունտները և դրանց ֆիզիկա-մեխանիկական հատկությունները չեն փոխվելու, ինչպես նաև այն փաստը, որ պատվարի բարձրությունը նվազել է, հետևաբար փոքրանում են կատարի հատվածի սեյսմիկ արագացումները, կարելի է վստահ պնդել, որ ներկայիս տարբերակով պատվարի լայնական կտրվածքում պատկերված շեպերի թեքությունները բավարար են պատվարի ընդհանուր կայունության և անվտանգության պայմանները բավարարելու համար:

***Եզրափակիչ մաս*** Հանրային լսումների ծանուցումը իրականացվել է համաձայն՝ «Շրջակա միջավայրի վրա ազդեցության գնահատման և փորձաքննության մասին» օրենքի և Կառավարության 2014 թվականի նոյեմբերի 19-ի N 1325-Ն որոշմամբ սահմանված կարգի: Հանրային բոլոր 4 լսումներն իրականացվել են Արթիկ համայնքի Նոր Կյանք վարչական շրջանի ղեկավարի նստավայրում, որտեղ ներկա են գտնվել ազդակիր բոլոր 5 բնակավայրերի ներկայացուցիչները: Հանրային լսումների նպատակն է հաշվի առնել բոլոր շահագրգիռ կողմերի և ազդակիր հանրության կարծիքները, առարկություններն, առաջարկություններն և դիտողությունները նախատեսվող գործունեության վերաբերյալ: Փորձաքննական ամբողջ գործընթացին ներգրավվել են առողջապահության, ներքին գործերի, կրթության, գիտության, մշակույթի և սպորտի նախարարությունները, կադաստրի կոմիտեն, քաղաքաշինության կոմիտեն, Շիրակի մարզպետարանը ինչպես նաև շրջակա միջավայրի նախարարության ստորաբաժանումները: Ստացված դիտողությունները և

առաջարկությունները հաշվի են առնվել հաշվետվության լրամշակված տարբերակում: Ծրագրի բնապահպանական և սոցիալական ազդեցությունները հաշվետվության մեջ գնահատվել և մշակվել են համապարփակ մեղմացման և փոխհատուցման միջոցառումներ: Բացի այդ, առաջարկվում են համայնքային զարգացմանն ուղղված միջոցառումներ՝ ստորին հոսքի գյուղերի կենսապայմանների մակարդակը բարձրացնելու նպատակով: Բնապահպանական և սոցիալական բոլոր բացասական ազդեցությունները լինելու են ցածր կամ միջին մակարդակի: Ծրագրի միջին մակարդակի ազդեցությունները վերաբերելու են հետևյալ ուղղություններին՝

- բուսական, կենդանական աշխարհի, կենսաբազմազանություն
- կենսամիջավայրերի կորուստ՝ բուսականության մաքրման և ջրամբարի ջրալցման հետևանքով:
- պատվարի շինարարության հետևանքով գետի աղտոտում:

Հիմք ընդունելով այս փաստը, ինչպես նաև այն, որ Արթիկջուր գետի ջրի որակը գնահատվում է որպես բավարար կամ վատ (հատկապես Արթիկ քաղաքին մոտ տարածքներում), կարելի է եզրակացնել, որ առաջարկվող ծրագիրը՝ կարող է իրականացվել առանց էական բացասական ազդեցություններ հասցնելու բնապահպանական և սոցիալական միջավայրին այն նախապայմանով, որ կիրականացվեն սահմանված մեղմացման և փոխհատուցման միջոցառումները:

«Պատմամշակութային արգելոց-թանգարանների և պատմական միջավայրի պահպանության ծառայություն» ՊՈԱԿ-ի կողմից տրված տեղեկատվության համաձայն՝ նախատեսվող Արթիկի ջրամբարին մոտեցող ջրագծի և մայր ջրանցքի հարևանությամբ առկա են հուշարձան և դամբարանադաշտ, որոնցից հեռավորությունները նախատեսվող գործունեության տարածքներից ապահոված է, ուստի անմիջական ազդեցություն չի լինելու համապատասխան մեղմացնող միջոցառումների իրականացման պայմաններում:

## Պարտադիր կատարման ենթակա պահանջներ

- Կառուցապատման աշխատանքների ընթացքում պահպանել «Մթնոլորտային օդի պահպանության մասին» օրենքի 11-րդ հոդվածով սահմանված պահանջները՝ շրջակա տարածքները զերծ պահել շինարարական աղբից՝ փոշին նվազագույնի հասցնելու նպատակով, շինարարության ընթացքում՝ ցանկապատել շինարարական հրապարակները,
- Պայթեցման աշխատանքների կատարման ժամանակ մարդկանց զգուշացնելու համար կիրառել հատուկ ձայնային ազդանշաններ: Արգելված գոտին պետք է լինի ամենամոտ լիցքից 20 մ-ից ոչ պակաս հեռավորության վրա:
- Ապահովել ջրամբարի տարածքում և ջրապահպանական գոտում շահագործման ջրապահպանական միջոցառումների իրականացումը՝ գործող սանիտարական նորմերի մակարդակով ջրամբարում ջրի որակի պահպանման, ջրային ողողումներից և աղտոտումից, հողերի պահպանմանը, ջրամբարի թասի տղմակալման և բուսածածկման, ծանծաղուտների «ծաղկման» և ափերի ողողման դեմ:
- Ջրապահպան գոտու սահմաններում արգելվում է՝ արդյունաբերական, գյուղատնտեսական և մյուս այն նոր ձեռնարկությունների և օբյեկտների շինարարությունն ու գործողների ընդլայնումը, որոնց գործունեությունը ուղղակի կամ անուղղակի ազդելու է ջրամբարի և դրան հարող հողերի սանիտարատեխնիկական վիճակի վրա:

## ԵԶՐԱԿԱՑՈՒԹՅՈՒՆ

«Ակադեմիկոս Ի.Վ. Եղիազարովի անվան ջրային հիմնահարցերի և հիդրոտեխնիկայի ինստիտուտ» ՓԲԸ-ի կողմից փորձաքննության ներկայացված Շիրակի մարզի Արթիկ համայնքի Արթիկի ջրամբարի վերակառուցման աշխատանքների շրջակա միջավայրի վրա ազդեցության գնահատման հաշվետվությանը տրվում է դրական փորձաքննական եզրակացություն՝ վերը նշված փորձաքննական պահանջների պարտադիր կատարման պայմանով:

Շրջակա միջավայրի վրա ազդեցության
փորձաքննական կենտրոն» ՊՈԱԿ-ի տնօրեն՝ Խաչիկ Մարտիրոսյան

«Շրջակա միջավայրի վրա ազդեցության
փորձաքննական կենտրոն» ՊՈԱԿ-ի
տնօրենի տեղակալ՝ Հերիքնազ Մկրտչյան

«Շրջակա միջավայրի վրա ազդեցության
փորձաքննական կենտրոն» ՊՈԱԿ-ի
գլխավոր մասնագետ՝ Շուշանիկ Կարապետյան

# Annex 2. Master plan of the Project area