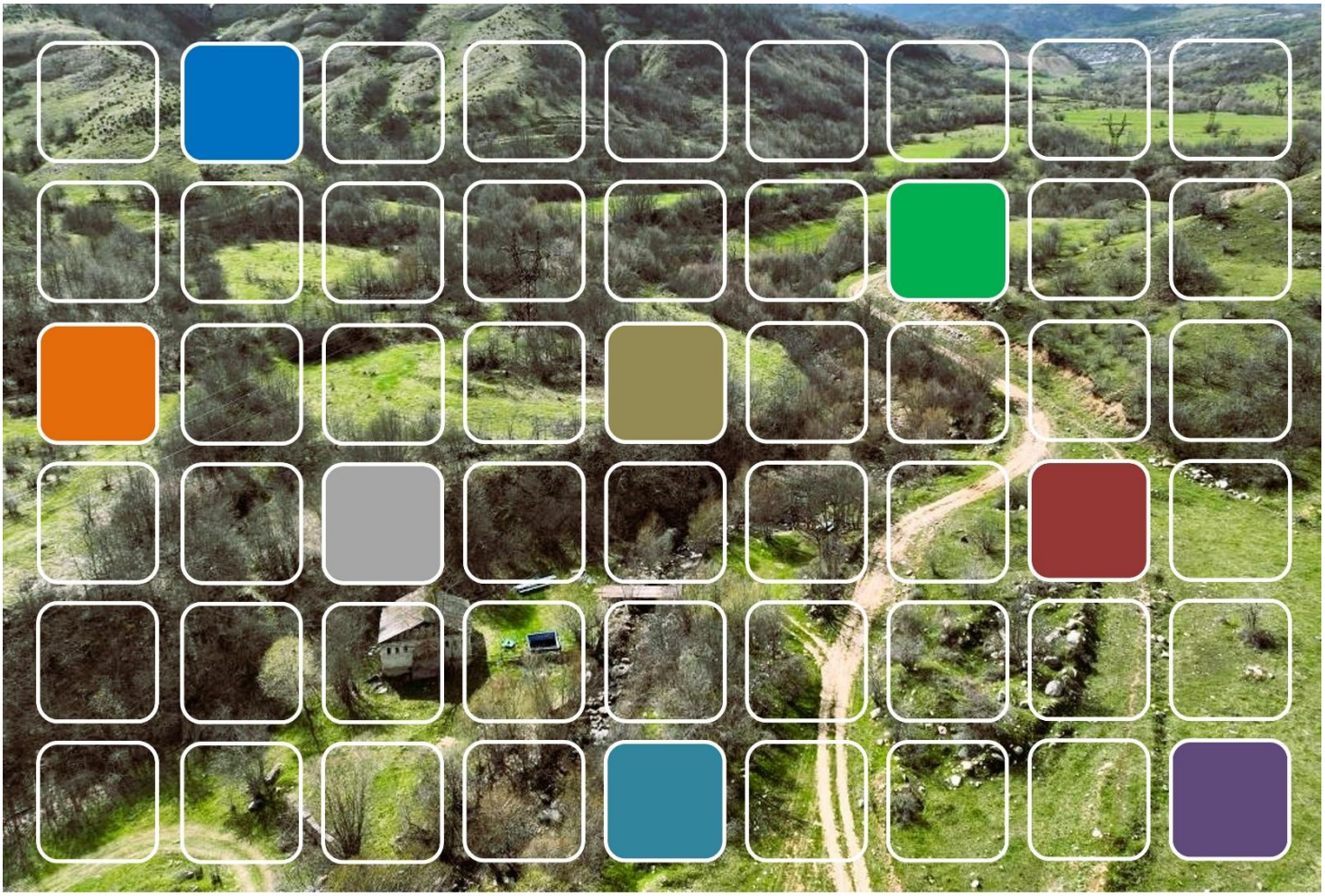

Source: Photos taken by the Consultant during the site visits

WATER RESERVOIRS PROJECT - ARMENIA

Environmental and Social Impact Assessment for the Lichk 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

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Consultancy Services Contract № 2023.009567

Prepared for:

- **European Bank for Reconstruction and Development**
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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 Center
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
FSP - Flora Sampling Plot
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

NVP - Net Present Value

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

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

WCRA - Water Committee of the Republic of Armenia

WMP - Waste Management Plan

WUA - Water Users Association

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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'):

- Kasakh 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 consultant 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 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 Lichk settlement in Meghri community (Syunik Marz, RA). The Lichk Reservoir is designed with a capacity of 3.76 mln. m^3 and will be fed by the Lichk (Arevik) tributary of the Meghri River. It is intended to provide irrigation water to approximately 1,510.8 ha of agricultural land across

[1]Marz - Region in Armenian

the settlements of Meghri, Agarak, Alvank, Shvanidzor, Nrnadzor, Lehvaz, Vardanidzor, and Karchevan.

This ESIA report presents the key findings of the national EIA report for the Lichk 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 №215-24 for the Lichk EIA report was issued by the EIEC under the ME on 16.10.2024 (**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:

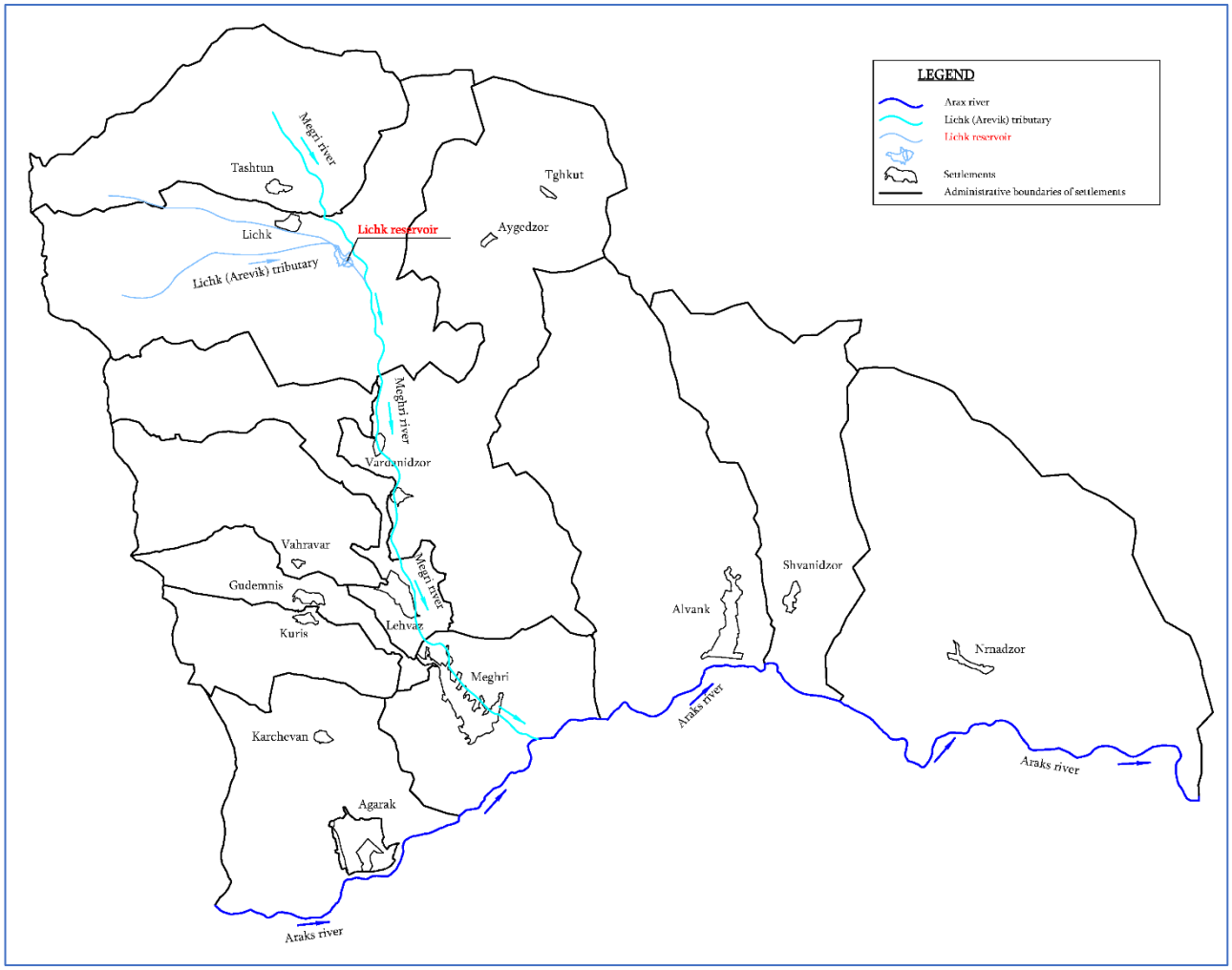
- Project ToR (issued by the EBRD),
- ToR for the local EIA consultant,
- National EIA report for the Lichk reservoir (in Armenian) (minenv.am),
- State examination conclusion №215-24 for the Lichk EIA report issued by the Environmental Impact Examination Centre under the Ministry of Environment on 16.10.2024,
- Project design document for the Lichk 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,
- Armenia reservoirs Project: Transboundary Impact Assessment Report, Revision A, June 2025, SLR Consulting,
- 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 and the Client,
- 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

The enlarged Meghri community comprises 15 settlements: Meghri, Agarak, Alvank, Shvanidzor, Nrnadzor, Lehvaz, Vardanidzor, Aygedzor, Tghkut, Karchevan, Tashtun, Lichk, Kuris, Gudemnis, and Vahravar. Agriculture is one of the region's primary occupations, with horticulture being the dominant sector. Due to limited pastures, animal husbandry is underdeveloped. Ensuring a reliable supply of irrigation water is also of strategic importance to the region (**Figure 2-1**).

Figure 2-1. Map of Meghri enlarged community



As of January 1, 2021, Meghri community has 2,936 households and a total permanent population of 11,769 people[2]. The total area of the community's housing stock is 386,166.9 m^2, with 76 apartment buildings and 2,072 private houses. The population is primarily engaged in fruit growing, viticulture, vegetable cultivation, and animal husbandry.

The total area of the Meghri community is 66,066.77 ha, of which 28,068.76 ha are agricultural lands. Arable land covers 995.16 ha, while perennial plantations account for 275.52 ha, including 67.25 ha of orchards and 208.26 ha of vineyards. Pastures span 5,757.32 ha, and grasslands cover 129.29

[2]According to the data from the *Bulletin - Socio-economic characteristics of Syunik Marz, 2024*, the permanent population of Meghri enlarged community as of January 1, 2024 is 9,438 persons (https://armstat.am/file/Map/MARZ_09.pdf)

ha. The total area of the settlements within the Meghri community is 914.14 ha, of which 50.75 ha are designated as homestead lands. Forests and water resources make up 888.64 ha, while lands dedicated to energy infrastructure, roads, communication lines, and gas pipelines total 291.78 ha. Specially protected areas cover 34,528.56 ha, and lands designated for industrial and mining use amount to 1,009.55 ha.

Thanks to the region's favourable climate and topography, high-value crops such as persimmon, pomegranates and figs are grown here. However, the effects of global warming have also reached this area, leading to a water deficit during the crucial irrigation months of August and September. As a result, irrigation is not fully carried out, which impacts both the quality and quantity of agricultural products.

2.2 Existing Irrigation System in Meghri Community

The Meghri River serves as the primary source of irrigation for Meghri community. Water is drawn from the river by both the Meghri community's irrigation systems and those operated by the "Syunik" Water Users Association (WUA). However, the key difference is that the "Syunik" WUA operates pumping stations fed by the Araks River, which help compensate for water shortages during the critical months of August and September.

In the past decade, the Meghri gravity irrigation system has been established along the Meghri River, allowing transition of mechanical irrigation systems to self-flow. However, due to global warming, the river's water levels drop significantly in August and September, resulting in an insufficient supply to meet the irrigation demand. To address this shortfall, irrigation water is supplied to the settlements from the Araks River through mechanical pumping.

The irrigation system of Meghri community can be divided into two main components: the Meghri gravity system and separate irrigation systems fed directly from the Meghri River. The Meghri gravity system, built in the past decade, consists of a closed pipeline network that draws water from the Meghri River via a headwaters facility located in the Lehvaz settlement. The Meghri gravity system experiences minimal water losses, while the remaining irrigated land relies on concrete canals, earthen channels, and other infrastructure, which suffer significant losses, approximately 60% of the irrigated area. To enhance the efficiency of the irrigation process, there is an urgent need to reconstruct the intra-farm irrigation network. The irrigation system is managed by both the Syunik WUA and the Meghri community, with the distribution of responsibility roughly split at 40% and 60%, respectively.

The high-water loss values are also associated with ineffective water management practices, including poor water metering. To address these issues, there are plans to construct a reservoir (Lichk reservoir) approximately two kilometers downstream from the Lichk settlement to better manage the waters of the Meghri River.

2.3 Calculation of the Irrigation Water Demand

The irrigation water demand was calculated by the Project designer using two methods: (i) bulletin 'Norms and Regimes of Agricultural 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[3] and (ii) composition of the selected crops approved by the Food and Agriculture

[3]Preparation of design and cost estimation documents for construction of the Lichk reservoir in Syunik Marz of the Republic of Armenia, Explanatory Note, 2024

Organization (FAO) and applying crops coefficients. The main purpose of the noted calculations is to determine the perspective water demand for the 15 settlements of Meghri community.

With the first method, the annual total gross water demand for irrigable lands in the Meghri community will be 21.42 mln. m^3, while with the second method, it will be 22.06 mln. m^3. Overall, this deviation is minimal, and it can be concluded that the results of both methods are applicable.

Since the results from the FAO methodology show a less favourable distribution of water demand across the months, they will be used as the basis for determining the required volume of the Lichk reservoir.

The Lichk Reservoir will supply irrigation water to eight settlements of the Meghri community: Meghri, Agarak, Alvank, Shvanidzor, Nrnadzor, Lehvaz, Vardanidzor, and Karchevan. According to data provided by Meghri Municipality, the total irrigable land area of these settlements was 1,315.8 ha as of 2022.

The results of the management calculations carried out within the Project design study show that it will be possible to irrigate an additional 195.0 ha of land that is currently not irrigated, although formally registered as irrigable land. At present, due to the lack of irrigation infrastructure, no crops are cultivated on these plots, though some areas may be used for natural grass production.

The **Table 2-1** presents the command area of the Project by settlements.

Table 2-1. Project command area by settlements

Settlement	Irrigated Land in 2022 (ha)	Additional Area to be Irrigated by the Lichk Reservoir (ha)	Total Irrigated Land with Lichk Reservoir (ha)	Actual Increase in Irrigated Land (%)
Meghri	276.0	40.0	316.0	14.5
Agarak	103.0	40.0	143.0	38.8
Alvank	158.7	20.0	178.7	12.6
Shvanidzor	184.9	10.0	194.9	5.4
Nrnadzor	180.1	30.0	210.1	16.7
Lehvaz	151.3	15.0	166.3	9.9
Vardanidzor	157.0	20.0	177.0	12.7
Karchevan	104.8	20.0	124.8	19.1
Total	1315.8	195.0	1510.8	14.8

2.4 Key Outputs of the Hydrological Study

2.4.1 Study of Water Flows

As part of the feasibility study and detailed design for the Lichk Reservoir, the Project Designer carried out a series of hydrological calculations, including:

- Calculation of discharges with reliability levels of P=50%, 75%, and 95%,
- Calculation of typical river flow discharges at the selected section,
- Assessment of climate change impacts on water discharges up to the year 2100,
- Assessment of environmental flow requirements in the river basin,
- Assessment of the potential annual sediment inflow to the reservoir.

The hydrometeorological surveys were based on actual measurement data, satellite imagery, digital elevation models, and site topographic survey results. They were conducted in accordance with the RA construction norms, including CN&R[4] 2.01.14-83 "Determination of Design Hydrological Characteristics" (updated in 2021) state standards, and relevant Government decrees, while also taking into account ICOLD standards. The calculations relied on hydrometric data provided by the Hydrometeorology and Monitoring Center under the RA Ministry of Environment. These data included maximum, minimum, and average water flow indicators, as well as sediment discharge. Measurements of water intake were also incorporated.

For the hydrological surveys carried out as part of the feasibility study for the Lichk Reservoir, both the reservoir catchment area and the catchment area of the Lichk observation (hydrometric) point on the Meghri River were analysed.

Observations of water flows and water levels were conducted from 1946 until 2001. Water temperature monitoring started in 1950 and continued for five years less than discharge observations. Ice phenomena in the river were also recorded during certain years. Since no sediment discharge data are available for the Lichk observation point, the data from the Meghri observation point on the Meghri River were used instead.

The Meghri River is located in Syunik Marz and is part of the Araks River Basin. While the overall river catchment area extends in a north-south direction, the Project area lies along an east-west axis. The Meghri River catchment encompasses nearly all of Armenia's altitudinal climatic zones; however, the section relevant to the Project is situated in the upper reaches of the catchment, at elevations ranging from 1,500 m to 3,700 m. The highest point of the catchment reaches 3,753 m.

The area of the river's catchment basin at the proposed reservoir dam site on the Arevik tributary of the Meghri River is 43.3 km^2, the length of the tributary to the source is about 13 km. The average balanced elevation of the basin is 2,832 m. The steepness of basin slopes is an important factor influencing flow generation. In the basin of the Arevik tributary of the Meghri River, slopes exceeding 20° are widespread, particularly in its middle section. In the highland areas of the basin, including the reservoir basin, gentler slopes of up to 10° are also present.

The *Fourth National Communication on Climate Change*, the only official source on climate change impacts on water resources in Armenia, presents the vulnerability of annual river flow under three scenarios. According to the CCSM4 RCP6.0 scenario, river flow is projected to decrease by 19.8% by 2100; under the CCSM4 RCP8.5 scenario, by 33.7%; and under the METRAS RCP8.5 scenario, by 39%. **Table 2-2** presents the projected characteristic discharge indicators at the dam site for the year 2100.

Table 2-2. Discharges at dam site at 50%, 75%, and 95% reliability (m³/s) in 2100 under different climate change scenarios

P%	CCSM4 RCP6.0 Scenario Decrease of 19.8%		CCSM4 RCP8.5 Scenario Decrease of 33.7%		METRAS RCP8.5 Scenario Decrease of 39.0%	
	empirical	teoretical	empirical	teoretical	empirical	teoretical
50%	1.1	1.11	0.91	0.92	0.84	0.85
75%	0.97	0.93	0.8	0.77	0.74	0.71
95%	0.63	0.7	0.52	0.58	0.48	0.53

[4]Construction Norms and Rules (SNiP)

The annual flow volumes of the Meghri River at the dam site, based on the theoretical curve, are estimated at 43.9 mln. m^3 for 50% availability, 36.6 mln. m^3 for 75% availability, and 27.5 mln. m^3 for 95% availability.

Under projected climate change scenarios, river flow may decrease by 19.8%, 33.7%, and 39% by 2100. In these cases, the annual flow with 50% availability is expected to decline to 35.0 mln. m^3, 29.0 mln. m^3, and 26.8 mln. m^3, respectively. Similarly, the annual flow with 75% availability is projected to decrease to 29.4 mln. m^3, 24.3 mln. m^3, and 22.4 mln. m^3 under the same scenarios.

The annual flow distribution is presented in **Table 2-3**. According to the calculations, at 50% reliability, the reservoir's required flow volume is available in each of the months from May to August, while at 75% reliability, the required volume is available from May to July.

Table 2-3. Annual flow distribution at the dam site on the Arevik tributary of the Meghri River

Reliability	Flow, m^3/s, by months											
	1	2	3	4	5	6	7	8	9	10	11	12
50%	0.30	0.25	0.39	1.07	3.11	5.71	3.56	1.41	0.65	0.32	0.29	0.29
75%	0.15	0.13	0.23	0.99	2.94	5.24	2.75	1.10	0.47	0.24	0.21	0.18
Reliability	**Volume of the flow, mln. m^3, by months**											
	1	2	3	4	5	6	7	8	9	10	11	12
50%	0.81	0.61	1.04	2.78	8.34	14.8	9.54	3.77	1.69	0.86	0.74	0.76
75%	0.40	0.32	0.62	2.57	7.87	13.58	7.36	2.95	1.23	0.63	0.54	0.48

2.4.2 Maximum Flow

Maximum flows at the Lichk observation point were calculated for the repeatability periods of 100 years (1%), 1,000 years (0.1%), and 10,000 years (0.01%), in accordance with the standards acting in the Republic of Armenia. The results of the maximum flow calculations based on the Gamble formula for the dam site are shown in the **Table 2-4**.

Table 2-4. Maximum flow repeatability at the Lichk observation point and dam site as per the Gamble formula

Locations	Maximum flow by repeatability period, m3/s		
	100	1000	10000
Lichk hydrometric point	7.9	10.1	12.2
Dam section	16.0	20.4	24.7

According to the water flow calculations conducted in accordance with local construction norms, the maximum flow values for the dam section of the Lichk Reservoir and Lichk observation point are presented in **Table 2-5**.

Table 2-5. Maximum flow repeatability at the Lichk observation point and dam site calculated based on the local construction norms

P%	Calculated maximum flows QP%, m3/s	
	Lichk hydrometric point	Dam section
0.01%	9.35	18.91
0.1%	8.40	16.99
1%	7.28	14.73
$\Delta Q_{P\%}$	1.03	2.08

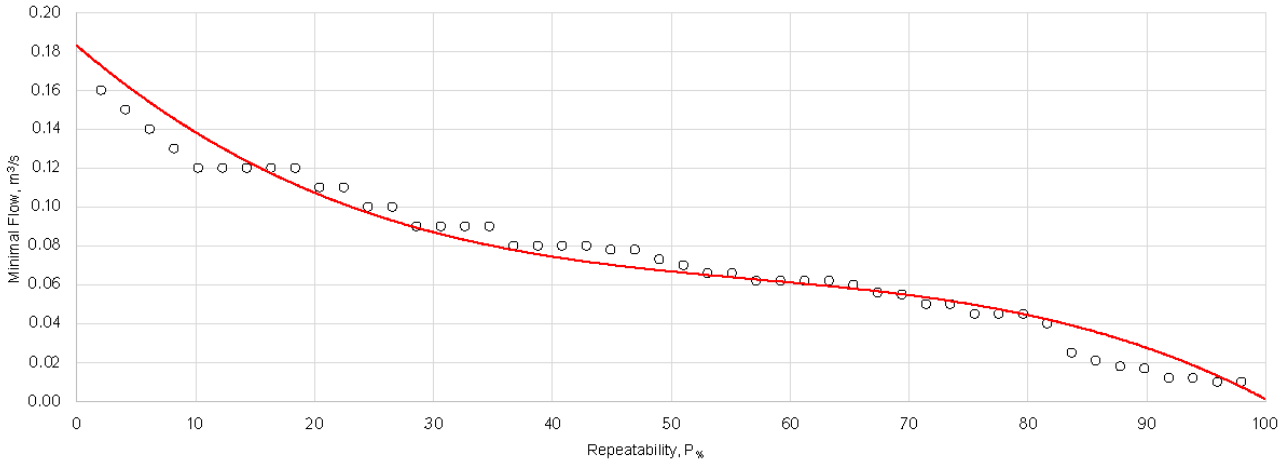
Thus, according to local construction norms, the calculated maximum discharge of the Meghri River at the dam site for a 0.01% repeatability is 18.91 m^3/s, while according to the Gamble formula, it is 24.7 m^3/s. For a 0.1% repeatability, the values are 16.99 m^3/s (SNiP) and 20.04 m^3/s (Gamble formula), respectively.

2.4.3 Minimal Flow

The hydrological calculation of minimum flows at the dam site was carried out using minimum discharge data from the Lichk observation (hydrometric) point. Since a complete data set was unavailable, the calculation was performed in accordance with the relevant provisions of CN&R 2.01.14-83. The average minimum discharge at the Lichk observation point is 0.07 m^3/s, with a standard deviation of 0.04, a coefficient of variation of 0.52, and a coefficient of asymmetry of 0.18.

According to the CN&R 2.01.14-83, the minimum discharge corresponding to an 80% probability is used for design calculations. At the Lichk observation point, the 80% minimum discharge is estimated at 0.045 m^3/s based on the empirical curve and 0.039 m^3/s based on the theoretical curve. The minimum discharge reliability curve is presented in **Figure 2-2**.

Figure 2-2. Theoretical and empirical curves of minimum flow at the Lichk observation point



The calculated minimum flow at the dam site observation point on the Arevik tributary of the Meghri River is 0.079 m^3/s at 80% repeatability.

2.4.4 Environmental Flow

The environmental flows at the dam section were calculated in accordance with RA Government Decree №57-N, based on data from the Lichk observation point. According to this decree, the environmental flow for each month is determined by adding the average of the minimum 10-day discharge values during the winter low-flow period to 33% of the minimum monthly discharge. The minimum 10-day discharge value at the Lichk observation point is 0.01 m^3/s. The calculated environmental flows at the dam site are presented in **Table 2-6**.

Table 2-6. Environmental flows at Lichk observation point and at the dam section, m^3/sec

River section	Months											
	1	2	3	4	5	6	7	8	9	10	11	12
Lichk observation point	0.011	0.010	0.016	0.068	0.271	0.485	0.239	0.093	0.048	0.017	0.016	0.016
Reservoir dam	0.023	0.021	0.033	0.143	0.570	1.019	0.502	0.194	0.101	0.036	0.034	0.034

Hence, the minimum environmental flow at the dam reservoir will be 0.021 m^3/sec during the February, while the maximum environmental flow will be 1.019 m^3/sec in June.

2.5 Sediment Load from the Feeding River

As with all channel-type reservoirs, in the case of the Lichk Reservoir, the river's solid flow (sediment load) settles on the reservoir bed due to a reduction in water velocity. The deposition of sediments, depending on their particle size, is distributed along the reservoir bottom from the river mouth to the dam site. Coarser sediments tend to settle near the inflow area, while finer suspended particles can remain in the water column and disperse throughout the entire reservoir basin.

Filling the reservoir with river runoff leads to sedimentation, which depending on the sediment transport capacity of the Meghri River may continue for several decades or even centuries. Based on the expected volume and rate of sediment accumulation, a dead storage volume has been designated for the reservoir.

For the hydrological calculation of sediment flow at the Lichk Reservoir dam, data from the Meghri and Geghi observation points, located on the Meghri and Geghi rivers, respectively, were used. The Meghri observation point provides a 16-year record of sediment flow data (1960-1975), while the Geghi observation point offers a 13-year record (1963-1975). Although both data series are relatively short, their durations are comparable. In terms of catchment area, the Geghi basin (195 km^2) more closely resembles the design site than the Meghri basin (274 km^2). Furthermore, unlike the Meghri observation point, the Geghi point is located at nearly the same elevation (~1600 masl) as the Lichk Reservoir dam site.

The annual average sediment load at the Geghi observation point is 0.227 kg/s. Based on this value, the sediment flow with a 50% probability of exceedance is calculated at 0.23 kg/s, equivalent to approximately 7,000 tons per year. This corresponds to a sediment yield (flow module) of 36 tons/km^2 at the Geghi observation point. Using this flow module, the estimated annual sediment load at the Lichk dam site, with a 50% probability of exceedance, is 1,559 tons, or 0.049 kg/s.

The sediment flow with a 75% probability of exceedance is calculated at 0.053 kg/s, equivalent to approximately 1,700 tons per year. In this case, the flow module at the Geghi observation point is 8.7 tons/km^2. Using this flow module, the estimated annual sediment load at the Lichk dam site, with a 75% probability of exceedance, is 377 tons, or 0.012 kg/s.

Taking into account the composition of the sediments, such as sand, clay, and silt, and their respective densities (1 m^3 of sand ≈ 1.53 tons, clay ≈ 1.1-1.6 tons, and silt ≈ 1.3-1.7 tons), the estimated annual sediment volume at the dam site is approximately 1,074 m^3 for a 50% probability of exceedance, and 253 m^3 for a 75% probability.

Assuming that the entire volume of sediment is deposited within the dead storage zone of the reservoir, the following dead storage capacities are required: for a 50-year operational period with a 50% probability of sediment inflow, the dead storage should be set at 53,700 m^3; for a 200-year period, it should be 214,800 m^3. In the case of a 75% probability of sediment inflow, the required dead storage is 12,650 m^3 for 50 years and 50,600 m^3 for 200 years.

The sedimentation index of the reservoir is calculated as the ratio of the reservoir volume at normal water level to the estimated annual sediment inflow:

$T = W_{NWL} / W_S$, where:

T - represents the planned operational lifetime of the reservoir, expressed in years,

W_{NWL} - the volume of the reservoir at normal water level,

W_S - annual volume of sediment inflow.

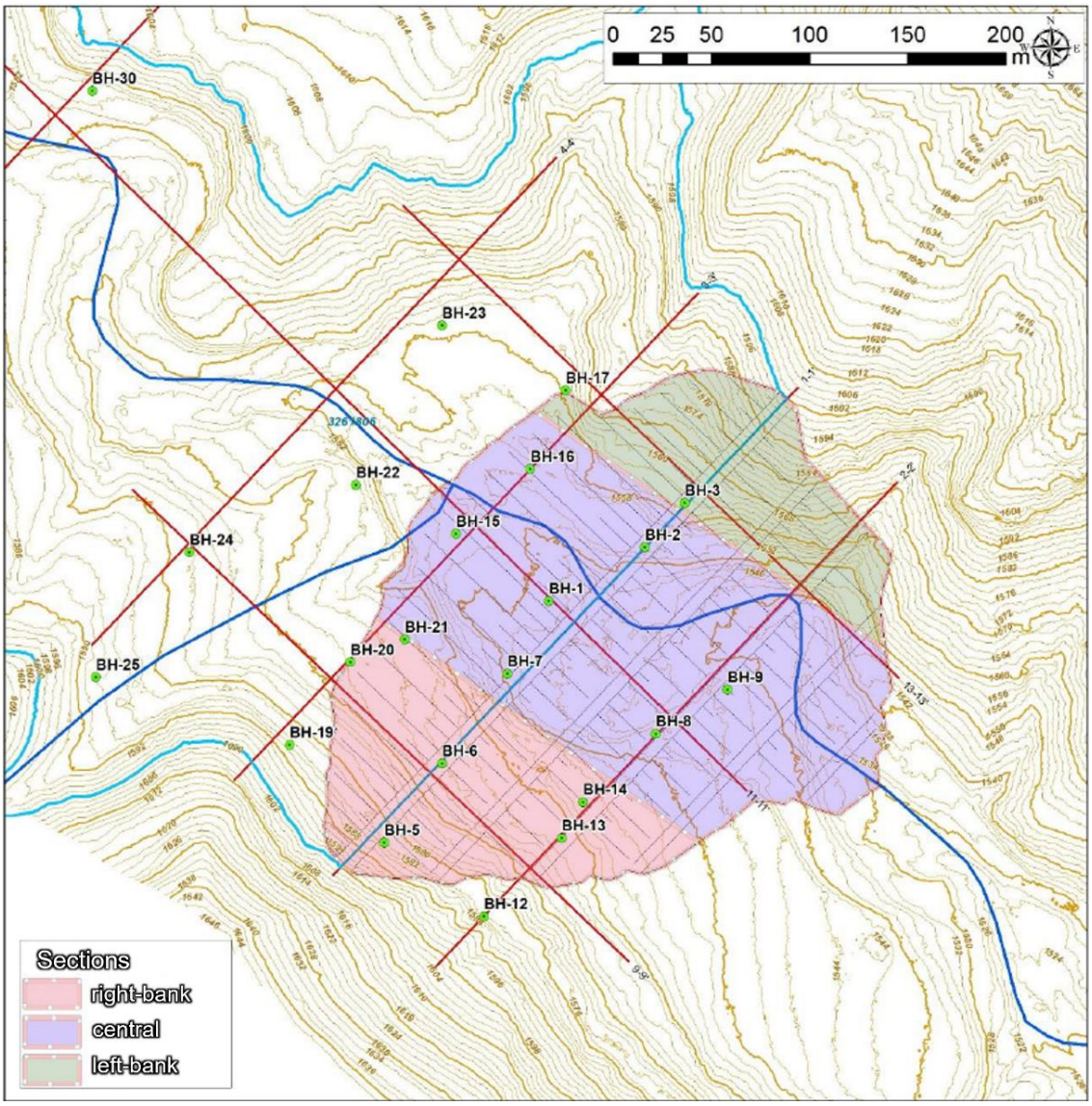
If the number of years (T) exceeds 200, the sedimentation calculation is discontinued. For the Lichk reservoir, with a volume of 4 mln. m^3, the calculated T is 3,724 years. Therefore, no further calculations are required.

2.6 Water Infiltration from the Reservoir and Dam

To estimate infiltration losses from the planned reservoir, the filtration characteristics of the upper soil layer in the project area were investigated. Field hydraulic tests were carried out in observation wells using the water-filling method to determine soil infiltration properties. The key parameter describing these properties is the permeability coefficient (K).

Based on the engineering-hydrogeological and geomorphological features, the selected dam axis (base) is divided into three blocks: Block 1 - the central section along the Meghri River bed, Block 2 - the left-bank section of the Meghri River and Block 3 - the right-bank section of the Meghri River (**Figure 2-3**).

Figure 2-3. The dam axis foundation divided into three blocks



The results of water infiltration calculations from all 3 blocks/sections under the reservoir dam are summarised in Table 2-7.

Table 2-7. Water infiltration under the reservoir dam body

Parameter	Unit	Block 1 [Q1]	Block 2 [Q2]	Block 3 [Q3]	Total
Water infiltration values	m^3/day	1,442	269	1,017	2,728
	m^3/year	526,330	98,185	371,205	**995,720**

Water infiltration may also occur through the bypass zones on both sides of the dam. It is estimated based on the permeability coefficient, hydraulic pressure, and the thickness of the geological layers in the upstream and downstream sections (biefs). The calculations of the water infiltration from the bypass zones on either side of the dam are summarised in Table 2-8.

Table 2-8. Water infiltration from the bypasses on either side of the dam

Parameter	Unit	Left bypass [Q4]	Right bypass [Q5]	Total
Water infiltration values	m^3/day	20.45	36.34	56.79
	m^3/year	7,464.25	13,264.1	**20,728.35**

The water infiltration losses from the dam base and the bypass zones on both sides of the dam will be:

$Q = Q_1 + Q_2 + Q_3 + Q_4 + Q_5 = 526,330 + 98,185 + 371,205 + 7,464.25 + 13,264.1 = 1,016,448.4$ m^3/year.

The total annual water infiltration losses from the dam foundation and the bypass zones amount to 1,016,448.4 m^3/year, exceeding 30% of the designed reservoir volume (≈3.0 mln. m^3). Therefore, the geological conditions are considered unfavourable for reservoir construction, and appropriate anti-filtration measures are required, including:

1) Excavate a trench in the bed area (central block) with a length of 130 m and an average depth of 10÷19 m down to the ceiling of the tuff breccias. The trench will be filled with clay soil and compacted to reduce the permeability coefficient to 0.01 m/day.
2) On the right bank of the dam (right block), a trench with a length of 120 m and a depth of 7 m is to be excavated down to the ceiling of the tuff breccias. The trench will be filled with clay soil and compacted to achieve a permeability coefficient of 0.01 m/day.
3) Excavate the diluvial and eluvial cover soils down to the bedrock.

After implementation of the infiltration measures, the water losses from the reservoir dam body and bypass zones are presented in Table 2-9:

Table 2-9. Water infiltration from the reservoir dam body and bypass zones after implementation of anti-infiltration measures

Parameter	Q1'	Q2'	Q3'	Q4'	Q5'	Q'
m^3/day	6.0	0.7	2.7	0.052	0.095	9.547
m^3/year	2,190	255.5	985.5	18.98	34.675	**3,484.7**

2.7 Project Overview

2.7.1 Background

Based on Contract №JK-BMKhTsZB-22/6-N, signed on 03.07.2023 between the Water Committee and Modul LLC design company, the latter was appointed to develop the design documentation for the construction of the Lichk Reservoir.

The construction of a reservoir with the designed capacity will ensure the sustainable and efficient use of scarce irrigation water, promote agricultural development, and reduce the vulnerability of the target group to the impacts of climate change. The implementation of the project will address several key challenges, including:

- Accumulating a portion of the river's available flow and regulating water discharges while maintaining environmental flows.
- Replacing the mechanical supply of irrigation water to meet the irrigation needs of 1,510.8 ha of land by gravity, thereby saving a significant amount of electricity and reducing operation and maintenance costs.
- Enhancing the water security of 1,315.8 ha of currently gravity-irrigated land, ensuring a stable water supply throughout the irrigation period.

According to the Procedure for the Implementation of the Expert Examination of Urban Planning Documents, approved by RA Government Decree №596-N[5], the Project design document is subject to a state complex examination, which is currently in progress.

2.7.2 Benefits of the Project

The Lichk reservoir is planned to irrigate 797 ha of agricultural land that was previously supplied by eight pumping stations. Currently, 619 ha of agricultural land are irrigated by gravity through canals fed by water intake structures on the Meghri River and its tributaries. However, if the water demand for irrigation, domestic use, and industrial supply is met, a water deficit of 2.62 mln. m^3 is expected during the months of August and September. To address this shortfall, the construction of a reservoir on the Lichk (Arevik) tributary of the Meghri River is planned.

The Lichk Reservoir is designed with a capacity of 3.76 mln. m^3 and will be fed by the Lichk (Arevik) tributary of the Meghri River. It is intended to provide irrigation water to approximately 1,510.8 ha of agricultural land across the settlements of Meghri, Agarak, Alvank, Shvanidzor, Nrnadzor, Lehvaz, Vardanidzor, and Karchevan.

The construction of a reservoir with the required capacity will ensure the sustainable and efficient use of limited irrigation water, promote agricultural development, and reduce the vulnerability of the target population to the impacts of climate change. The successful implementation of this project will address several critical challenges:

- Accumulating a portion of the river's usable flow and regulating water levels to ensure adequate environmental flows,
- Eliminating the mechanical irrigation systems and addressing the water deficit for 1,510.8 ha of land through gravity-based irrigation, leading to significant electricity savings and reduced operation and maintenance costs,

[5] https://www.arlis.am/hy/acts/206688

- Improving the water security for 1,315.8 ha of land currently irrigated by gravity, ensuring a stable water supply throughout the irrigation season.

2.7.3 Current Design Study

During the design study, a series of desktop and field studies were conducted by the "Modul" LLC design company, including:

- Assessment of the agricultural problems in the Project region,
- Engineering-geological investigations,
- Geophysical surveys,
- Geodetic survey,
- Seismic microzoning study and seismic risk probability assessment,
- Hydrological studies,
- Design solutions for the reservoir, dam and supporting infrastructure,
- Feasibility study.

The results of the aforementioned surveys and studies are summarized in the relevant volumes of the Project design documentation used in the preparation of this ESIA report and highlight the need for supplementary environmental and social studies.

In addition, calculations of the main structures and determination of their dimensions were carried out based on the principle of integrating modern studies with alternative solutions to ensure the selection of the most efficient option.

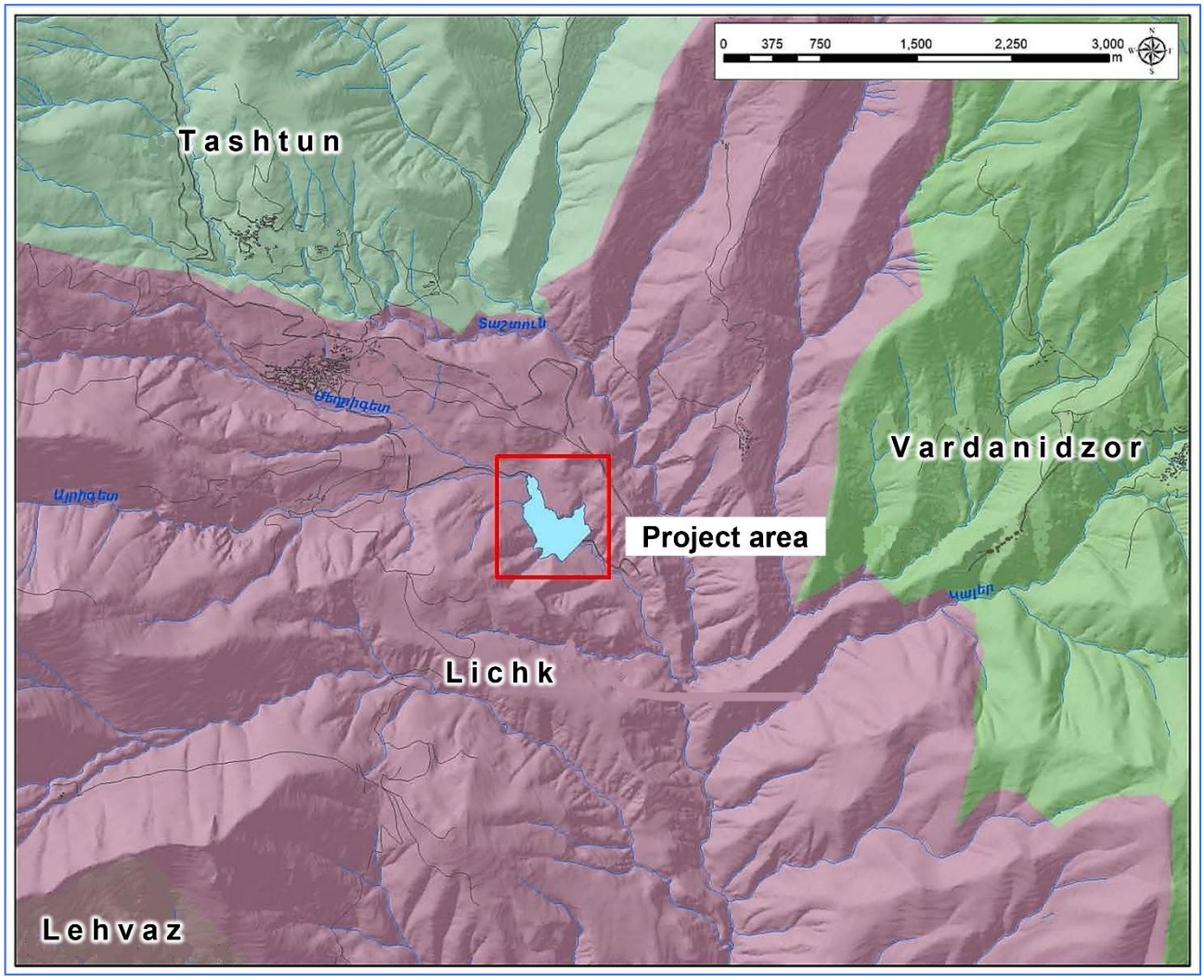
The national EIA study for the Project started in 2023, and the positive environmental expert examination conclusion № 215-24 for the Lichk EIA report was issued by the EIEC under the Ministry of Environment on 16.10.2024 (**Annex 1**).

In parallel, a licensed company was engaged in 2024 by the Water Committee to identify the scope of the main impacts based on a social impact assessment, conduct detailed measurement survey, determine the affected lands and persons, assess their physical and economic losses resulting from the project implementation, and propose measures to compensate affected persons (APs) and assist them in restoring their livelihoods, in accordance with PR5 of the EBRD ESP, as well as the applicable regulations of the RA. All of the above has already been formalised in the Resettlement Plan (RP) for the Project.

2.7.4 Project Location

The Lichk Reservoir is planned for construction within the administrative boundaries of Lichk rural settlement of Meghri enlarged community, RA Syunik Marz (**Figure 2-4**). The Lichk rural settlement borders the Tashtun settlement to the north, Vardanidzor to the west, and Lehvaz to the south. The reservoir will be fed by the Arevik (Lichk) tributary of the Meghri River.

Figure 2-4. Map of the Project region



The M2 interstate highway (Yerevan - Iranian Border) passes through the territory of the Meghri community. The road distance from the M2 highway to Lichk village is approximately 1,900 m, while the direct distance to the planned Lichk reservoir is about 200 m. The reservoir site is located at 1,529 to 1,602 masl altitude and visible from the M2 highway (**Figure 2-5**).

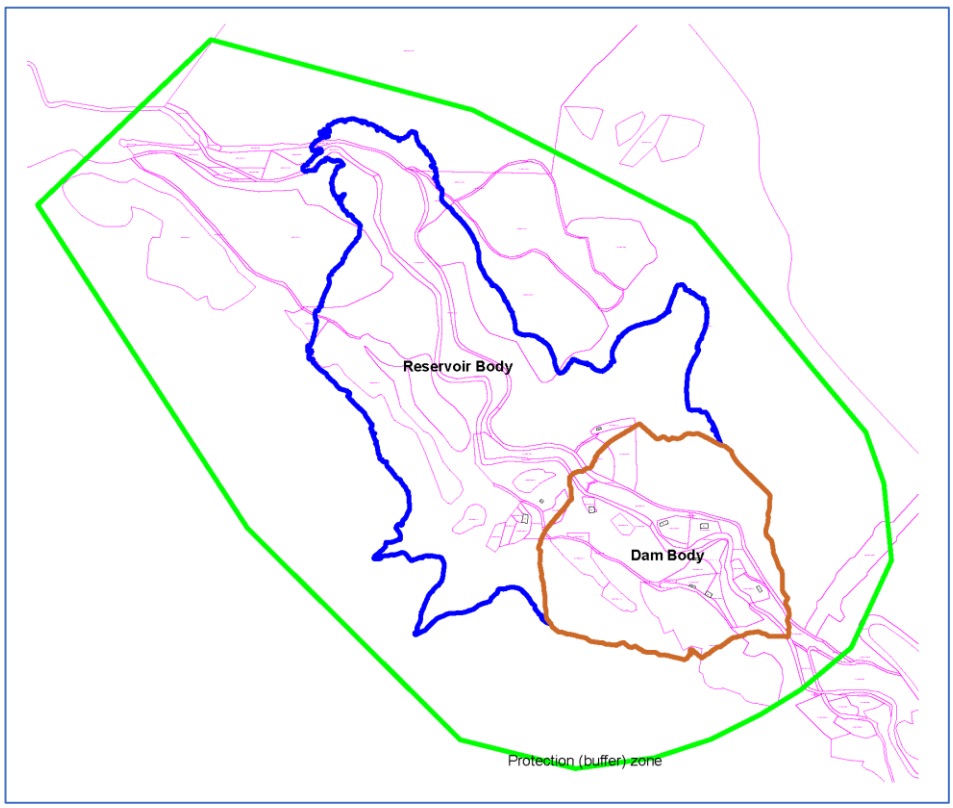
Figure 2-5. View to the Project site from the M1 highway

The reservoir site is located approximately 1.5 km southeast, downstream of the Lichk rural settlement. The distance between Lichk village and the town of Meghri is 20 km. Kapan, the regional center of Syunik Marz, is situated about 52 km from the project site. The distance from the Project site to Yerevan, the capital of Armenia, is approximately 350 km.

2.7.5 Project Components

The hydraulic unit of the Lichk Reservoir will occupy 27.1 ha of land; however, an 80 ha protection (buffer) zone around the reservoir was designated during the Project design study (**Figure 2-6**).

Figure 2-6. Area occupied by the hydraulic unit of the reservoir and protection (buffer) zone



The reservoir hydraulic unit comprises the following components:

1. Dam,
2. Construction (diversion) outlet,
3. Irrigation outlet,
4. Emergency spillway,
5. Service facilities and structures.

The Master Plan of the Project area, indicating Lichk Reservoir, its components and surrounding infrastructure is provided in **Annex 2** of this ESIA report.

2.7.6 Technical Solutions

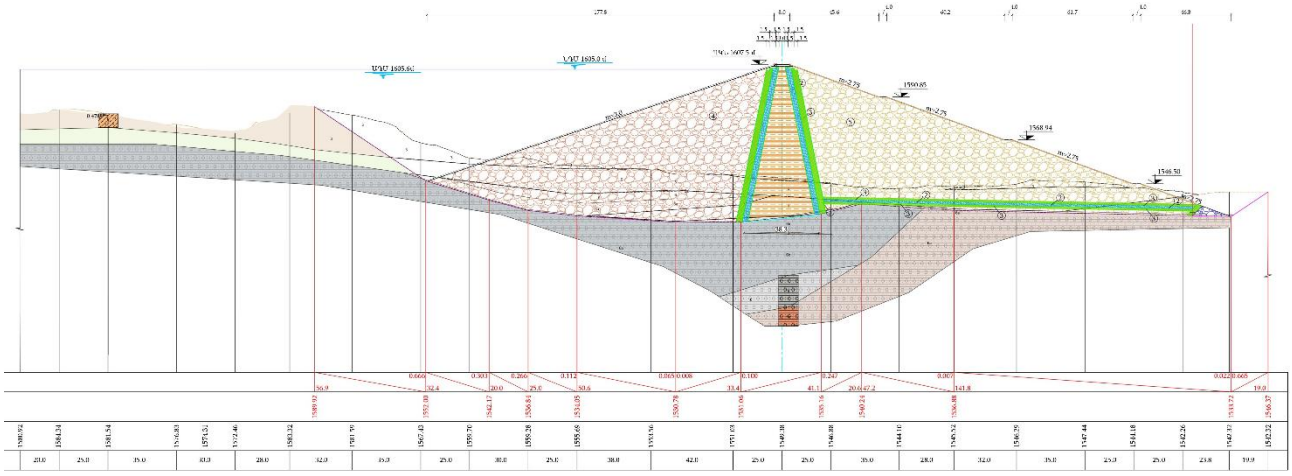
Dam structure

The dam body will be constructed using locally available construction materials, specifically cobble-pebble gravel-ground prisms. To prevent infiltration, a central sandy clay core is planned (**Figure 2-7**).

The dam will have a maximum height of 61.5 m. The upstream slope has been designed at 1:3.0, and the downstream slope at 1:2.75. The crest width is 8.0 m and the dam length at the 1607.5 masl elevation is 367.0 m.

It is planned to reinforce the upstream slope of the dam with a 0.5-meter-thick layer of stone, and to stabilize the downstream slope with perennial grass. At the base of the dam, rock surface preparation is planned, involving the gradual smoothing of sharp slope transitions to ensure that the inclination angle of adjacent rock sections does not exceed 20 degrees.

Figure 2-7. Structure of the dam



Stability calculations for the upstream and downstream slopes of the dam were performed under the influence of both static and dynamic forces, taking into account the maximum horizontal acceleration value (Amax = 0.40g), as determined by seismic microzonation studies.

Construction (diversion) outlet

The construction outlet is a temporary structure designed to divert river flows into the inner bief during the construction of the hydraulic unit, ensuring that the construction site remains dry. In this project, the outlet will operate through an arched floor gallery with a cross-section of 3.5 × 3.5 m and a length of 365.0 m. Hydraulic calculations were performed for a 10% safety discharge, resulting in Q10% = 11.73 m^3/s. Based on these calculations, the gallery cross-sectional dimensions and floor slope were determined.

To manage construction outflows from the river and direct them into the bottom gallery, the upstream slope of the dam will be built up to elevation 1560 masl, serving as a barrier. The riverbed will be drained through an earthen channel leading to the construction gallery. A downstream barrier is not planned in the inner bief, as the natural river slope is sufficient to prevent water from flowing back into the construction site during construction.

Irrigation outlet

For irrigation purposes, a steel pipeline with a length of 373.0 m and a diameter of Ø820×8 mm is planned to be installed in the basement hall to withdraw water from the reservoir at a rate of Q = 1.0 m^3/s and deliver it to consumers. Water will be drawn from the reservoir through a water intake structure to be constructed at the beginning of the construction outlet. A metallic mesh will be installed on the intake to prevent debris entry. The minimum intake level is set at elevation 1560.0 masl, corresponding to the dead storage level of the reservoir.

In addition, an emergency spillway is planned, consisting of a Ø1020×10 mm steel pipeline. At the downstream end of the construction outlet, a valve chamber will be constructed to control the discharge from both pipelines. These two pipelines will also be used to regulate the environmental flow, in line with the limits presented in the hydrology section.

The emergency pipeline is designed for rapid drawdown of the reservoir; however, during this process the irrigation outlet valve may also be operated. When the reservoir is completely full, the valves of both pipelines should not be opened fully. Calculations show that if both pipelines operate simultaneously, the reservoir can be emptied within approximately 12 days.

Emergency valves are also installed on the pipelines to allow repair works if necessary. After the installation of the above-mentioned pipelines, the construction outlet will be sealed with a 22 m long concrete plug.

Emergency spillway

To manage emergency discharges, an open-channel spillway has been designed. It consists of the following components: (1) a lateral spillway, (2) a transition section, (3) a gallery beneath the dam crest, (4) a high-velocity conveyance section, and (5) a terminal spillway section.

The emergency spillway is designed for a 0.01% probability flood with a discharge of 24.7 m³/s. After hydraulic routing, the peak discharge was reduced to 21.6 m³/s, which has been adopted as the design value. The spillway is intended to safely convey excess water to the inner bief. According to the design, it is located on the right bank of the reservoir, directly adjacent to the dam, with a total length of 330.5 m.

Flood discharges from the emergency spillway are conveyed to the downstream bief through a high-velocity structure. This structure is constructed of reinforced concrete with a rectangular cross-section and a floor width of 2–3 m at different sections. At the downstream end of the high-velocity structure, a transition section up to 5 m wide is provided, leading into the spillway. Hydraulic calculations were performed to determine the depth and diameter of the funnel formed at the spillway, ensuring that it does not cause damage to the dam's inner bief or any other structures.

The technical characteristics of the main components of reservoir hydraulic unit are set out in **Table 2-10**.

Table 2-10. Main technical characteristics of the Lichk reservoir

№	Key technical data	Measurement unit	Details
1. General data			
1.1	Location of the reservoir		Lichk settlement of Meghri community
1.2	Capacity of the Lichk reservoir	mln. m^3	Total: 4.02
		mln. m^3	Active: 3.76
		mln. m^3	Dead: 0.112
1.3	Area occupied by the reservoir	ha	27.1
1.4	Area to be permanently allocated for the Project needs	ha	33.0
1.5	Surface area of the water horizon at the FSL	m^2	192,000
2. Dam			
2.1	Material of the body		Cobble-pebble, stone
2.2	Dam type		Ground
2.3	Anti-infiltration element		Central sandy clay core

№	Key technical data	Measurement unit	Details
2.4	Dam class (Armenian Standards)		I
2.5	Dam crest level	masl	1607.5
2.6	Elevation of the bottom	masl	1546.0
2.7	Dam height	m	61.5
2.8	Length of the dam with the crest	m	367
2.9	Width of the crest	m	8.0
2.10	Dam slopes (v:h)		Upstream slope: 1:3.0
			Downstream slope: 1:2.75
2.11	Stabilization of the upstream slope		Stone masonry
2.12	Stabilization of the downstream slope		Vegetation planting
2.13	Type of drainage		Drainage blanket
2.14	Volume of the dam body	ths. m^3	2,900.0
2.15	Volume of the dam core	ths. m^3	264.0
3. Reservoir			
3.1	Type		On-stream
3.2	Dead Storage Level (DSL)	masl	1560.0
3.2	Full Supply Level (FSL)	masl	1605.0
3.4	Maximum Water Level (MWL)	masl	1605.6
4. Construction (diversion) outlet			
4.1	Type		Bottom gallery
4.2	Construction discharge, $Q_{10\%}$	m^3/sec	11.73
4.3	Cross-section	m	3.5×3.5
4.4	Length of outlet	m	365.0
5. Irrigation outlet (offtake)			
5.1	Water intake structure		R/c intake well
5.2	Garbage collection		Metallic mesh
5.3	Type of spillway		A steel pipe with a Ø820×8mm
5.4	Length	m	373
6. Emergency spillway			
6.1	Type		trench
6.2	Total flow	m^3/s	24.7 (P=0,01%)
6.3	Flow after transformation	m^3/s	21.6
6.4	Type of spillway		high velocity
6.5	Length of spillway	m	330.5

2.7.7 Land Resources Required for the Project

In total, 75 land plots covering a surface area of 582,501.60 m² will be affected in Lichk settlement as a result of the Project[6], including:

- 7 private land plots totaling 17,490.50 m^2,
- 58 community land plots totaling 531,848.70 m^2,
- 10 state land plots totaling 33,162.40 m^2.

Private lands

There are 7 privately owned land plots (2 agricultural and 5 non-agricultural), affecting **6 affected households (AH)**, with a total area of 17,490.50 m^2. All agricultural lands[7] are arable, totaling 14,084.40 m^2. The 5 non-agricultural plots cover 3,406.10 m^2, including:

- 1 power energy land plot measuring 1,499.10 m^2,
- 4 residential land plots totaling 1,907.00 m^2.

Community lands

There are 58 community-owned land plots covering 531,848.70 m^2. All lands are agricultural, of which:

- 50 plots are arable, totaling 115,387.60 m^2,
- 8 plots are other agricultural lands[8], totaling 56,709.20 m^2.

State lands

There are 10 state-owned land plots (5 agricultural and 5 non-agricultural), totaling 33,162.40 m^2. The agricultural lands include:

- 1 arable land plot measuring 1,496.90 m^2,
- 1 other land plot measuring 909.70 m^2,
- 3 pasture lands totaling 1,227.40 m^2.

The 5 non-agricultural lands are designated for mining purposes, covering 29,528.40 m². No illegal users are present on state-owned lands.

2.7.8 Description of the Construction Activities

The construction site covers an area of approximately 38.14 ha, including:

- 0.76 ha along the "Zvar" bypass waterway (1,262 m),
- 0.28 ha for the 512 m access road,
- 24.6 ha for the reservoir dam and body (including the gravel-pebble borrow pit within the reservoir basin),
- 12.5 ha for the stone pit.

For convenience, the construction site is divided into the following sections:

1. Dam and associated structures,
2. Reservoir body, which also serves as a borrow pit for cobble, pebble, and filter materials,
3. Stone borrow pit,

[6]Draft Resettlement Plan for the Construction of Lichk Reservoir in Meghri Community, Syunik Marz, September 2024

[7]There is 1 AH using 2 arable land plots. The AH cultivates fruit trees on those lands.

[8]The AH of private non-agricultural power land has servitude right on 5 community owned agricultural other land.

4. Water pipeline of the "Zvar" treatment plant, bypassing the Lichk reservoir, with a length of 1,262 m,
5. 10 kV overhead transmission line to be replaced.

Borrow pits and construction materials

The required sandy clay and gravel for the construction of the reservoir dam will be excavated from within the planned reservoir area. Rockfill material will be supplied from borrow pits located approximately 5 km from the Project site. These sources were originally investigated during the Soviet Union era, and relevant data has been obtained from previous surveys.

In addition, spoil material excavated during the construction of the North-South highways may also be used as backfill for the dam. However, the final decision regarding its use will be made by the selected construction contractor prior to the start of construction activities.

No reclamation activities are required except for the stone borrow pit, as the sandy clay and gravel will be extracted from within the reservoir basin, which will eventually be submerged. Only basic leveling is planned for these areas. For the stone borrow pit, remediation is planned using topsoil removed from the reservoir site and spoil materials excavated from the reservoir basin.

According to the soil balance calculations conducted within the Project design study:

- A total of 25,205 m^3 of topsoil will be removed from the area designated for the reservoir, dam, and supporting infrastructure. Of this volume, 10,705 m^3 will be used to cover the lower bief of the dam, while the remaining 14,500 m^3 will be used for the reclamation of the stone borrow pit.
- Approximately 1,020,397.1 m^3 of stone will be transported from the stone borrow pit**,** located about 5 km from the Project site**,** and used in the construction of the dam.
- A total of 2,916,253.6 m^3 of ground material**,** consisting of sandy clay, gravel, cobble-pebble, tuff breccia**,** and other materials, will be excavated from the area allocated for the reservoir, dam, and supporting infrastructure. The majority of thess materials will be used for the construction of the reservoir dam and body**,** while the remaining 468,131.8 m^3 will be used for the remediation of the stone borrow pit**.**

Access road

The construction machinery and equipment will primarily access the Project site via the M1 'Yerevan - Iranian Border' highway. Access from the M1 highway to the construction site, as well as connections between the construction site, the stone borrow pit, and various components of the reservoir, will be facilitated via earthen roads.

Construction camps

Two construction camps will be established to meet the needs of the Project, each equipped with the necessary facilities and equipment. The first camp will support the construction of the dam, reservoir body, associated infrastructure, and access roads. The second camp will serve the stone borrow pit. The location of the first construction camp is shown in the Master Plan of the Project area (**Annex 2**), while the second one will be situated adjacent to the stone borrow pit and will require temporary land take. This will not result in involuntary resettlement but may 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.

If the designated construction camp areas are insufficient to accommodate a batching plant, concrete will be supplied from the nearest centralized concrete mixing facility, equipped with batch weighing systems, and transported to the Project site. These arrangements will be further discussed between the selected construction contractor and the Client.

Spoil disposal areas and top soil storage

The temporary storage of topsoil removed from the Project area will be arranged within the construction site (**Annex 2**).

As described above, approximately 85% of the 2,916,253.6 m³ of materials to be excavated from the reservoir basin, including sandy clay, gravel, pebble, tuff breccia, and other materials, will be used for the construction of the dam and reservoir body. The remaining 468,131.8 m³ will be utilized for the reclamation of the stone borrow pit. Consequently, no permanent Spoil Disposal Areas (SDAs) will be required during the construction phase. However, it is expected that the excavated materials will be temporarily stored within the construction site prior to use. The specific locations of these temporary SDAs are not defined in the Project design documents and will instead be proposed by the construction contractor before the commencement of construction works.

Blasting

For rocky soils, two options are recommended for consideration as preliminary loosening methods:

- Blasting of rock using borehole or blasthole charges (stone quarry method),
- Use of a hydraulic hammer for excavation of the reservoir body and dam.

Blasting operations should be conducted at fixed times of the day, preferably in the afternoon or at the end of the working shift. The blasting schedule must be communicated in advance to people in the surrounding area.

All blasting activities must be carried out by qualified and experienced specialists who are fully trained in handling explosives and conducting blasting operations.

Explosives must be stored in a secure location at a safe distance from the work site and kept under the special supervision of a guard. Matches and other flammable materials must not be brought near the storage area. Any unused explosives must be returned to the warehouse on the same day.

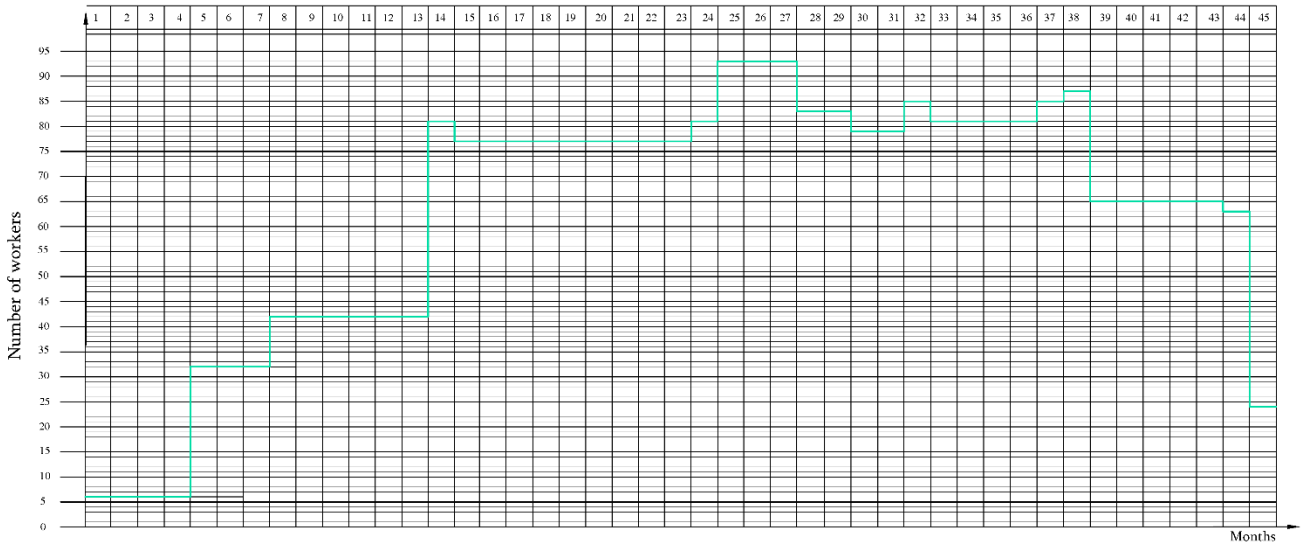
Time Schedule

Duration of the construction works was determined based on the volume and labour intensity of the main earth and excavation 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 was determined according to the construction work schedule (**Figure 2-8**) and amounts to 45 months or 1125 days[9].

The construction work schedule including the required workforce load is presented in **Figure 2-8**.

[9]Preparation of design and cost estimation documents for construction of the Lichk reservoir in Syunik Marz of the Republic of Armenia, Explanatory Note, 2024

Figure 2-8. Construction work schedule and required workforce



The required number of workers will vary throughout the Project implementation period. According to the construction schedule (**Figure 2-8**), the maximum workforce will comprise 93 workers. In total, 140 workers will be required during the construction stage, including 22 engineers and 24 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.

Construction machinery and equipment

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 2-11. Construction machinery and equipment to be used for the construction of the reservoir

№	Type of machinery / equipment	Specifications / capacity	Quantity, pcs.
1	Heavy truck	25 t	8
2	Heavy truck	25-36 t	18
3	Heavy truck	16 t	2
4	Side-loading truck	10 t	2
5	Concrete mixer truck	4 m^3	2
6	Concrete pump	65 m^3/hour	2
7	Truck-mounted crane	16 t	2
8	Bulldozer	225 kW	4
9	Bulldozer	96 kW	2
10	Vibration roller	10 t	1
11	Compressor	10 m^3/min	2
12	Jackhammer	MO-10	4
13	Excavator	bucket - 0.65m^3	1

№	Type of machinery / equipment	Specifications / capacity	Quantity, pcs.
14	Excavator	bucket - 1.25m^3	2
15	Excavator	bucket - 2.5m^3	8
16	Needle vibrator	IV	8
17	Pneumatic hammer	-	4
18	Welding machine	-	2
19	Pump	40 m^3/hour	2
20	Autograder	79 kW	1
21	Loader mechanism equipped with a traversing system	Excavator, bulldozer or other mechanism	2

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**[10].

All components of the reservoir, except for the power supply line are included in the Project design documents. Therefore, the power supply line, which will service the operational reservoir and its components, is considered an **Associated Facility** for the Project.

2.9 Project Justification

The Government of Armenia (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.

[10]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

Agricultural lands in eight settlements of the enlarged Meghri community, Meghri, Agarak, Alvank, Shvanidzor, Nrnadzor, Lehvaz, Vardanidzor, and Karchevan, will be irrigated with water from the planned Lichk Reservoir. As of 2022, a total of 1,315.8 ha of agricultural land in these settlements is irrigated, with 619 ha supplied by gravity and the remainder through mechanical pumping.

Calculations carried out during the Project design study indicate that an additional 195.0 ha of land, which is formally registered as agricultural, but is currently not cultivated due to the lack of irrigation infrastructure, can also be irrigated.

Thus, the construction of the Lichk Reservoir will ensure stable gravity-based irrigation for a total of 1,510.8 ha of agricultural land across the eight settlements.

The construction of the Lichk Reservoir will address a number of water management challenges in the region, including:

- Ensuring the irrigation of Meghri's gravity-fed lands and to expand the irrigated area by an additional 195 ha,
- In the future, approximately 13 km section from the Lichk Reservoir to the head of the Meghri gravity system will be constructed as a closed pipeline. This will save up to 1 mln. m^3 of water, helping to offset the deficit expected from the depletion of water resources in the coming years,
- A closed pipeline to be constructed from the Lichk Reservoir to the head of the Meghri gravity system will generate water pressure of up to 600 m, potentially enabling hydro power production,
- Potential to save more than 2.0 mln. kWh of electricity annually,
- The reservoir will enhance water security for surrounding settlements and will also contribute to a moderate improvement of the regional climate.

The "Zero Option" of the Project, meaning the reservoir is neither constructed nor operated, would result in significant water losses and continued reliance on the mechanical irrigation system for 1,315.8 ha in eight settlements of the Meghri community. Additionally, 195 ha of agricultural land would remain unirrigated due to water shortages and the operation of inefficient pumping stations. This scenario would have several negative consequences and is therefore not considered an acceptable solution:

1) An additional 2.0 mln. kWh of electricity is consumed annually for mechanical pumping, indirectly contributing to greenhouse gas (GHG) emissions from power generation sources,
2) The high operational and maintenance costs of the pumping stations make agricultural production in the planned reservoir's command area economically unfeasible and uncompetitive,
3) High levels of water loss that are also attributed to inefficient water management practices, primarily due to the incomplete implementation of water metering,
4) Due to the lack of reliable irrigation water, some high-value fruits, such as pomegranate, fig, and pear, are not cultivated on the agricultural lands of the Meghri community.

3.2 Analysis of Alternative Capacities of the Reservoir

As part of the process of determining the capacity of the Lichk Reservoir, the irrigation water demand for 15 settlements within the Meghri enlarged community was calculated. These settlements were grouped (**Figure 3-1**) based on the following principles:

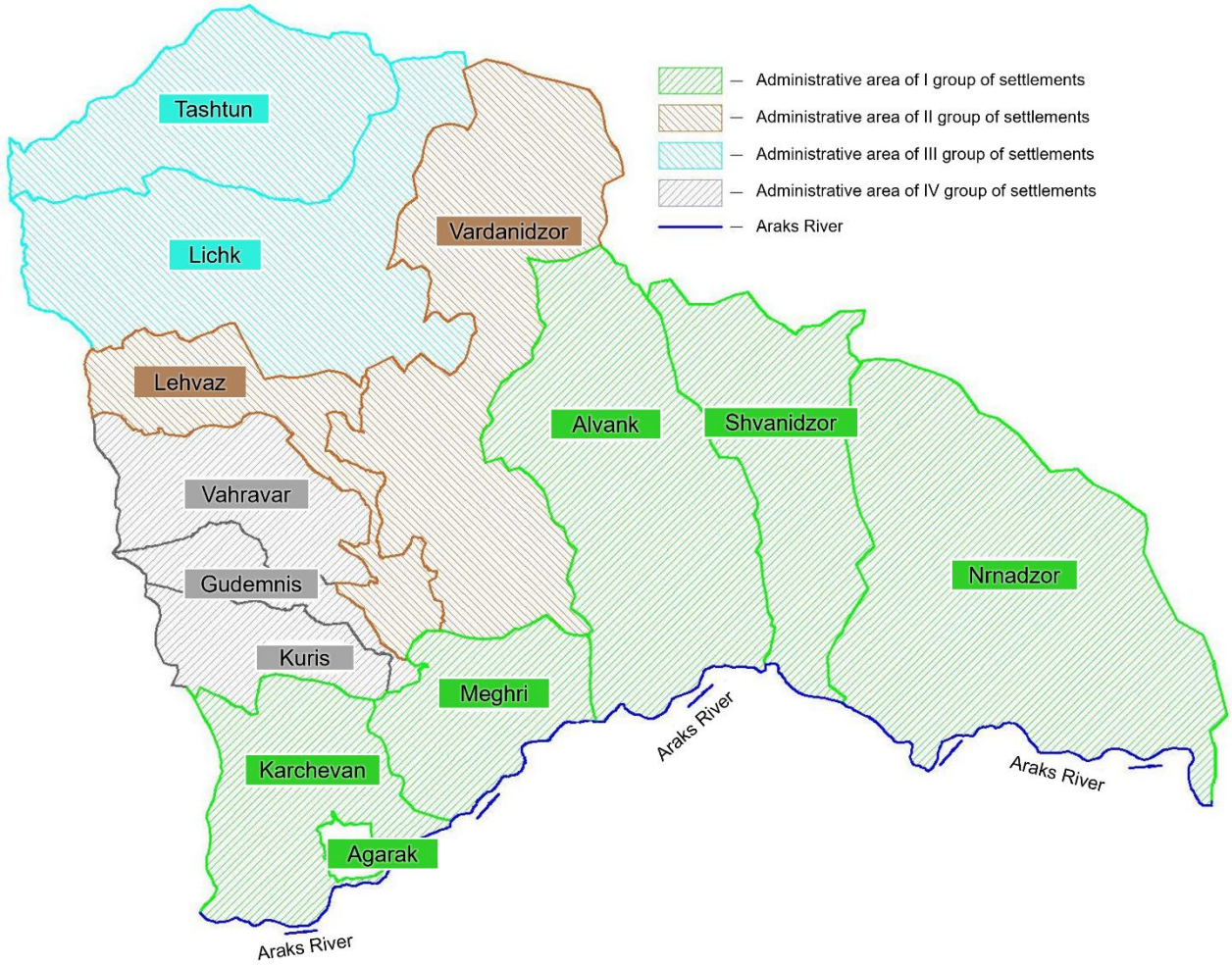
I group - Settlements that are fed by the Meghri gravity irrigation system: part of the Megri, Agarak, Alvank, Shvanidzor, Nrnadzor, Karchevan. In total, 881.5 ha of agricultural land is irrigated by the Meghri gravity system.

II group - Settlements that are located downstream the planned Lichk Reservoir and currenlty irrigated from the Meghri River (the reservoir will also serve as source of enhancing their water security level): Lehvaz, Vardanidzor, Tkhkut and Aygedzor. Irrigated area - 343.3 ha.

III group - Settlements that are irrigated from the Meghri River basin from sources located upstream the Lichk Reservoir: Lichk and Tashtun. Irrigated area - 438.1 ha.

IV group - Settlements that are fed by the tributaries of the Meghri River or directly from the Megri River, however, are not included into the water balance of the Lichk Reservoir: Vahravar, Gudemnis and Kuris. They have more than 210 ha of agricultural land, but currently only 60-70 ha are irrigated.

Figure 3-1. Grouping of 15 settlements within Meghri enlarged community



For the settlement groups mentioned above, hydrological calculations were performed at two nodal points, based on 75% water availability. These calculations were conducted using a comparative analysis of the catchment areas of the Lichk Reservoir. The results are presented in the **Table 3-1**.

Table 3-1. Water management balance

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Water resources, mln.m^3													
Water volume	1.462	1.293	2.249	9.666	28.619	51.04	26.77	10.737	4.621	2.29	2.057	1.746	142.542
Water resources													
I, II, III groups of settlements	0	0	0	2.411	5.39	6.661	9.773	9.547	5.056	0.587	0	0	39.424
Veolia Jur	0.263	0.263	0.263	0.263	0.263	0.263	0.263	0.263	0.263	0.263	0.263	0.263	3.154
Tatstoune Ltd.	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.056
Environmental flow	0.225	0.205	0.32	1.394	5.551	9.923	4.891	1.894	0.98	0.253	0.333	0.333	26.403
Balance	**0.969**	**0.82**	**1.661**	**5.593**	**17.41**	**34.188**	**11.838**	**-0.972**	**-1.683**	**1.182**	**1.456**	**1.145**	**73.505**

The water management balance sheet indicates that the Meghri gravity system experiences a total deficit of 2.653 mln. m^3 during August and September ([-0.972]+[-1.683]). In all other months, the balance is positive, indicating that the capacity of the Lichk Reservoir is sufficient to cover the Meghri gravity system's deficit.

To cover the Meghri gravity system's deficit, the required volume of water must be conveyed from the Lichk Reservoir to the Meghri gravity head along the Meghri River, a distance of approximately 13 km. During this transfer, water losses (29.4% or 0.294) will occur. Hence, the useful volume of the reservoir will equal to:

$W_U = 2.653 / (1 - 0.294) = 3.76$ mln. m^3.

This option offers the potential to improve irrigation capacity by approximately 1 mln. m^3 in the future, by transferring water from the Lichk Reservoir to the Meghri gravity system through a 13 km closed pipeline instead of via the Meghri River.

3.3 Analysis of Alternative Locations of the Reservoir Dam

Preliminary studies conducted by the Project designer revealed that there are limited options for selecting a suitable location for the reservoir dam in this region.

An engineering-geological and hydrological studies was carried out along the entire length of the Arevik tributary of the Meghri River. The study revealed that, in order to fully utilize the potential of the Arevik catchment basin, the reservoir dam axis must be located in the lower reaches of the tributary, downstream of Lichk settlement, where two tributaries converge. Otherwise, the reservoir's volume will be insufficient to meet current water demand, and the required dam height would be greater than at the proposed location due to the steep gradient of the riverbed.

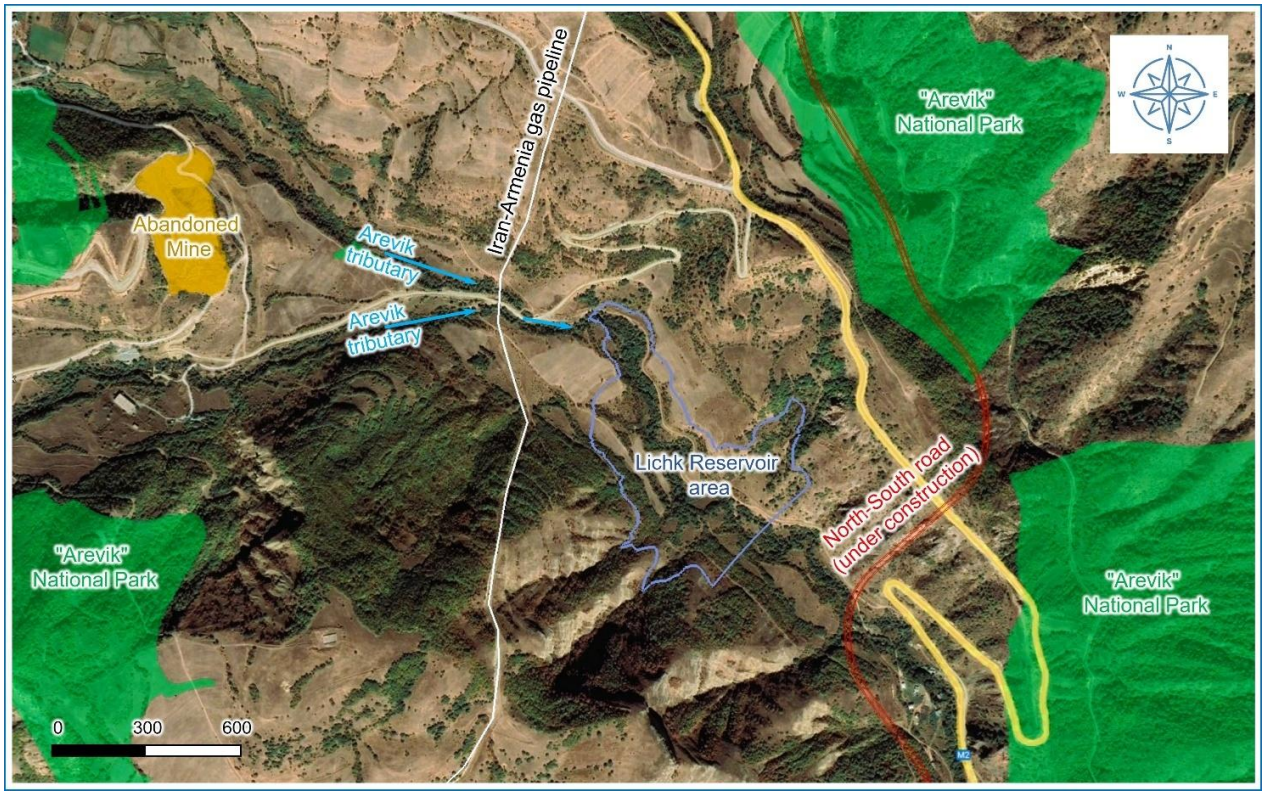
The Project designer also reviewed feasibility studies conducted during the Soviet era, as well as those prepared in the early 2000s by "ArmJrnakhagits" CJSC. All of these studies identified a single general location for the reservoir, approximately 3 km from Lichk village. Within this area, the proposed dam axis was positioned at various points up to 0.5 km apart, resulting in different estimated reservoir volumes, ranging from 1 to 2.5 mln. m^3.

Other sections of the Meghri River basin were investigated for the construction of the reservoir dam; however, no alternative location was found to be more suitable than the selected site, taking into account the following factors (**Figure 3-2**):

- The presence of the "Arevik" National Park, a specially protected natural area,
- The alignment of the North-South Road, which runs along the Meghri River,
- The presence of rural settlements within the project area,

- The Iran-Armenia gas pipeline, which passes north of the proposed reservoir site,
- The existence of other commercial infrastructure (Tatstone Ltd. mining company, Kantegh HPP, etc.),
- The proposed design alignment.

Figure 3-2. Lichk Reservoir area and surrounding infrastructure and factors limiting Project alternatives



3.4 Conclusion

1. The optimal capacity of the proposed Lichk Reservoir was determined based on the irrigation water deficit during the summer season, particularly in August and September, which amounts to 2.653 mln. m^3. To ensure a sufficient water supply to the Meghri gravity irrigation head via the Meghri River stream and accounting for water losses the reservoir must have an active capacity of 3.76 mln. m^3.
2. This option also allows for a future increase of approximately 1.0 mln. m^3 in available irrigation water by transferring water from the Meghri Reservoir to the Meghri gravity irrigation head through a 13 km long closed pipeline, thereby minimizing water losses and enhancing resilience to climate change.
3. The engineering-geological and hydrological surveys conducted during the Soviet Union period, in the 2000s and by the Project designer in 2023-2024 showed the limited area where the dam of the planned Lichk Reservoir can be constructed. These limiting factors are:
   - The "Arevik" National Park, which borders the reservoir area on the west (approx. 1.0 km away) and the east (approx. 300 m away),
   - The North-South Road currently under construction, which will pass approximately 280 m southeast of the reservoir dam,
   - The Iran-Armenia gas pipeline, located approximately 180 m west of the reservoir body,
   - The confluence point of two streams of the Arevik tributary of the Meghri River.

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)***[11], 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[12].

The ***Water Code (2002)***[13] 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[14].

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[15].

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

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

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, eutrophication 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[16] 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[17],
- 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.

Before the establishment of the WPZs, the national economic facilities[18] 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

[16] https://www.arlis.am/DocumentView.aspx?docid=4965
[17] 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'
[18] national economic facility is a term used in the former Soviet Union time, now it means commercial units

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)***[19] 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)***[20] 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)***[21] 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)***[22] 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[23], 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[24],
- 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[25],
- The procedure for soil excavation, approved by the RA Government Decree №572-N dated 10.05.2019[26].

The ***Law on surveillance over the land use and land conservation (2008)***[27] 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.

The ***Law on waste (2004)***[28] 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

[19] https://www.arlis.am/documentview.aspx?docid=166250
[20] https://www.arlis.am/DocumentView.aspx?docid=166244
[21] https://www.arlis.am/documentview.aspx?docid=200928
[22] https://www.arlis.am/documentview.aspx?docid=150513
[23] 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.
[24] https://www.arlis.am/documentview.aspx?docID=71439
[25] https://www.arlis.am/DocumentView.aspx?docID=117360
[26] https://www.arlis.am/documentview.aspx?docid=130889
[27] https://www.arlis.am/DocumentView.aspx?docid=144520
[28] https://www.arlis.am/documentview.aspx?docid=140521

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)***[29] 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, re-edited in 2022)***[30] 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)***[31] and ***Law on fauna (2000)***[32] 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***[33] and ***RA Red Book of plants***[34] 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)***[35] 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[36].

The ***Law on protection and use of immovable cultural and historic monuments and historic environment (1998)***[37] 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 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

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

of immovable historic and cultural monuments, approved by the RA Government Decree №438 dated 20.04.2002[38]. The RA Government Decree №2322-N[39], №754-N[40], №80-N[41], №628[42] and №1270-N[43] define the State lists of immovable historical and cultural monuments in the RA Syunik, Gegharqunik, 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[44].

The ***Law on intangible cultural heritage (2009)***[45] 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"[46], (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"[47], (iii) Government Decree №241-N "On approving the criteria for defining cultural spaces and published the list of cultural spaces"[48], etc.

The ***Code on subsoil resources (2011)***[49] 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)***[50] 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)***[51] 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 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)***[52] regulates the organization and implementation of preventive and anti-epidemic measures, immunoprophylaxis of diseases, prevention of the impact of harmful

[38] https://www.arlis.am/documentview.aspx?docid=137204
[39] https://www.arlis.am/DocumentView.aspx?DocID=36406
[40] https://www.arlis.am/DocumentView.aspx?DocID=38081
[41] https://www.arlis.am/DocumentView.aspx?DocID=37837
[42] https://www.arlis.am/DocumentView.aspx?DocID=36898
[43] https://www.arlis.am/DocumentView.aspx?docid=12877
[44] https://www.arlis.am/DocumentView.aspx?docid=55737
[45] https://www.arlis.am/DocumentView.aspx?docid=121003
[46] https://www.arlis.am/DocumentView.aspx?docid=151791
[47] https://www.arlis.am/DocumentView.aspx?docID=157499
[48] https://www.arlis.am/DocumentView.aspx?docID=134827
[49] https://www.arlis.am/documentview.aspx?docid=146898
[50] https://www.arlis.am/DocumentView.aspx?docid=121312
[51] https://www.arlis.am/documentview.aspx?docid=146636
[52] https://www.arlis.am/hy/acts/191172

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)***[53] 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***[54]. 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)***[55] 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)[56]).

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.

[53] https://www.arlis.am/documentview.aspx?docid=152137
[54] https://www.arlis.am/DocumentView.aspx?docid=138982
[55] https://www.arlis.am/documentview.aspx?docid=144513
[56] https://www.arlis.am/documentview.aspx?docID=99397

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. 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. 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. 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. 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. 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. 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: (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; (b) Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production; (c) Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development. Ratified by Armenia in 2017.

International agreements (convention or protocol)	Description
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. 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. 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. 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»). 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. The permitting state must take these comments into account in its final decision and communicate it to the affected country and the public. The projects subject to consultations under the Convention are those listed in Appendix I including 'large dams and reservoirs'. Ratified by Armenia in 1997.
International Labour Organization (ILO) Conventions	Armenia has ratified 29 ILO conventions including the following fundamental ones: - Forced Labour Convention, 1930 (Ratified 17.12.2004), - Freedom of Association and Protection of the Right to Organize Convention, 1948 (Ratified 02.01.2006), - Right to Organize and Collective Bargaining Convention, 1949 (Ratified 12.11.2003), - Equal Remuneration Convention, 1951 (Ratified 29.07.1994), - Abolition of Forced Labour Convention, 1957 (Ratified 17.12.2004) - Discrimination (Employment and Occupation) Convention, 1958 (Ratified 29.07.1994),

International agreements (convention or protocol)	Description
	- Minimum Age Convention, 1973 (Ratified 27.01.2006), - 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[57]. 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[58]. 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)[59] and calls for the implementation of EU requirements on the use of BATs and related standards for emissions and discharges.

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

[57]EBRD. 2019. ESP. https://www.ebrd.com/news/publications/policies/environmental-and-social-policy-esp.html.
[58]'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).
[59]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.

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 Directive[60]. 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)[61]

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 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);

[60]EBRD. 2019. Access to Information Directive. www.ebrd.com/documents/strategy-and-policy-coordination/access-to-information-policy-directive.pdf?blobnocache=true

[61]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

- 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)[62]

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)[63]

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)[64]

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).

Directive 2000/60/EC establishing a framework for Community action in the field of water policy (the Water Framework Directive)[65]

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[66])

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

[62]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
[63]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
[64]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
[65]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
[66]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

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)[67]

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)[68]

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)[69]. 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 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)[70]*** (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.*

[67]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

[68]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

[69]https://www.ebrd.com/downloads/about/sustainability/Building_Construction_Activities.pdf

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

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 Centre (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.
- **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 Lichk Reservoir, with a capacity of 3.76 mln. m^3, 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 • 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) • Water and soil quality survey • Ambient noise study (determination of actual noise levels within the Project's area of influence) • Socio-economic data collection and interviews • Archaeological field surveys
Supplementary studies conducted by the ESIA Consultant
• Cumulative impact assessment, • Assessment of impacts of the associated facilities, • Water infiltration and loss study, water and soil quality survey, • Assessment of Greenhouse Gas (GHG) emissions and climate change mitigation measures, • Spring season field biodiversity surveys and Critical Habitat Assessment, • Appropriate Assessment procedure, • 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 during the 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.

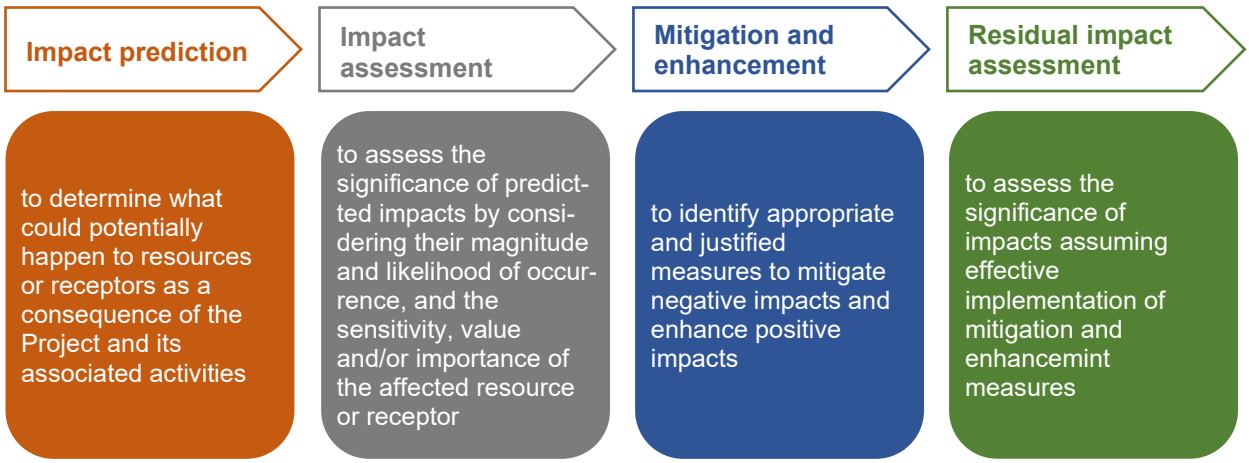
5.5 Impact Assessment and Mitigation

The potentially significant impacts identified during the scoping stage are subject to a full-scale appraisal in the course of 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. **Indirect impact** between the proposed activity and the environment/ receptor as a result of subsequent interactions within it. **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. **Short-term (low duration)**, when impact is likely to be restricted for a duration of up to three years. **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. **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. **Low**, when resulting in slight changes of prevailing baseline conditions. **Medium**, when resulting in changes which are within the benchmark norms or shows some signs of stress on any of the components of environment. **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. **Medium**, when event is likely to occur at some time during normal operating conditions. **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 and are not added in response to an impact significance assessment) were considered as part of the Project (i.e., prior to the impact assessment stage of the ESIA process). As such, they are not described as mitigation measures in the individual topic assessment sections.

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 Lichk Reservoir is planned to be constructed within the administrative boundaries of the Lichk rural settlement, which is part of the Meghri enlarged community. It will be fed by the Arevik (Lichk) tributary of the Meghri River. The selected site is located at an elevation of 1,529 to 1,602 masl. The closest settlements to the Lichk Reservoir area are Lichk and Tashtun, located approximately 1.5 km and 2.5 km to the northwest, respectively, and Tkhkut, situated about 6 km to the south.

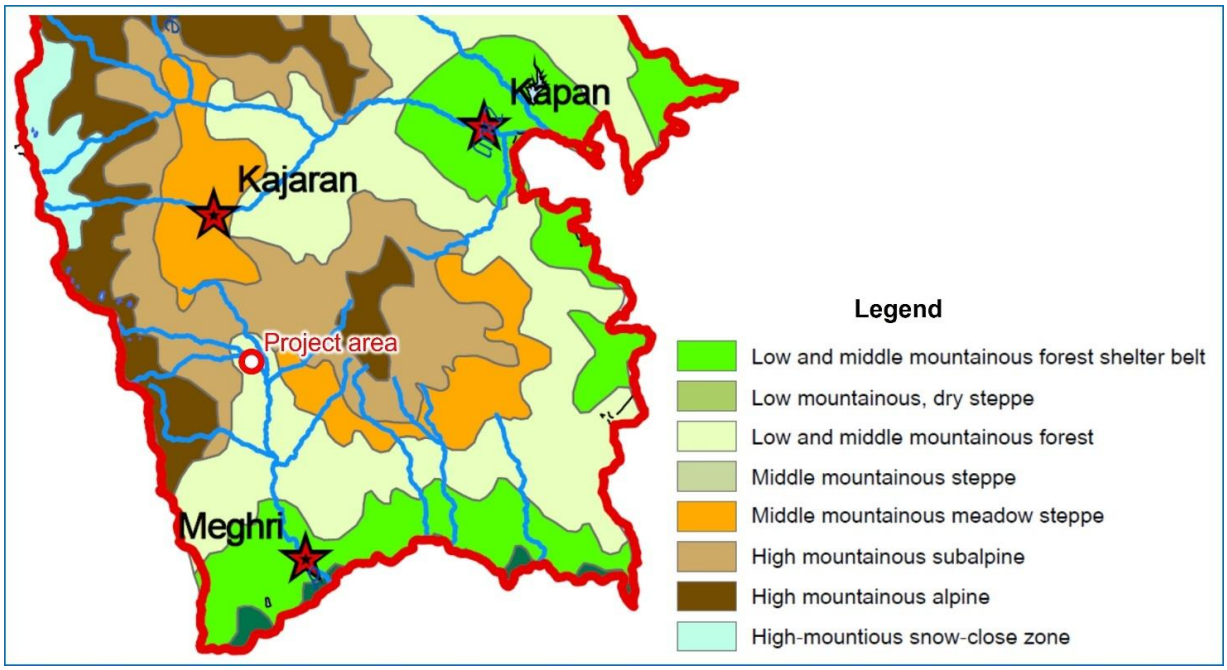
The Meghri community is located in the southern part of the RA Syunik Marz. The area of the community is 660.7 km^2, accounting for approximately 2.2% of the country's total territory. The community comprises 15 settlements, including 2 urban and 13 rural ones. About 42.6% of the area is occupied by agricultural land, of which 20.4% consists of pastures, 3.6% is arable land, and 74.5% is covered by other types of land.

The M2 "Yerevan Iranian Border" interstate highway runs through the community's territory. The maximum length of the area is 37 km from east to west, and 29 km from north to south. The lowest point is at the confluence of the Araks River and the eastern border of the Republic of Armenia, at 374 masl. The highest point is Pharakan Peak in the Zangezur mountain range, which rises to 3,826 masl and marks the junction of the Zangezur and Meghri mountain ranges. Approximately 60% of the community's territory consists of large relief slopes ranging from 16° to 30°. The community is also distinguished from other areas by its unique geological structure.

6.1.2 Relief, Landscape and Visual Amenity

The Meghri community is characterized by a complex relief with pronounced indentation and fragmentation. It encompasses six distinct vertical landscape zones: low and middle mountain forest and shelter belt, low and medium mountain forest, medium mountain meadow-steppe, and high mountain subalpine and alpine zones. Among these, the low and medium mountain forest zone is the most prevalent. The landscape zones within the project area are shown in **Figure 6-1**.

Figure 6-1. Landscape zones in the Project region



From a geomorphological perspective, the Project area is located on the south-southeastern slopes of the Zangezur and Meghri mountain ranges. The region is characterized as a typical mountainous terrain with a highly dissected relief. The landscape features canyon-like formations carved by the river networks of the Meghriget, Tashtun, and Ayriget rivers, as well as by temporary watercourses, all contributing to a general south-eastward slope. Morphologically, the area can be classified as a highly fragmented terrain type.

An aerial view of selected characteristic sections of the reservoir area is presented in **Figure 6-2**.

Figure 6-2. Aerial view of the Project site's different sections

General view of the Project area *Proposed starting area of the reservoir site*

Five habitats have been identified within the area allocated for reservoir construction, based on the habitat classification system for Armenia, which was developed using the EUNIS classification (see **Section 6.2.4**).

6.1.3 Geology and Hydrogeology

The engineering-geological survey was carried out by "Georisk" CJSC and consisted of both desktop and field investigation stages[71]. During the desktop study, available archival and literature-based engineering-geological data related to the project area were collected and analysed.

The geological structure of the planned Lichk Reservoir area consists primarily of Lower Eocene intrusive rocks, such as quartz gabbrodiorites, intradacites and quartz monzonites. These are overlain by Middle Eocene volcanogenic-sedimentary formations, including tuffaceous sandstones, tuff-shales, sandstones, tuffs, and tuff-breccias. These are covered by Quaternary alluvial, diluvial, and proluvial deposits.

Stratigraphy (bottom to top):

- **Quartz Gabbrodiorites (Lower Eocene)**
  These are the oldest rocks in the region, exposed on the left slope of the Meghri River canyon. They appear dark grey, fractured, and in places below the dam site, are significantly altered and blackened. Hydrothermal alteration and tectonic disturbances are common, with visible mineralization of pyrite and chalcopyrite.
- **Volcanogenic-Sedimentary Complex (Late Eocene, Arevik Horny Layer)**

[71]Preparation of design and cost estimation documents for construction of the Lichk reservoir in Syunik Marz of the Republic of Armenia, Book 2 - Engineering geological surveys, 2024

Overlying the gabbrodiorites is a thick sequence of tuffaceous sandstones, tuff-shales, sandstones, tuffs, and tuff-breccias. This unit is well-developed on the right slope of the Meghriget River gorge, with a total thickness of up to 500 meters, according to published sources.

- **Intradacites:**
  Younger than the quartz diorites, the intradacites extend from northwest to southeast. They are fresh, dense, coarse-grained, and exposed on the left slope of the canyon, in contact with the quartz diorites. These rocks are associated with zones of hydrothermal alteration and tectonic disturbance.
- **Quaternary Deposits:**
  - Diluvial Deposits (Second Alluvial Terrace): Composed of boulders and cobbles (up to 20%) with sandy and sandy-loam matrix.
  - Alluvial Formations: Brown sandy clays forming an alluvial terrace on the right slope of the gorge.
  - Sandy Loams: Contain up to 30% bedrock fragments, also observed on the right slope.
  - Alluvial-Diluvial and Modern Diluvial Sediments: Characterized by boulders and cobblestones (up to 20%) with sandy fillers.

Field investigations were carried out in June-July 2023 with the purpose to:

- Conduct engineering-geological investigations with drillings up to 75 m,
- Soil sampling from disturbed and undisturbed structure, studies of the physical and mechanical properties of soils.

Hydrogeological conditions

During the field investigations, the upper horizon of groundwater was recorded in wells BH-1, 2, 7, 8, 12, 14, 16, 21 and 24, at depths ranging from 2.8 to 17.6 m.

Atmospheric precipitation and water from the Meghri River infiltrate through loose detrital and gravel-pebble deposits, forming an interfacial groundwater horizon. Most of the underground water accumulates above a regional aquiclude composed of Upper Pliocene volcanic-sedimentary rocks. Based on their occurrence, recharge, and discharge conditions, these underground waters are classified as unconfined groundwater.

Special soils

The special soils in the study area include black sandy loam, sandy loam-rich soils, and fill materials. These soils are limited in extent within the proposed reservoir site, with thicknesses ranging from approximately 1.0 to 4.0 m. They were also identified in boreholes BH-20, BH-2 and BH-15.

Conclusions of the engineering-geological survey

The results of the engineering-geological survey conducted within the Project area and its vicinity are summarized below:

1) From a geomorphological perspective, the study area occupies the south-southeastern slopes of the Zangezur and Meghri mountain ranges, with absolute surface elevations ranging from 1,529 to 1,602 meters. The primary hydrological features are the Meghri River and its right-bank tributary.

2) From a geological perspective, the study area is composed of volcaniclastic tuff-breccias and dacites of Middle Eocene age, overlain by modern eluvial, diluvial, and alluvial-proluvial deposits consisting of clay, sand, gravel, and gravel-pebble formations.
3) During the field investigations, the upper horizon of groundwater was recorded in wells BH-1, 2, 7, 8, 12, 14, 16, 21 and 24, at depths ranging from 2.8 to 17.6 m. Based on installation conditions, recharge sources, and discharge characteristics, this groundwater is classified as near-surface and unconfined.
4) Field measurements of soil filtration properties indicate that the infiltration coefficients fall within the following ranges: 0.005 m/day - practically impermeable, 0.005-0.299 m/day - slightly permeable, 0.322-2.9 m/day - permeable and 3.012-7.362 m/day - highly permeable.
5) Four Geotechnical Elements (GTE) were identified in the study area:
   - GTE-1. Modern Quaternary silt formations (e,dQ4) consist of clay, sandy clay, and siltstone,
   - GTE-2. The Modern Quaternary loose formations (e,dQ4) are composed of pebble-gravel deposits and coarse-grained clay soils,
   - GTE-3. Upper Quaternary - modern soft formations (al, glQ3-4) consisting of loamy-pebble and sandy soils,
   - GTE-4. Upper Pliocene - Lower Quaternary igneous formations (N2-Q1), dacite tuff breccias fractured and hydrothermally altered.
6) Geological processes in the area are characterized by mudflows, which occur in the Meghri River bed running through the central part of the region. These mudflow events have a recurrence interval of approximately once every two years,
7) The dam foundation will rest on dacite tuff breccias of N2-Q1 age, which are widespread across the central, left-bank, and right-bank areas. These are overlain by modern gravel-sand, pebble-gravel and sandy clay formations up to 23 meters thick,
8) The engineering-geological conditions in the project area are generally favourable for reservoir construction.

6.1.4 Tectonics, Seismic Stability and Landslides

In the Meghri region, the Meghri-Bagakar and Vank-Paravan anticlines are prominent structural features, with the Lichk syncline situated between them. Another important aspect of the region's tectonics is the presence of disjunctive (fault-related) disturbances.

One of the major nappe-related faults in the region is the Shishkar-Giratagh fault, which marks the contact between Middle Devonian and Upper Jurassic sediments. The fault has a displacement amplitude of approximately 1,500 m and dips westward.

In addition to the major structural disturbances, several smaller faults are clearly identifiable in the region. The site of the proposed Meghri reservoir is located approximately 5-6 km southeast of the Debakli fault. The tectonic faults and hydrothermally altered zones identified within the reservoir area are not associated with the Debakli fault.

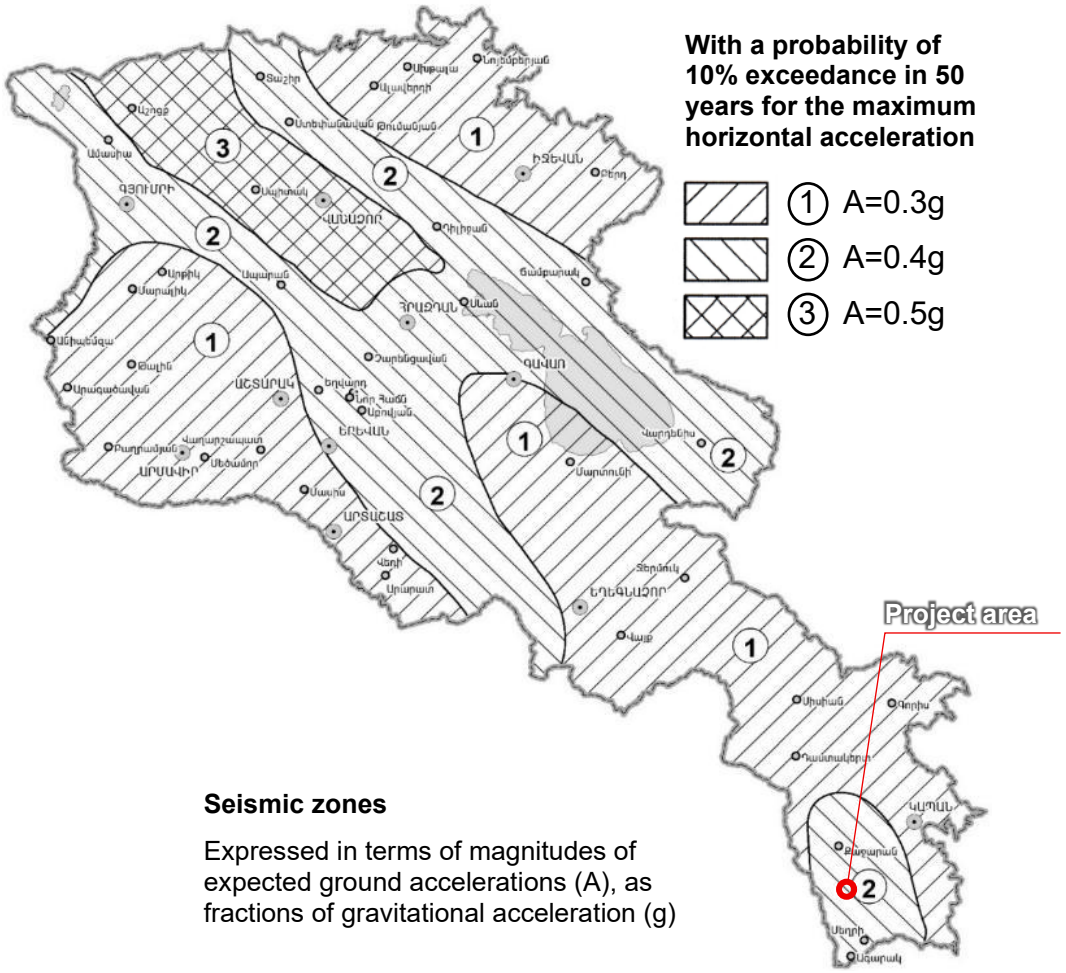
These features were formed as a result of dacite intrusions cutting through quartz gabbrodiorites, which led to the development of hydrothermal alteration and mineralization in structurally weak and disturbed zones.

As per the RA CN 20.04 'Earthquake-resistant construction, Design norms'[72], 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 (Lichk settlement) is located in Seismic Zone 2 (**Figure 6-3**), where the expected seismic hazard is estimated at Amax = 0.4g. Thus, the Project is not situated within the medium seismic hazard zones of Armenia.

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



The Probabilistic Seismic Hazard Assessment (PSHA) was performed for the planned Lichk Reservoir dam platform by the "Territorial Service of Seismic Protection" SNCO, Armenian Association of Seismology and Geophysics and "Terraform" LLC[73]. The R-CRISIS software was used for the PSHA, allowing consideration of input data uncertainties through the logic tree approach. Two seismotectonic models were used for the calculations.

The expected maximum horizontal acceleration values in the area of the planned reservoir were calculated in accordance with the RA CN 20.04 'Earthquake-Resistant Construction: Design Norms'.

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

[73] Report on the Probabilistic Assessment of Seismic Hazard of the designed Lichk Reservoir Dam Site, 2023

To estimate the average propagation velocity of transverse seismic waves in the area, geophysical investigations were carried out using the Multichannel Analysis of Surface Waves (MASW) method. Based on the results obtained, the maximum horizontal accelerations and representative synthetic accelerograms for the site were generated.

Based on the results of the geophysical (seismological) investigations conducted using the MASW method of seismic sounding, the thick-layered soils (horny layer soils) in the study area should be classified as Category II, in accordance with clause 16 of RA CN 20.04.

As previously noted, the study area is located in 2nd seismic zone, corresponding to a horizontal acceleration value of 0.4g, and is composed of both Category I and Category II soils. According to RA CN 20.04, the soil condition coefficient (K_0) for the Project area is 0.8 for Category I soil and 1.0 for Category II soil.

The anticipated maximum horizontal acceleration values in the studied area are[74]:

- Category I soil: A_{max} = 0.4g × 0.8 = 0.32g,
- Category II soil: A_{max} = 0.4g × 1.0 = 0.4g.

In terms of geological processes and phenomena, the engineering-geological conditions of the site are favourable; no landslide or mudflow activity has been observed.

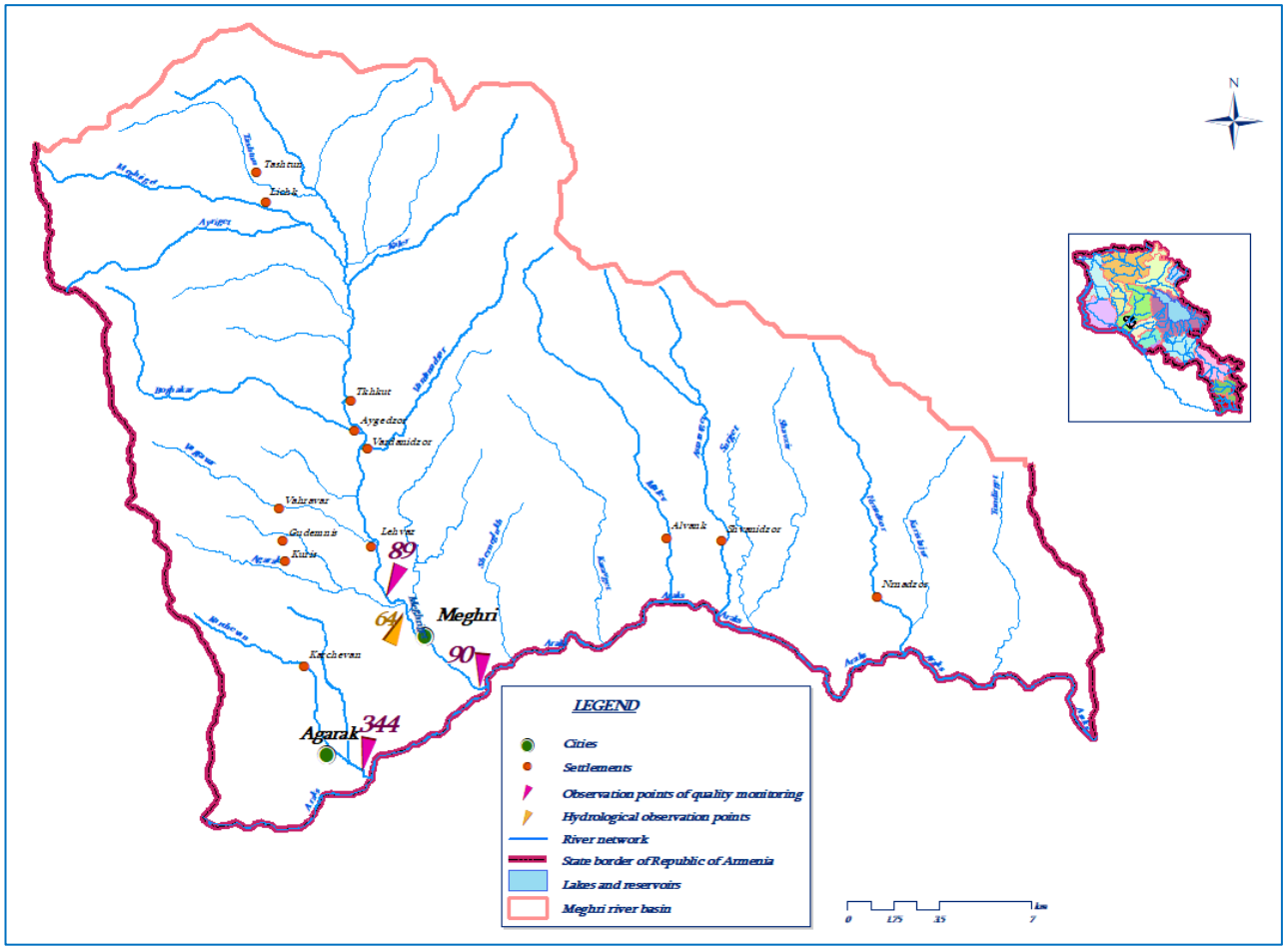
6.1.5 Hydrology (surface and groundwater resources)

Surface water

The Meghri River is the main water body in the project area and a tributary of the transboundary Araks River. Over its 36-kilometer course, it descends steeply from its source at Blue Lake (3,250 meters above sea level) to an elevation of 380 meters at its confluence with the Araks River. The river's catchment area covers 336 km² and is fed by several tributaries, including the Arevik (Lichk), Ayrijur, Tashtun, Boghaqar, Vagravar, Vardanidzor, Agarak, Kaler and Zvari. The Meghri River basin is shown in **Figure 6-4**.

[74]Comprehensive geophysical surveys and seismic microzonation data are included in the Complex Geophysical Investigations Report

Figure 6-4. Map of the Meghri River basin



Source: Website of Hydrometeorology and Monitoring Centre

The RA Government Decree №75-N specifies the classification (categories) and environmental norms for surface water bodies (rivers). According to that Decree five water quality categories 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 rivers within the Project area belong to the Meghri River basin. Therefore, the environmental norms established by RA Government Decree № 75-N for the Meghri River basin (Appendix 25) were applied to assess water quality in the streams located within the Project area.

There are two water quality monitoring stations (№89 and №90) installed on the Meghri River. According to the *2024 Bulletin on Surface Water Quality in the Republic of Armenia*[75], published by the Hydrometeorology and Monitoring Centre under the Ministry of Environment, the water quality of the Meghri River was classified as 'poor' (Class 4) both upstream of Meghri town and at its mouth. The poor water quality upstream is primarily attributed to elevated manganese (Mn) levels, while at the river mouth, increased concentrations of manganese (Mn), cobalt (Co), and iron (Fe) are the main contributing pollutants. The high content of metals also can be attributed to the natural leaching processes, because the area is rich in metallic deposits.

Two samples were taken from the Arevik (Lichk) River in June 2024: Sample №1 (upstream, before the reservoir site) and Sample №2 (downstream, after the reservoir site) by the national EIA consultant. The samples were analysed at the accredited laboratory of the Hydrometeorology and

[75] https://armmonitoring.am/public/admin/ckfinder/userfiles/files/texekanq/tarekan/Water%20report%202024%20-%20WEB.pdf

Monitoring Centre (accreditation certificate №077/T-130). The results of the water quality analysis and the corresponding water quality categories determined based on the analysed parameters are summarized in **Table 6-1**.

Table 6-1. Results of water quality analysis and water quality categories

№	Analysed parameters	Unit	№1		№2	
			Result of analysis	Category	Result of analysis	Category
1	Colour	rank	5	natural	5	natural
2	Smell	points	0	natural	0	natural
3	Transparency	cm	31	*	31	*
4	Suspended solids	mg/l	16.6	2	24.2	2
5	pH (Hydrogen index)	-	7.34	*	7.12	*
6	Mineralization	mg/l	37	*	42	*
7	El.conductivity	μs/cm	57	1	69	1
8	BOD_5 (Biochemical Oxygen Demand)	mgO_2/l	1.98	1	2.45	1
9	COD (Chemical Oxygen Demand)	mgO/l	5	1	5	1
10	Fluoride ion	mg/l	<0.03	*	<0.03	*
11	Sulphate ion	mg/l	3.765	1	4.4.8	1
12	Chloride ion	mg/l	1.351	1	1.62	1
13	Nitrate ion	mg/l	1.823	2	1.74	2
14	Nitrite ion	mg/l	0.00855	1	0.0282	2
15	Ammonium ion	mg/l	0.0686	2	0.0766	2
16	Total inorganic nitrogen	mgN/l	0.468	1	0.461	1
17	Phosphate ion	mg/l	0.0145	1	0.00992	1
18	Silicate ion	mg/l	2.393	1	2.555	1
19	Hardness	mgeq/l	0.47	1	0.54	1
20	Magnesium	mg/l	1.576	1	1.904	1
21	Aluminium	mg/l	0.0319	2	0.0331	2
22	Calcium	mg/l	6.815	1	7.675	1
23	Iron	mg/l	0.0384	1	0.0631	1
24	Copper	mg/l	0.00349	1	0.00556	1
25	Zinc	mg/l	0.000462	1	0.000578	1

*the environmental norm for this water quality indicator has not been specified

The results of chemical analyses of water samples taken from the Arevik (Lichk) River indicate that the water quality meets the standards for Class 1 (Excellent) and Class 2 (Good). However, it should be noted that Mn and cobalt Co concentrations were not measured in the analysed samples.

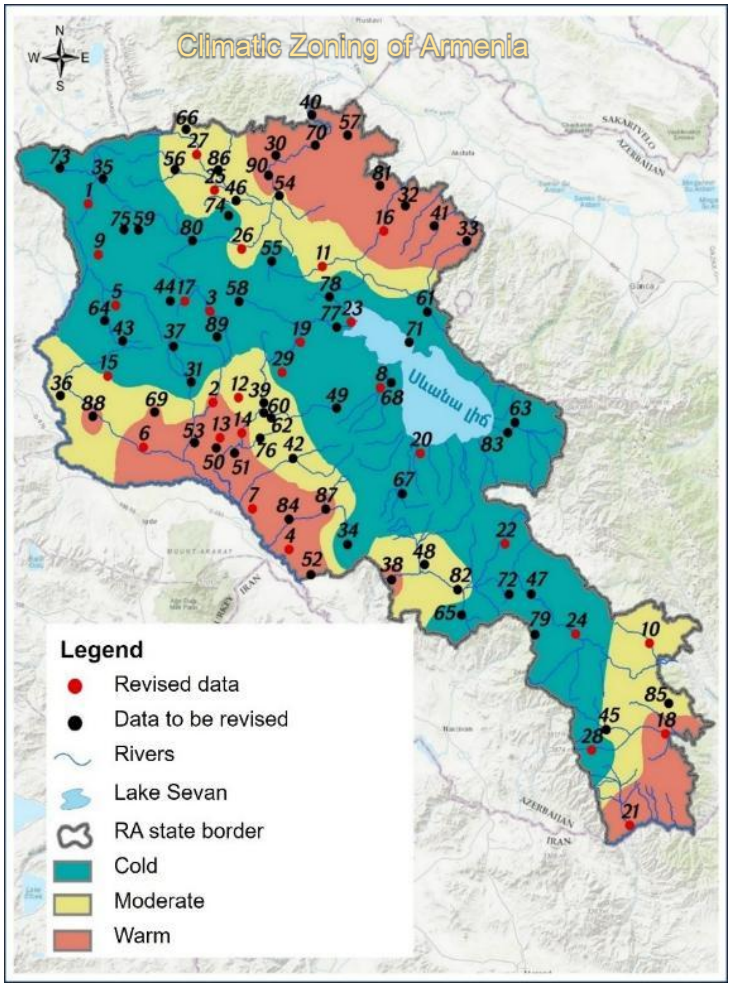
Groundwater Resources

According to the Report on the results of monitoring of underground water national network in the area of the Republic of Armenia for 2024 prepared by the Hydrometeorology and Monitoring Center[76], the quality and hydrological parameters of underground water in the basin of the Meghri River are not studied.

[76] https://armmonitoring.am/public/admin/ckfinder/userfiles/files/hydro-2025/M_G_W_2024.pdf

6.1.6 Climate and Meteorology

According to the RA Construction Norms CN 22-01-2024 "Construction Climatology"[77] the Project site (located between №21 and №28) is situated within the moderate climatic zone (see the map of climatic zoning of Armenia to the right).



The nearest meteorological station is located in Kajaran town, approximately 11 km north of the Project site. Based on data from the Kajaran meteorological station, the average annual air temperature in the Project region is 7.0°C, with an average of -3.0°C in January and 17.2°C in July. The absolute minimum temperature of -24.0°C was recorded in January, while the absolute maximum of 35.0°C was observed in July.

The average annual relative humidity is 68%, and total annual precipitation amounts to 608 mm. The highest rainfall occurs in August, contributing up to 65 mm. The average number of days with snow cover per year is 112. The winter season lasts for 95 days, beginning on December 4 and ending on March 8.

The average temperature, relative humidity, precipitation, wind velocity in different directions and snow cover data observed at the 'Kajaran' 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			
Kajaran	-3.0	-2.7	0.8	6.3	10.4	14.6	17.2	16.9	13.6	8.2	2.8	-1.4	7.0	-24	35

[77] 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
Kajaran	68	70	71	69	71	66	61	63	68	71	70	68	68	68	63	61	54

Table 6-4. Precipitation

Meteoro-logical station	Amount of precipitation by month, mm average monthly daily maximum												Yearly	November-March, mm	April-October, mm
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII			
Kajaran	48	55	74	79	85	48	22	19	29	52	53	44	608	274	334
	54	35	62	53	37	37	27	65	35	38	52	36	65		

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
Kajaran	91	112	242	-

Table 6-6. Wind

Monitoring station	Months	Repeatability, % 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						
Kajaran	January	5	1	13	27	6	9	19	20	58	1.2	Eastern	2.4	North-Western	4.1
		2.7	3.0	1.9	2.2	2.5	3.1	3.6	4.1						
	April	4	1	17	42	6	6	11	13	50	1.3				
		2.5	2.5	2.1	2.2	2.0	2.7	3.3	3.2						
	July	2	1	28	56	3	1	2	7	49	1.3				
		1.7	1.6	2.4	2.8	2.0	1.9	1.9	1.9						
	October	3	1	23	39	4	6	13	11	60	1.0				
		2.6	2.5	1.9	2.4	2.0	2.6	3.1	2.9						

6.1.7 Climate Risk Profile

Background

According to the Armenia's Fourth National Communication on Climate Change (2020)[78] 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 has 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[79] Global Climate Model used and reported in the NC3[80] 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[81] 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

[78] https://unfccc.int/sites/default/files/resource/NC4_Armenia_.pdf
[79] CCSM4 - Community Climate System Model, version 4
[80] NC3 - Third National Communication
[81] 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 Project region is characterized by the following types of soil (**Figure 6-5**):

- Mountainous-forest steppe soils,
- Brown mountainous-forest soils of dry forests and bushes,
- Subalpine mountain-meadow brown soils.

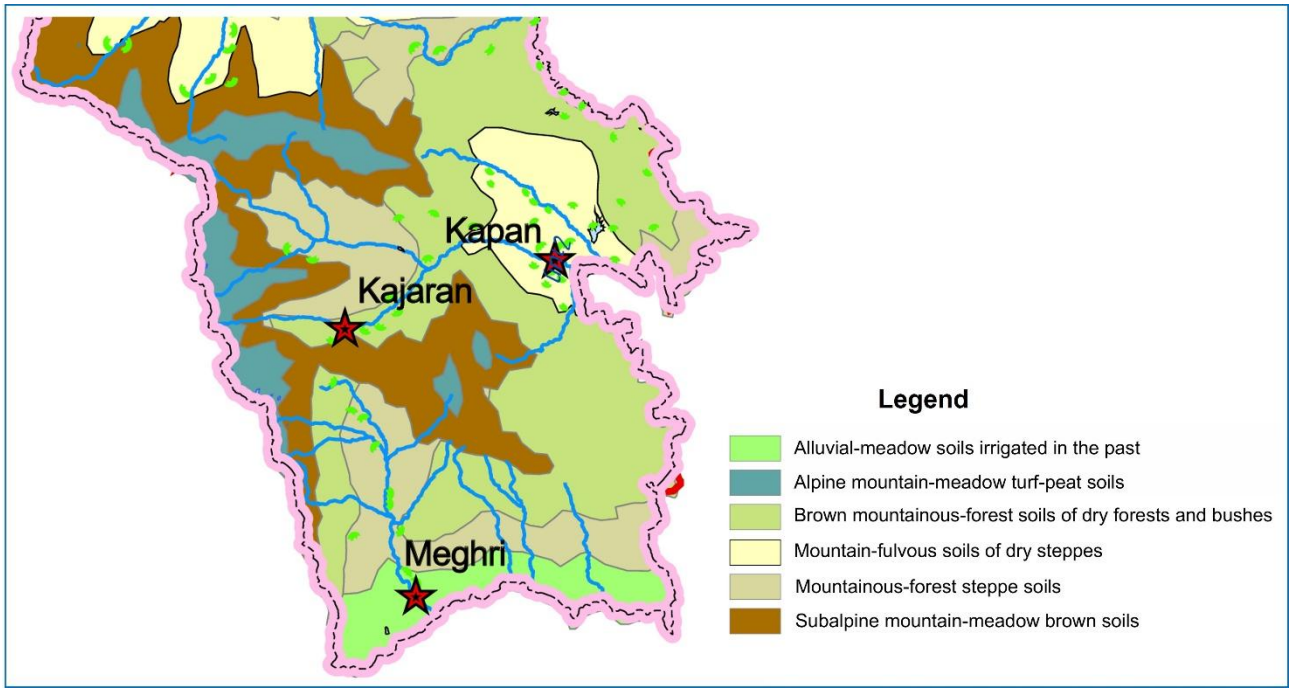
During the national EIA study, samples of soil were taken from the area of planned Lichk reservoir on April 2024. Soil samples were analysed using the ISO 17294-2:2016 standard method at the accredited laboratory of the Hydrometeorology and Monitoring Center. Results of the soil analyses compared to the Admissible Concentration Limits (ACL) for chemical elements in soil set out in the Sanitary Rules and Norms №2.1.7.003-10 "Hygienic requirements for soil quality"[82] are given in **Table 6-9**.

[82] https://www.arlis.am/DocumentView.aspx?docid=146741

Table 6-9. Concentrations of chemical elements in soil samples taken from the Project site compared with the Armenian ACLs

№	Chemical elements	Unit	Results of analysis	ACL of chemicals in soil
1	Lithium	mg/kg	0.0136	-
2	Beryllium	mg/kg	0.00152	-
3	Boron	mg/kg	0.0138	-
4	Sodium	mg/kg	16.22	-
5	Magnesium	mg/kg	6.915	-
6	Aluminium	mg/kg	38.5	-
7	Total phosphorus	mg/kg	1.296	-
8	Potassium	mg/kg	20.015	-
9	Calcium	mg/kg	15.22	-
10	Titanium	mg/kg	5.303	-
11	Vanadium	mg/kg	0.175	150
12	Chrome	mg/kg	0.0586	6
13	Iron	mg/kg	36.024	-
14	Manganese	mg/kg	0.776	1500
15	Cobalt	mg/kg	0.0228	5
16	Nickel	mg/kg	0.0451	4
17	Copper	mg/kg	0.177	3
18	Zinc	mg/kg	0.0759	23
19	Arsenic	mg/kg	0.0421	2
20	Selenium	mg/kg	0.00578	-
21	Strontium	mg/kg	0.168	-
22	Molybdenum	mg/kg	0.00335	-
23	Cadmium	mg/kg	0.000189	-
24	Tin	mg/kg	0.0000375	-
25	Antimony	mg/kg	0.00212	4. 5
26	Barium	mg/kg	0.193	-
27	Lead	mg/kg	0.0123	32
28	Bismuth	mg/kg	0.000524	
29	Uranium	mg/kg	0.00152	

Figure 6-5. Map of soil types in the Project region



Source: Water Resources Atlas of Armenia, Yerevan, 2008

The concentrations of none of the chemical elements in the soil sample exceed the ACLs set by national sanitary rules and norms.

6.1.9 Ambient Air Quality

There are no industrial facilities operating in the Project region, apart from a abandoned mine situated approximately 850 m northwest of the Project site. The nearest residential houses are located at the following distances (**Figure 6-6**):

- 1.55 km in Lichk village,
- 2.6 km in Tashtun village,
- 4.3 km in Vank village,
- 6.0 km in Tkhkut village,
- 350 m - summer houses downstream the reservoir.

The Hydrometeorology and Monitoring Center is not monitoring air quality in this region, as there are no significant sources of air emissions. However, the Consultant has identified at least two potential sources of air emissions: an abandoned mine with its associated waste rock storage area, and the construction of the North-South Road, which passes close to the Project site (see **Figure 3-2**) and may generate dust emissions (PM2.5 and PM10[83]).

Another source of gaseous emissions within the designated Project area and its vicinity is agricultural machinery and infrequent vehicle traffic; however, their impact on air quality is not high. Dust emissions may occur during land cultivation activities, particularly during ploughing in spring and autumn seasons.

[83]Particle Metters

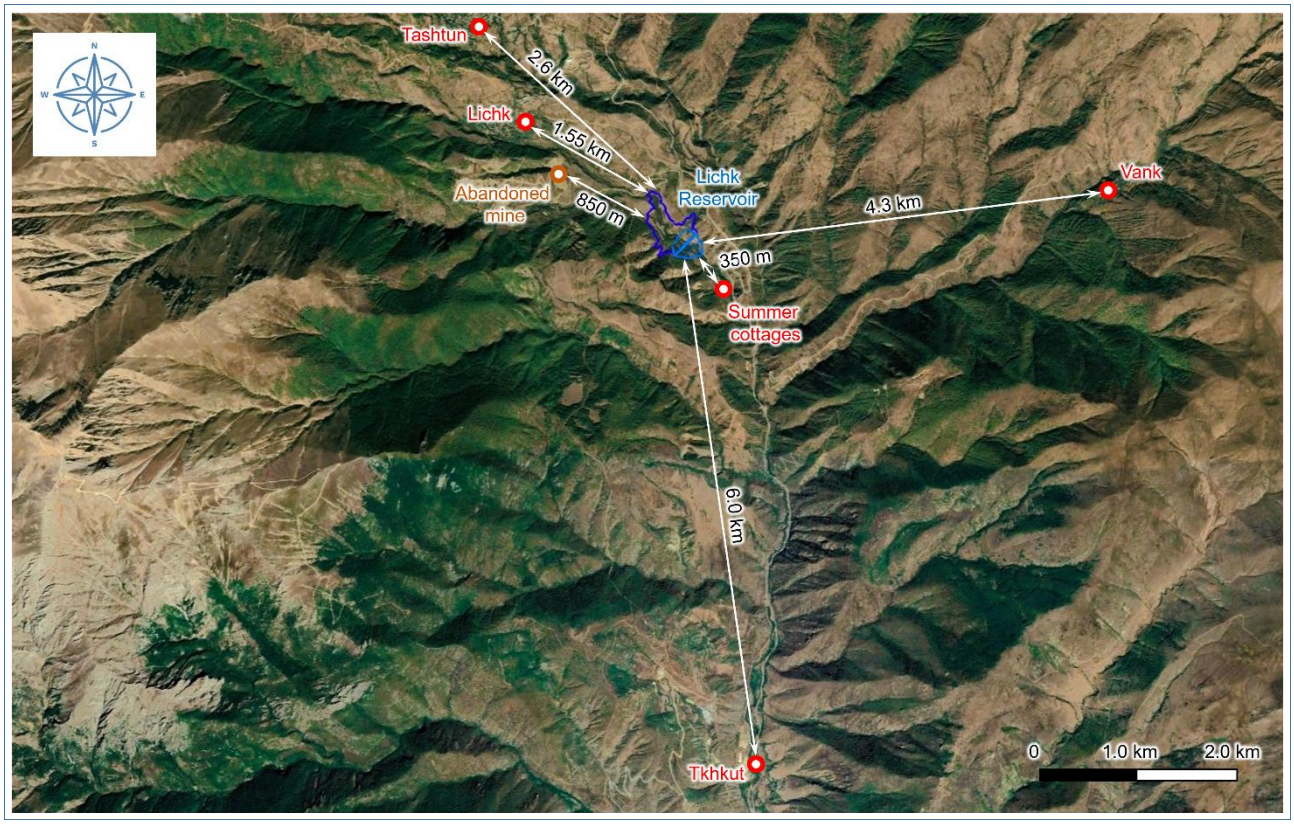
During the national EIA study, instrumental measurements of dust (PM2.5 and PM10) concentrations as well as equivalent and maximum noise levels were performed. The map indicating dust and noise measurement points is presented in **Figure 6-7**.

PM2.5 and PM10 instrumental measurements are carried out during the daytime. Duration of each measurement was 20 minutes. The results of the PM2.5 and PM10 are provided in **Table 6-10**. Ambient air quality standards for residential areas in Armenia are set by RA Government Decree №160-N and the World Health Organization's (WHO) Air Quality Guidelines - Global Update 2021.

Table 6-10. The results of PM2.5 and PM10 instrumental measurements

Point		Dust actual concentrations, mg/m³	Maximum permissible concentration (MPC) for dust, mg/m³		
			Daily average	Maximum value	IFC/WHO[84] (24 hours)
Point: DN1	PM2.5	0.003	0.035	0.16	0.025
	PM10	0.004	0.06	0.3	0.05
Point: DN2	PM2.5	0.004	0.035	0.16	0.025
	PM10	0.006	0.06	0.3	0.05

Figure 6-6. Locations of residential settlements, individual houses, and other facilities in relation to the Project area



[84]IFC refers to the World Health Organization (WHO). Air Quality Guidelines Global Update, 2021

Figure 6-7. Dust (PM2.5 and PM10) and noise measurement points

The actual concentrations of PM2.5 and PM10 within the Project area are below the maximum permissible concentrations (MPC) established by both national standards and IFC/WHO guidelines. However, ambient air quality assessments in the areas surrounding the Project site, particularly near the summer cottages and residential houses in Lichk rural settlement, should be conducted prior to the commencement of construction works.

6.1.10 Noise and Vibration

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"[85] are comparable with the IFC Environmental, Health, and Safety General Guidelines (2007)[86] and WHO Guidelines for Community Noise (1999). 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	

[85] https://www.arlis.am/hy/acts/163246
[86] https://www.ifc.org/content/dam/ifc/doc/2000/2007-general-ehs-guidelines-en.pdf

№	Premises and territories, receptors		TLV, dBA		
			National		IFC/WHO
			Equivalent to sound level	Maximum sound level	One hour equivalent sound level
	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[87]	55	70	55
		night-time[88]	45	60	45

The main sources of noise and vibration within the Project area and its vicinity are the operation of machinery within the North-South road construction project and agricultural equipment and vehicles used by local residents to access their agricultural land plots. These activities are infrequent but can generate some noise. Equivalent and maximum noise levels were measured during the national EIA study. The results of the noise measurements are compared with the threshold limit values (TLVs) established by Sanitary Norms №2-III-11.3 and are summarized in **Table 6-12**.

Table 6-12. Equivalent and maximum noise measurement results (baseline)

Noise №	Sound levels, dB(A)		Threshold limit value, dB(A)		
			National		IFC standards night-time/day-time
	Equivalent to sound level, Leq	Maximum sound level, Lmax	Equivalent to sound level	Maximum sound level	
DN1	46.1	55.8	*	*	*
DN2	55.7	59.8	*	*	*

**there are no sensitive receptors near the locations where the noise measurements were conducted; therefore, the TLVs are not presented in the table above*

Before the commencement of construction works, the construction contractor will carry out instrumental noise and vibration measurements at nearby residential houses to establish baseline conditions. These data will serve as a reference for regularly assessing and, if necessary, mitigating the Project's impact on sensitive receptors (see **Section 8.2.10**).

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

[87]between 07:00 and 23:00
[88]between 23:00 and 07:00

- 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.

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 Lichk Reservoir, including data from field surveys conducted in April-May 2024. These findings are further supplemented by the results of additional studies, including field surveys carried out in spring-summer 2025.

6.2.2 Vegetation and Flora

Methods

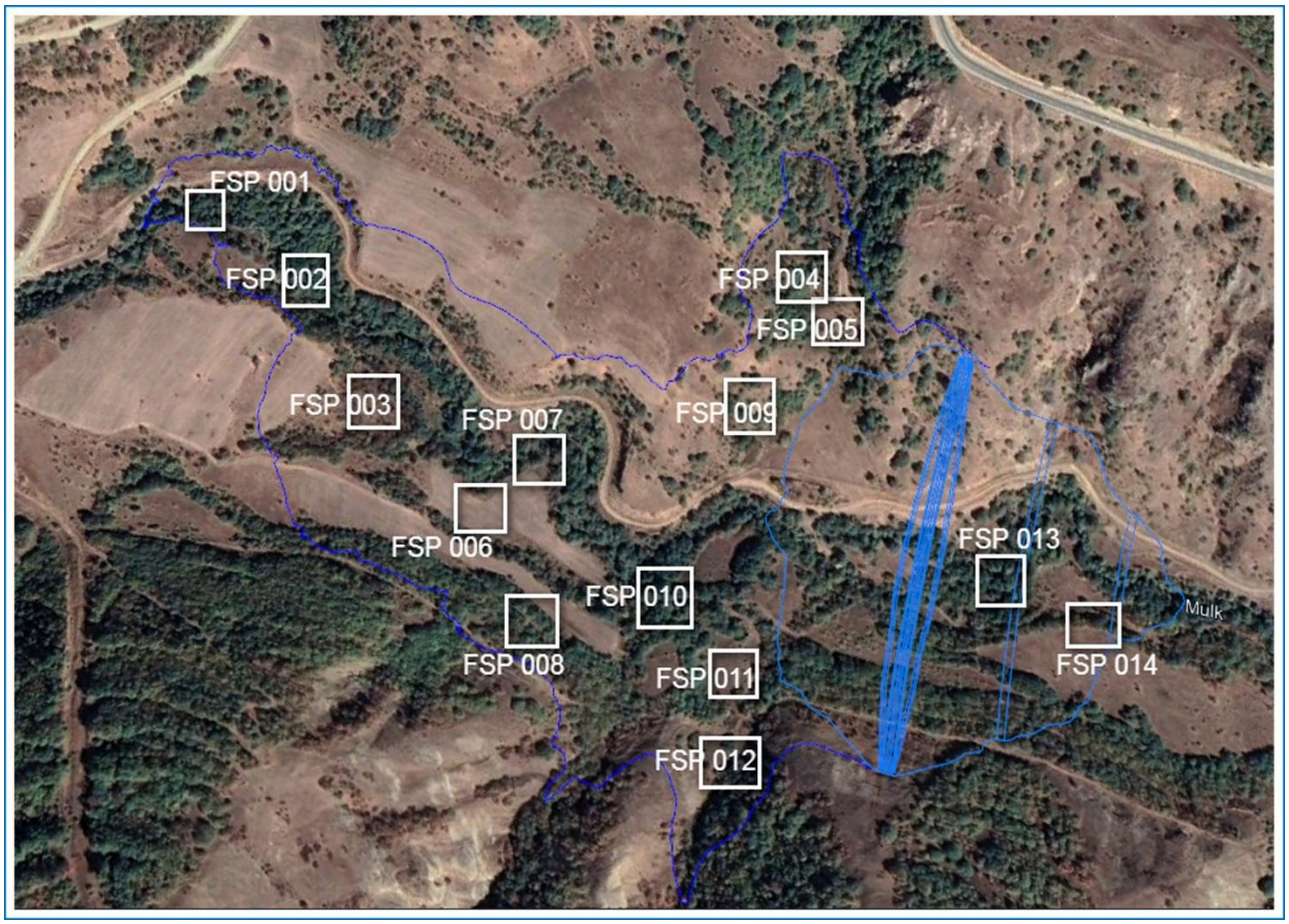
The types of vegetation within the Project-affected area were determined and categorized based on the results of field surveys conducted under the national EIA.

The surveys employed itinerary and semi-stationary geospatial research methods. The study area was divided into sampling plots based on the main biotopes, taking into account the site's terrain and landscape features. A total of 14 Flora Sampling Plots (FSPs), each measuring 100 × 100 meters, were established (see **Figure 6-8**). A complete inventory of plant species was carried out in each FSP, 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).

Figure 6-8. Flora sampling areas



Vegetation types

Based on the floristic divisions by A.L. Takhtajyan (1954), the proposed site for the Lichk reservoir falls within the Meghri floristic region. The site is situated in the concave valley of the Lichk River, southeast of the Lichk village, at an elevation ranging from about 1,540 to 1,670 masl.

The forested areas are predominant here; forests are mainly located on slopes with high sreepness (30% and more), do not form a complete forest layer but appear in fragmented patches. The broadleaf forests (**Figure 6-9, a**) comprise species such as willow-leaved pear, buckthorn, rose, and almond. Some mountain slopes are represented by arid scarce woodlands (**Figure 6-9, b**), including mountain steppe vegetation on the dry slopes.

Certain areas display intrazonal vegetation types, including riparian along riverbed (**Figure 6-10**), wetland and swamp areas, as well as petrophilic vegetation in rocky, scree, and rockfall environments.

Figure 6-9. The view of the Lichk River valley

a) broadleaf forest *b) arid scarce woodland*

Figure 6-10. The view of the Lichk River valley: intrazonal riparian vegetation

Flora

Species of the higher vascular plants found in the Project area are listed in Table 6-13. The flora is presented by 196 species of 44 families.

Table 6-13. List of plant species registered in the study area

Family (in brackets - number of species)	Field sampling plots	Latin name of species
Fagaceae (2)	FSP 1; 2; 8	Quercus macranthera Fisch. et Mey
	FSP 1; 2; 8	Quercus iberica Stev
Corylaceae (1)	FSP 2; 8	Carpinus betuleus L.
Aceraceae (2)	FSP 8	Acer hyrcanum Fisch. et Mey
	FSP 1; 2	Acer ibericum M. Bieb.
Oleaceae (1)	FSP 1; 2; 7	Fraxinus excelsior L.
Poaceae (17)	FSP 5;6;11	Brachypodium sylvaticum (Huds.) P. Beauv.
	FSP 11	Briza elatior Schibt. et Sm.
	FSP 6;11	Eremopoa persica (Trin.) Roshev.
	FSP 6;11	Phleum paniculatum Huds.
	FSP 5; 6	Poa nemoralis L.
	FSP 5;6;11	Festuca pratensis Huds.

Family (in brackets - number of species)	Field sampling plots	Latin name of species
	FSP 11	Apera interrupta (L.) P. Beauv.
	FSP 11	Milium vernale M.Bieb
	FSP 5; 11	Koeleria macrantha (Ledeb.) Schult.
	FSP 11	Trisetum rigidum (M.Bieb) Roem. et Schult.
	FSP 5;6;11	Anisantha tectorum (L.) Nevski
	FSP 4;5;6	Bromus squarrosus L.
	FSP 3; 5;6;	Avena persica Steud.
	FSP 9;12	Aegilops triaristataWilld.
	FSP 5;11;12	Trachinia distachya (L.) Link.
	FSP 6;11;12	Elytrigia armena (Nevski) Nevski
	FSP 12	Aegilips triuncialis L.
Rosaceae (22)	FSP 3;5;9	Pyrus syriaca Boiss.
	FSP 3;5;12	Pyrus salicifolia Pall.
	FSP 9;12	Cotoneaster integerrima Medik.
	FSP 3;5;14	Cerasus incana (Pall.) Spach.
	FSP 5;12	Prunus spinosa L.
	FSP 12	Prunus divaricate Ldb.
	FSP 12;14	Malus orientalis Uglitzkich
	FSP 5;9;14	Amygdalus fenzliana (Fritsch.) Lipski
	FSP 3;9	Crataegus meyeri Pojark.
	FSP 5;9;14	Crataegus armena Pojark.
	FSP 8	Crataegus pentagyna Waldst. et Kit.
	FSP 8	Fragaria viridis Duch.
	FSP 4;12	Potentilla foliosa Somm. et Lev.
	FSP 3;4	Potentilla impolita Wahlenb.
	FSP 4	Geum urbanum L.
	FSP 2	Filipendula ulmaria (L.) Maxim.
	FSP 3;4;9;11	Rosa spinosissima L.
	FSP 5;12	Spiraea crenata L.
	FSP 12;14	Rubus caesius L.
	FSP 5;11	Alchemilla grossheimii Juz.
	FSP 1	Poterium polygamum Waldst. et Kit.
	FSP 1;2	Agrimonia eupatoria L.
	FSP 6	Alchemilla sericea Willd.
Lamiaceae (14)	FSP 7	Lamium amplexicaule L.
	FSP 6;11	Stachys iberica L.
	FSP 8	Stachys sylvatica L.
	FSP 7;10	Lamium album L.
	FSP 5;11	Ayuga chia Schreb
	FSP 3;9;12	Teucrium polium L.
	FSP 3;4;5	Scutellaria orientalis L.

Family (in brackets - number of species)	Field sampling plots	Latin name of species
	FSP 5;14	Sideritis balansae Boiss.
	FSP 3;12	Nepeta mussinii Spreng.
	FSP 3;9;11;12	Stachys iberica L.
	FSP 4;11;14	Salvia sclarea L.
	FSP 6;11;12	Ziziphora capitate L.
	FSP 12	Saturea hortensis L.
	FSP 5;6;11	Thymus fedtschenki Ronn.
Ranunculaceae (6)	FSP 10;13	Ranunculus caucasica M. Bieb
	FSP 13	Ficaria ficarioides (Bory et Chaub.) Halaczy
	FSP 2;10	Talictrum minus L.
	FSP 6	Nigella arvensis L.
	FSP 7	Ranunculus arvensis L.
	FSP 3;9	Ceratocefalus falcatus (L.) Pers.
Valerianaceae (1)	FSP 13	Valeriana alliariifolia Adams.
Ulmaceae (2)	FSP 2;8;10	Ulmus minor Mill.
	FSP 5;12	Celtis planchoniana K. I. Chr.
Scrophulariaceae (7)	FSP 3;6	Veronica polita Fries
	FSP;9;12	Veroniva persica Poir.
	FSP12;	Veronica orientalis Mill.
	FSP 4	Verbascum orientale (L.) All.
	FSP11	Verbascum flavidum (Boiss.) Freyn et Bornm
	FSP 2	Digitalis nervosa Steud. et Hochst.
	FSP 2;8	Euphrasia pectinate Ten.
Convolvulaceae (2)	FSP 9;12	Convolvulus cantabrica L.
	FSP 6	Convolvulus lineatus L.
Asteraceae (23)	FSP 3;6;11	Cichorium intibus L.
	FSP 6;12	Taraxacum bessarabicum (Hornem.) Hand.-Mazz.
	FSP 5;5;11	Helichrysum graveolens (M.Bieb.) Sweet.
	FSP 11	Helichrysum pilcatum DC
	FSP 5;12	Inula mariae Bordz.
	FSP 8;9	Anthemis triumfettii (L.) All.
	FSP 14	Tripleurospermum caucasicum (Willd.) Hayek
	FSP 5;11	Scorzonera rigida Auch. ex DC
	FSP 11	Trapogon coloratus C.A. Mey
	FSP 3;12	Leontodon hispidus L.
	FSP 12	Hieracium murorum L.
	FSP 4	Crepis pannonica (Jacq.) K.Koch
	FSP 5;9;11	Echinops sphareocephalus L.
	FSP 11;14	Xeranthemum squarrosum L.
	FSP 4;9	Carlina vulgaris L.
	FSP 7;9	Arctium lappa L.

Family (in brackets - number of species)	Field sampling plots	Latin name of species
	FSP 5;9;11;12;	Centaurea solstitialis L.
	FSP 2;9	Senecio vernalis Waldst. et Kit.
	FSP 6	Inula germanica L.
	FSP 5;6;12	Achillea biebersteinii Afan.
	FSP 12	Achillea vermicularis Trin.
	FSP 9;14	Tanacetum argyrophyllum (K.Koch) Tzvel.
	FSP 11	Artemisia splendens Willd.
	FSP 6;11	Artemisia fragrans Willd.
Fumariaceae (2)	FSP 10;13	Corydalis angustifolia (M.Bieb.) DC
	FSP 13	Fumaria vaillantii Loisl.
Boraginaceae (6)	FSP 3;14	Cerinthe minor L.
	FSP 12	Echium vulgare L.
	FSP2	Myosotis alpestris F.W. Schmidt.
	FSP 6	Lithospermum tenuiflorum L.
	FSP 5;6	Lithospermum arvense L.
	FSP 5;14	Alkanna orientalis L. Boiss.
Campanulaceae (2)	FSP;2;8	Campanula glomerate L.
	FSP;8	Campanula rapunculoides L.
Orchidaceae (2)	FSP1;2	Dactylorhiza urvelleana (Steud.) H. Baumann et Kunkele
	FSP2	Orchis mascula (L.) L.
Geraniaceae (2)	FSP 8	Geranium sylvaticum L.
	FSP 2	Geranium pusillum L.
Primulaceae (1)	FSP 2;8 13	Primuls veris subsp. macrocalix (Bunge) Ludi
Malvaceae (1)	FSP 10	Malva sylvestris L.
Fabaceae (12)	FSP 8	Vicia hirsute (L.) S.F.Gray.
	FSP 7;10	Vicia sativa L.
	FSP 10;12;14	Medicago lupulina L.
	FSP 5;11	Medicago sativa L.
	FSP 7;12;14	Medicago coerulea Less. in Ledeb.
	FSP 9	Anthyllis boissieri Sag.
	FSP 3;5;12	Lotus caucasica Kupr.
	FSP 7	Coronilla coronate L.
	FSP 12	Onobrychis radiata M. Bieb.
	FSP 4;9	Melilotus officinalis (L.) Desr.
	FSP 9	Trifolium arvense L.
	FSP 5;6	Trifolium campestre Schreb. in Sturm.
Apiaceae (5)	FSP 1;2	Astrantia maxima Pall.
	FSP 3;12	Eryngium billardieri Delar.
	FSP 8	Pimpinella rodantha Boiss.
	FSP 9;12	Prangos ferulacea (L.) Lindl.
	FSP 5;12;14	Falcaria vulgaris Bernh.

Family (in brackets - number of species)	Field sampling plots	Latin name of species
Dipsacaceae (1)	FSP 5;14	Scabiosa bipinnata K.Koch
Convallariaceae (1)	FSP 2;8	Polygonatum orientale Desf.
Moraceae (1)	FSP 10;13	Morus alba L.
Cornaceae (1)	FSP 3;5	Swida australis (C.A.Mey.) Pojark.
Caprifoliaceae (1)	FSP 5;14	Lonicera iberica M.Bieb.
Grossulariaceae (1)	FSP 12	Ribes orientale Dsf.
Brassicaceae (6)	FSP 3;14	Sisymbrium loeselii L.
	FSP 11;14	Descurainia sofia (L.) Webb. et Prantl
	FSP 11	Rorippa islandica (Oeder) Borbas
	FSP 6;11	Alyssum tortuosum Willd.
	FSP 6	Alyssum strictum Willd.
	FSP 3;12	Thlaspi arvense L.
Iridaceae (4)	FSP 3;5;14	Crocus adamii J. Gay
	FSP 9;12	Iris imbricate Lindl.
	FSP 12	Iris paradoxa Steven
	FSP 11;12	Gladiolus atroviolaceus Boiss.
Rubiaceae (2)	FSP 4	Asperula prostate (Adams) K.Koch
	FSP 5;11	Galium vernum Scop.
Chenopodiaceae (2)	FSP 6;11	Chenopodium foliosum (Moench.) Asch.
	FSP 5	Chenopodium album L.
Hypericaceae (4)	FSP 5;6	Hypericum hirsutum L.
	FSP 6;12	Hypericum hyssopifolium Will.
	FSP 8	Hypericum perforatum L.
	FSP 12;14	Hypericum scabrum L.
Euphorbiaceae (1)	FSP 6	Euphorbia squamosa Willd.
Alliaceae (2)	FSP 5;9	Allium rotundum L.
	FSP 5;14	Allim flavum L.
Salicaceaea (4)	FSP 7;10	Populus nigra L.
	FSP 7;10;13	Salix excelsa S.G. Gmel.
	FSP 10;13	Salix caprea L.
	FSP 7;10	Salix purpurea L.
Juncaceae (2)	FSP 7;13	Juncus effuses L.
	FSP 13	Juncus compressus Jacq.
Cyperaceae (3)	FSP 10;13	Carex capillaris L.
	FSP 7	Carex supina Willd.
	FSP 7;10	Carex polyphylla Kar. et Kir.
Saxifragaceae (1)	FSP 10	Saxifraga cymbalaria L.
Asclepidaceae (2)	FSP 7	Cynanchum acutum L.
	FSP 13	Periploca graeca L.
Urticaceae (1)	FSP 10;13	Urtica dioica L.
Ephedraceae (1)	FSP 9;12	Ephedra procera F. et M.

Family (in brackets - number of species)	Field sampling plots	Latin name of species
Caryophyllaceae (8)	FSP 4	Minuartia oreina (Mattf.) Schischk.
	FSP 14	Arenaria dianthoides Smitt.
	FSP 5;9	Silene compacta Fisch.
	FSP 9	Silene dianthoides Pers.
	FSP 12;14	Telephium orientale Boiss.
	FSP 6	Paronychia kurdica Boiss.
	FSP 14	Herniaria incana Lam.
	FSP 11	Dianthus orientalis Adams
Crassulaceae (4)	FSP 11;14	Sempervivum transcaucasicum Muirhead
	FSP 14	Sedum caucasicum (Grossh.) Bor.
	FSP 6;11	Sedum oppositifolium Sims.
	FSP 5;6	Sedum hispanicum L.

There are 97 plant species included in the RA Red Book (2010)[89] that can be found in the Meghri floristic region; among them, 26 species are endemic. According to the RA Red Book, ten species can be found in the vicinity of the Project area (Table 6-14). These plant species were not recorded within the site area during the field surveys. However, as surveys were carried out in early spring, when many species are not yet in bloom or bearing fruit, additional field survey will be required at the pre-construction phase to confirm or rule out the presence of these endangered plant species in the Project area.

Table 6-14. Protected plant species registered in the vicinity of the Lichk reservoir (according the RA Red Book)

№	Latin name	Category in the IUCN Red list	Category in the RA Red Data Book
1	*Astragalus sangezuricus Boriss.*	-	EN
2	*Carex capitellata L.*	-	EN
3	*Centaurea elbrusensis Boiss&Buhse*	-	EN
4	*Centaurea schelkovnikovii Sosn.*	-	CR
5	*Cousinia qaradaghensis Rech.*	-	CR
6	*Erysimum lilacinum E. Steinb.*	-	EN
7	*Linaria megrica Tzvelev*	-	EN
8	*Pyrus raddeana Woronow*	-	EN
9	*Pyrus voronovii Rubtzov*	-	EN
10	*Tulipa sosnovskyi Achverdov & Mirzoeva*	-	EN

[89]The Red Book (second edition of 2010) includes the Red Book of Animals and Red Book of Plants, are together called the Red Book in this ESIA.

6.2.3 Fauna

Terrestrial mammals

Methods

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, and collections of the Armenian Institute of Zoology. 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 the preliminary data for the Emerald network in the RA (2016)).

During the national EIA field trips to the Project site, all signs of the animal's presence were registered (including footprints, holes, visually seen excrements etc.). In addition, some mammals were observed by chance.

Results

Based on the abovementioned sets of data, the list of mammalian species that are found or expected to be found in this area is listed in **Table 6-15**.

Table 6-15. Mammalian species of the study area

№	Latin name	Armenian name	English name	1	2	3	4	5	6	7
Erinacedae										
1	*Erinaceus concolor*	Սպիտակափորն ոզնի	Southern white-breasted hedgehog	+	+					
Gliridae										
2	*Dryomys nitedula*	Անտառային քնամոլ	Forest dormouse	+	+	LC				+
Hystricidae										
3	*Hystrix indica*	Հնդկական մացառախոզ	Indian crested porcupine	+	+	LC	VU			
Leporidae										
4	*Lepus europaeus*	Նապաստակ	European hare	+	+					
Cervidae										
5	*Capreolus capreolus*	Այծյամ	Roe deer	+	+					
Mustelidae										
6	*Martes foina*	Քարակզաքիս	Beech marten	+	-					
7	*Mustela nivalis*	Աքիս	Least weasel	+	+					
8	*Meles meles*	Գորշուկ	Badger	+	+					
Canidae										
9	*Canis lupus*	Գայլ	Gray wolf	+	+	LC		+	+	+
10	*Canis aureus*	Չախկալ	Jackal	+	+					
11	*Vulpes vulpes*	Սովորական աղվես	Red fox	+	+					
Felidae										

№	Latin name	Armenian name	English name	1	2	3	4	5	6	7
12	*Felis silvestris*	Անտառային կատու	Wildcat	+	-	LC	VU			+
13	*Lynx lynx*	Լուսան	Lynx	+	+	LC		+	+	+
Cricetidae										
14	*Cricetulus migratorius*	Մոխրագույն համստերիկ	Gray dwarf hamster	+	-					
15	*Arvicola terrestris*	Եվրոպական ջրառնետ	European water vole	+	+					
16	*Microtus arvalis*	Սովորական դաշտամուկ	Common vole	+	+					
Gerbillidae										
17	*Meriones persicus*	Պարսկական ավազամուկ	Persian jird	+	-					
Muridae										
18	*Sylvaemus uralensis*	Փոքր անտառային մուկ	Ural field mouse	+	+					
Rhinolophidae										
19	*Rhinolophus hipposideros (?)*		Lesser horseshoe bat		+	LC				+
Vespertilionidae										
20	*Pipistrellus sp. (?)*		Pipistrelle bats		+					+

Keys to Table 6-15

Column titles:
1 - Information from various sources
2 - Data from field studies
3 - IUCN Red List
4 - Red Book of the RA
5 - Resolution 6 of Bern Convention
6 - Annex II of the Habitats Directive
7 - Annex IV of the Habitats Directive

Signs:
+ listed or registered
- not registered
no sign - not listed
? – not confirmed

Conservation status (in - IUCN Red List, column 3):
VU - Vulnerable
LC - Least Concern

As shown in **Table 6-15**, the study area is home to **20 mammal species** belonging to **13 families**. During the field studies, presence of 16 species was confirmed through visual observations, tracks in mud and dust, food remnants, and discovered excrement. Red fox and jackal footprints were the most frequently found. In the evening, a solitary male deer was observed in a small clearing above the area. At night, under lantern light, the Common vole, Ural field mouse, Hares, and Southern white-breasted hedgehog were encountered. Based on the presence of feces, wolves and lynx were determined utilizing this area. European badger's burrows and excrement were observed near the upper boundary of the proposed flooded area.

Two species are listed in the RA Red Book under category "Vulnerable" - Indian Crested Porcupine and Wild Cat. Quills of Indian Crested Porcupine were found only once along the shore of the Lichk River. Local residents report that this species is very rare in the area. Wild Cat was not recorded during the field surveys. According to local residents, while collecting edible plants in the spring, they occasionally encounter Wild Cat on slopes covered with small trees and bushes.

Of the 20 identified species, two are classified as Priority Biodiversity Features under EBRD PR6, Criterion 12(i), as they are listed in Resolution 6 of the Bern Convention, and Annex II of the EU Habitats Directive (see **Table 6-15**). One of these, Lynx, 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 more species are listed in the RA Red Book under category “Vulnerable” and therefore classified as Priority Biodiversity Features under EBRD PR6, Criterion 12(iii) “significant biodiversity features identified by a broad set of stakeholders or governments”. One of these two species, Wild Cat, 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.

In addition, the Forest Dormouse and its habitat is qualified as Critical Habitat on the same basis.

Bats at least of two species were visually observed in the Project area during field survey (see Table 6-16, № 19, 20). It was impossible to determine species of the animals observed; in one case, only genus (Pipistrellus) was determined. Therefore, focused bat field study has to be done at the pre-construction phase.

The both bat species are qualified as Critical Habitat under EBRD PR6, Criterion 14(ii), as the species is listed in Annex IV of the EU Habitats Directive.

Birds

Methods

Data collection included the methods of 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[90].

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 6-16** below and includes 81 species. Among those, there are 55 bird species, which breed in the area, 17 species, which breed in proximity to the site and use the area as a part of their foraging range, and 9 species which pass the area during the seasonal migration.

Among breeding birds, none of the species is listed in the RA Red Book (2010), and four species are included in the Resolution 6 of the Bern Convention, and in Annex 1 of the EU Birds Directive

[90]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)

Among large-ranged birds, which use the area as a part of their foraging range in the breeding season, there are nine species listed in the RA Red Book and ten species included in the Resolution 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 in non-breeding period, there is one species listed in the RA Red Book, and one species included in the Resolution 6 of the Bern Convention, and in Annex 1 of the EU Birds Directive.

From the 81 identified species, 18 species are assessed as the Priority Biodiversity Features (PBF) according to the EBRD PR6 criterion 12: seventeen species as they are listed in the Resolution 6 of Bern Convention and Annex I of the EU Birds Directive, and one species*, Phylloscopus nitidus*, as regularly occurring range-restricted species (**Table 6-16**).

Table 6-16. Bird species of the Lichk site area

№	Armenian names	English names	Scientific names	Occurrence Status in Armenia	Occurrence Status in the Project site	Unit	Number	IUCN	RDB RA	Bern Res6	BD Annex 1	RR species
Accipitridae												
1	Կրետակեր	Honey-buzzard	*Pernis apivorus*	B - regular	Foraging	ind	2-5	LC		+	+	
2	Մորուքավոր անգղ	Bearded Vulture	*Gypaetus barbatus*	Yr - regular	Foraging	ind	1-2	NT	VU	+	+	
3	Սպիտակագլուխ անգղ	Griffon Vulture	*Gyps fulvus*	Yr - regular	Foraging	ind	2-14	LC	VU	+	+	
4	Գիշանգղ	Egyptian Vulture	*Neophron percnopterus*	B - regular	Foraging	ind	1-2	EN	EN	+	+	
5	Օձակեր արծիվ	Short-toed Snake-eagle	*Circaetus gallicus*	B - regular	Foraging	ind	1-2	LC	VU	+	+	
6	Լորաճուռակ	Eurasian Sparrowhawk	*Accipiter nisus*	Yr - regular	Foraging	ind	2-3	LC				
7	Ցախաքլորաորս	Northern Goshawk	*Astur gentilis*	Yr - regular	Foraging	ind	1-2	LC				
8	Մեծ ճուռակ	Eurasian Buzzard	*Buteo buteo*	B - regular	Foraging	ind	2-5	LC				
9	Տափաստանային ճուռակ	Long-legged Buzzard	*Buteo rufinus*	Yr - regular	Foraging	ind	1-2	LC		+	+	
10	Քարարծիվ	Golden Eagle	*Aquila chrysaetos*	Yr - regular	Foraging	ind	1-2	LC	VU	+	+	
11	Փոքր ենթաարծիվ	Lesser Spotted Eagle	*Clanga pomarina*	B - regular	Foraging	ind	1-2	LC	VU	+	+	
12	Գաճաճ արծիվ	Booted Eagle	*Hieraaetus pennatus*	B - regular	Foraging	ind	1-2	LC	VU	+	+	
Falconidae												
13	Սովորական հողմավար բազե	Common Kestrel	*Falco tinnunculus*	Yr - regular	Foraging	ind	1-2					
14	Արտույտաբազե	Hobby	*Falco subbuteo*	B - regular	Migratory	ind	30-70	LC				
15	Սապսան	Peregrine Falcon	*Falco peregrinus*	Yr - regular	Foraging	ind	1-2	LC	VU	+	+	
Phasianidae												
16	Լոր	Common Quail	*Coturnix coturnix*	B - regular	Breeding	pair	2-3					
17	Քարակաքավ	Chukar	*Alectoris chukar*	Yr - regular	Breeding	pair	1-2					

№	Armenian names	English names	Scientific names	Occurrence Status in Armenia	Occurrence Status in the Project site	Unit	Number	IUCN	RDB RA	Bern Res6	BD Annex 1	RR species
Scolopacidae												
18	Անտառակտցար	Eurasian Woodcock	*Scolopax rusticola*	B - regular	Breeding	pair	1-2					
19	Սպիտակավիզ կտցար	Common Sandpiper	*Actitis hypoleucos*	B - regular	Breeding	pair	1-2					
Columbidae												
20	Թխակապույտ աղավնի	Rock Pigeon	*Columba livia*	Yr - regular	Foraging	ind	10-30					
21	Անտառային աղավնի	Common Woodpigeon	*Columba palumbus*	Yr - regular	Breeding	pair	2-3					
Cuculidae												
22	Սովորական կկու	Common Cuckoo	*Cuculus canorus*	B - regular	Breeding							
Strigidae												
23	Եվրոպական բվիկ	Common Scops-owl	*Otus scops*	B - regular	Breeding							
24	Ականջավոր բու	Long-eared Owl	*Asio otus*	Yr - regular	Foraging							
Caprimulgidae												
25	Այծկիթ	Eurasian Nightjar	*Caprimulgus europaeus*	B - regular	Breeding	pair	1-2	LC		+	+	
Apodidae												
26	Սև մանգաղաթև	Common Swift	*Apus apus*	B - regular	Breeding							
Meropidae												
27	Ոսկեգույն մեղվակեր	European Bee-eater	*Merops apiaster*	B - regular	Foraging							
Upupidae												
28	Հոպոպ	Eurasian Hoopoe	*Upupa epops*	B - regular	Breeding							
Picidae												
29	Մեծ փայտփոր	Great Spotted Woodpecker	*Dendrocopos major*	Yr - regular	Breeding							

№	Armenian names	English names	Scientific names	Occurrence Status in Armenia	Occurrence Status in the Project site	Unit	Number	IUCN	RDB RA	Bern Res6	BD Annex 1	RR species
30	Սիրիական փայտփոր	Syrian Woodpecker	*Dendrocopos syriacus*	Yr - regular	Breeding	pair	1	LC		+	+	
Alaudidae												
31	Անտառային արտույտ	Wood Lark	*Lullula arborea*	B - regular	Breeding	pair	8-13	LC		+	+	
Hirundinidae												
32	Ժայռային ծիծեռնակ	Eurasian Crag-martin	*Hirundo rupestris*	B - regular	Breeding							
33	Գյուղական ծիծեռնակ	Barn Swallow	*Hirundo rustica*	B - regular	Breeding							
34	Քաղաքային ծիծեռնակ	House Martin	*Delichon urbica*	B - regular	Breeding							
Motacillidae												
35	Լեռնային խաղտտնիկ	Grey Wagtail	*Motacilla cinerea*	Yr - regular	Breeding							
36	Սպիտակ խաղտտնիկ	White Wagtail	*Motacilla alba*	Yr - regular	Breeding							
37	Անտառային ձիաթռչնակ	Tree Pipit	*Anthus trivialis*	B - regular	Breeding							
Cinclidae												
38	Ջրաճնճղուկ	White-throated Dipper	*Cinclus cinclus*	Yr - regular	Breeding							
Troglodytidae												
39	Եղնջաթռչնակ	Winter Wren	*Troglodytes troglodytes*	Yr - regular	Breeding							
Muscicapidae												
40	Մոխրագույն ճանճորս	Spotted Flycatcher	*Muscicapa striata*	B - regular	Breeding							
41	Կիսասպիտակավիզ ճանճորս	Semicollared Flycatcher	*Ficedula semitorquata*	B - regular	Migratory	ind	5-20	LC	DD	+	+	

№	Armenian names	English names	Scientific names	Occurrence Status in Armenia	Occurrence Status in the Project site	Unit	Number	IUCN	RDB RA	Bern Res6	BD Annex 1	RR species
42	Սովերական կարմրատուտ	Common Redstart	*Phoenicurus phoenicurus*	B - regular	Breeding							
43	Արշալույսիկ	Robin	*Erythacus rubecula*	Yr - regular	Breeding							
44	Մարգագետնային չքչքան	Whinchat	*Saxicola rubetra*	B - regular	Migratory							
45	Սիբիրյան սևագլուխ չքչքան	Siberian Stonechat	*Saxicola maurus*	B - regular	Breeding							
Turdidae												
46	Սև կեռնեխ	Eurasian Blackbird	*Turdus merula*	Yr - regular	Breeding							
47	Սոսնձակեռնեխ	Mistle Thrush	*Turdus viscivorus*	Yr - regular	Breeding							
48	Երգող կեռնեխ	Song Thrush	*Turdus philomelos*	B - regular	Breeding							
49	Սպիտակախածի կեռնեխ	Ring Ouzel	*Turdus torquatus*	Yr - regular	Migratory							
Scotocercidae												
50	Լայնապոչ եղեգնաթռչնակ	Cetti's Warbler	*Cettia cetti*	Yr - regular	Breeding							
Sylviidae												
51	Սևագլուխ շահրիկ	Blackcap	*Sylvia atricapilla*	B - regular	Breeding							
52	Այգու շահրիկ	Garden Warbler	*Sylvia borin*	B - regular	Breeding							
53	Մոխրագույն շահրիկ	Greater Whitethroat	*Curruca communis*	B - regular	Breeding							
54	Մորու շահրիկ	Lesser Whitethroat	*Curruca curruca*	B - regular	Breeding							
Phylloscopidae												
55	Կանաչ գեղգեղիկ	Green Warbler	*Phylloscopus nitidus*	B - regular	Breeding	pair	2-3	LC				+
56	Ծնկլտան գեղգեղիկ	Common Chiffchaff	*Phylloscopus collybita*	B - regular	Breeding							
57	Գարնանային գեղգեղիկ	Willow Warbler	*Phylloscopus trochilus*	M - regular	Migratory							

№	Armenian names	English names	Scientific names	Occurrence Status in Armenia	Occurrence Status in the Project site	Unit	Number	IUCN	RDB RA	Bern Res6	BD Annex 1	RR species
Aegitalidae												
58	Երկարագի երաշտահավ	Long-tailed Tit	*Aegitalos caudatus*	Yr - regular	Breeding							
Paridae												
59	Սև երաշտահավ	Coal Tit	*Periparus ater*	Yr - regular	Breeding							
60	Երկնագույն երաշտահավ	Eurasian Blue Tit	*Cyanistes caeruleus*	Yr - regular	Breeding							
61	Մեծ երաշտահավ	Great Tit	*Parus major*	Yr - regular	Breeding							
Sittidae												
62	Սովորական սիտեղ	Eurasian Nuthatch	*Sitta europaea*	Yr - regular	Breeding							
63	Ժայռային փոքր սիտեղ	Western Rock-nuthatch	*Sitta neumayer*	Yr - regular	Breeding							
Laniidae												
64	Ժուլան	Red-backed Shrike	*Lanius collurio*	B - regular	Breeding	pair	5-7	LC		+	+	
65	Սևաճակատ շամփրուկ	Lesser Grey Shrike	*Lanius minor*	B - regular	Migratory	ind	5-10	LC		+	+	
Corvidae												
66	Անտառային կաչաղակ	Eurasian Jay	*Garrulus glandarius*	Yr - regular	Breeding							
67	Սովորական կաչաղակ	Black-billed Magpie	*Pica pica*	Yr - regular	Breeding							
68	Կարմրակտուց ճայ	Red-billed Chough	*Pyrrhocorax pyrrhocorax*	Yr - regular	Breeding	pair	1	LC		+	+	
69	Մոխրագույն ագռավ	Hooded Crow	*Corvus corone*	Yr - regular	Breeding							
70	Սև ագռավ	Common Raven	*Corvus corax*	Yr - regular	Breeding							
Passeridae												
71	Ժայռային ճնճղուկ	Rock Sparrow	*Petronia petronia*	Yr - regular	Breeding							
72	Դաշտային ճնճղուկ	Tree Sparrow	*Passer montanus*	Yr - regular	Migratory							

№	Armenian names	English names	Scientific names	Occurrence Status in Armenia	Occurrence Status in the Project site	Unit	Number	IUCN	RDB RA	Bern Res6	BD Annex 1	RR species
Fringillidae												
73	Ամուրիկ	Eurasian Chaffinch	*Fringilla coelebs*	Yr - regular	Wintering							
74	Կարմրաճակատ սերինոս	Fire-fronted Serin	*Serinus pusillus*	Yr - regular	Breeding							
75	Կանաչ սերինոս	European Greenfinch	*Chloris chloris*	Yr - regular	Breeding							
76	Կարմրակատար	European Goldfinch	*Carduelis carduelis*	Yr - regular	Breeding							
77	Կանեփնուկ	Eurasian Linnet	*Linaria cannabina*	Yr - regular	Breeding							
78	Սովորական ոսպնուկ	Common Rosefinch	*Carpodacus erythrinus*	B - regular	Migratory							
Emberizidae												
79	Լեռնային դրախտապան	Rock Bunting	*Emberiza cia*	Yr - regular	Breeding							
80	Սևագլուխ դրախտապան	Black-necked Bunting	*Emberiza melanocephala*	B - regular	Breeding							
81	Կորեկնուկ	Corn Bunting	*Emberiza calandra*	Yr - regular	Breeding							

Keys to the Table 6-16:

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

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

Data from previous studies conducted in the area, along with other available scientific information related to the region, were used during the desktop research. This included articles, reports, and collections from the Armenian Institute of Zoology. Additionally, data from the national EIA report (including field survey results) were also considered. During the field survey, reptiles and amphibians were observed visually. Reptiles were also searched for under stones, while amphibians were additionally surveyed using acoustic methods.

Results

The list of reptiles and amphibians presented in **Table 6-17**.

Table 6-17. Reptiles and Amphibians of the study area

№	Latin name	Armenian name	English name	1	2	3	4	5	6
Reptilia									
Gekkonidae									
1	*Tenuidactylus caspius*	Կասպիական գեկոն	Caspian bent-toed gecko	+	+				
Anguidae									
2	*Pseudopus apodus*	Դեղնափորիկ	European glass lizard	+	+			+	
Agamidae									
3	*Laudakia caucasia*	Կովկասյան ագամա	Caucasian agama	+	+				
Scincidae									
4	*Ablepharus bivittatus*	Չոլավոր մերկաչք	Twin-striped skink	+	-				
Lacertidae									
5	*Darevskia raddei*	Ռադդեի ժայռային մողես	Darevskia raddei	+	+				+
6	*Lacerta media*	Միջին մողես	Medium Lizard	+	-			+	
Colubridae									
7	*Elaphe hohenackeri*	Անդրկովկասյան սահնօձ	Transcaucasian rat snake	+	+	LC	VU		+
8	*Coronella austriaca*	Սովորական պղնձօձ	Smooth snake	+	-			+	
9	*Eirenis punctatolineatus*	Հայկական Էյրենիս	Dotted dwarf racer	+	-				
Viperidae									
10	*Montivipera raddei*	Հայկական իժ	Armenian viper	+	+	NT	VU		+
11	*Macrovipera lebetina*	Գյուրզա	Lebetine viper	+	+				
Amphibia									
Bufonidae									
12	*Bufo viridis*	Կանաչ դոդոշ	European green toad	+	+			+	
13	*Rana ridibunda*	Լճագորտ	Marsh frog	+	+				
Ranidae									
14	*Rana macrocnemis*	Փոքրասիական գորտ	Long-legged wood frog	+	+				

Keys to the Table 6-17

Column titles:
1 - Information from various sources
2 - Data from field studies
3 - IUCN Red List
4 - Red Book of the RA
5 - Annex IV of the EU Habitats Directive
6 - Range-restricted species

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

Conservation status (in - IUCN Red List, column 3, in the RA Red Book):
LC - Least Concern
NT – near threatened
VU – vulnerable

Based on the above, 11 species of reptiles can potentially inhabit the area (including six species of lizards and five species of snakes) and three species of amphibians. The species of reptiles and amphibians are unevenly distributed in the study area, which is explained by the different habitats. Thus, lizards are mainly found in rocky areas, amphibians are mainly found in humid, near-stream areas, and snakes are mainly found on slopes with shrub and herbaceous vegetation. Out of all the species mentioned, two species, the Transcaucasian rat snake (*Zamenis hohenackeri*) and Armenian viper (*Montivipera raddei*), are included in the RA Red Book.

Of the 14 species of reptiles and amphibians that potentially inhabit the area, 10 species were recorded during the field survey (**Table 6-17**). Both species listed in the RA Red Book were observed. One individual of Transcaucasian Rat Snake was observed in the very centre of the reservoir area crossing a dirt road towards the Mulk River. Armenian Viper individuals were observed twice on gentle slopes, both in the middle of the area and in the lowest part, where the dam is planned to be built. In both cases, the snakes moved towards the Mulk River and hid in low-growing bushes when attempts were made to capture them.

Of the 11 identified reptilian species, three species and their habitats are qualified as the Priority Biodiversity Features (PBF) according to the EBRD PR6 criterion 12 - as regularly occurring range-restricted species; two of these species are also listed in the RA Red Book under the category "Vulnerable".

Three more reptilian species and one amphibian species are assessed as the Critical Habitat according to the EBRD PR 6 criterion 14-ii as they are listed in Annex IV of the EU Habitats Directive (**Table 6-17**).

Ichthyofauna

Upon detailed review and analysis of the specified literary sources it was determined that only one scientific study (Pipoyan, 2012) specifically addresses the composition of fish species in the Meghri River. This study identifies several species present in the river, including Trout (*Salmo caspius*), Caucasian scraper (*Capoeta capoeta*), Kura barbel (*Barbus cyri*), South Caspian sprilin (*Alburnoides eichwaldii*), Wild common carp (*Cyprinus carpio*), Silver prussian carp (*Carassius gibelio*), Angora loach (*Oxynoemacheilus sp*), and Wels catfish (*Silurus glanis*). Notably, the carp, catfish, and silver prussian carp are predominantly found near the Meghri River's mouth and do not appear upstream near Meghri city. Additionally, there is a possibility that Rainbow Trout (*Oncorhynchus mykiss*) may also be found in the Meghri River.

Summarizing the data and considering the hydrographic characteristics of the Lichk River, it is possible to identify the fish species that may migrate from the Meghri River to the Lichk River. These species include the Trout, South Caspian sprilin, Kura barbel and probably Rainbow trout, which is not a native fish species to Armenia.

However, ichthyological studies conducted on the Lichk River on April 6, 2024, confirmed the absence of fish. Interviews with local population supported these findings, as they reported never having observed fish in the river. At the same time, residents mentioned that some individual farmers had attempted to raise Rainbow Trout in the Lichk River, and the fish demonstrated high growth rates.

Given the absence of fish in the Lichk River, the construction of the Lichk Reservoir is unlikely to have significant impact on river’s aquatic life. The river, a typical upland tributary, is devoid of fish for several possible reasons. These include the presence of various river slides that hinder fish migration, poaching, seasonal fluctuation in water flow, the operation of small hydropower plants, and water abstraction for agricultural use.

Summarizing the above, no fish were recorded at the surveyed sites along the Lichk River. Therefore, the construction of the reservoir does not require the inclusion of fishway structures to support fish migration.

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.

Data processing included visualization of the insects' community in the table form that also shows 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 invertebrates' diversity survey are presented in **Table 6-18** and include 43 species.

Table 6-18. Terrestrial invertebrates of the study area

№	Latin names	RDB AM	Regional endemic	Bern Res 6
LEPIDOPTERA				
Hesperiidae				
1	Erynnis tages			
2	Carcharodus alceae			
3	Spialia orbifer			
Papilionidae				
4	Iphiclides podalirius			
5	Papilio machaon			
Pieridae				
6	Leptidea sinapis			
7	Anthocharis cardamines			
8	Pontia edusa			
9	Pieris pseudorapae			
10	Pieris brassicae			
11	Colias sareptensis			
12	Colias crocea			
13	Gonepteryx rhamni			
Lycaenidae				
14	Lycaena phlaeas			
15	Lycaena tityrus			
16	Lycaena thersamon			
17	Celastrina argiolus			
18	Pseudophilotes vicrama			
19	Glaucopsyche alexis			
20	Aricia agestis			
21	Lysandra bellargus			
22	Polyommatus (icarus) icarus			

№	Latin names	RDB AM	Regional endemic	Bern Res 6
Nymphalidae				
23	Libythea celtis			
24	Pararge aegeria			
25	Lasiommata megera			
26	Coenonympha pamphilus			
27	Thaleropis ionia		X	
28	Vanessa atalanta			
29	Vanessa cardui			
30	Inachis io			
31	Polygonia c-album			
32	Aglais urticae			
33	Issoria lathonia			
34	Euphidrias aurinia			X
35	Melitaea didyma			
36	Melitaea cinxia			
Sphingidae				
37	Macroglossum stellatarum			
COLEOPTERA				
Carabidae				
38	Carabus hollbergi		X	
39	Procerus scabrosus	VU	X	
41	Cicindela campestris			
Cerambicidae				
42	Dorcadion scabricolle			
43	Dorcadion laeve		X	

Keys to the Table 6-18

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

Conservation status (in -Red Book of the RA):
VU - vulnerable

From the 43 identified species, five species are assessed as the Priority Biodiversity Features (PBF) according to the EBRD PR6 criterion 12 (ii) - four species as they are range-restricted species of the Caucasian region (one of these is also listed in the RA Red Book under the category "Vulnerable"), and one species (*Euphydryas aurinia*) as included to the Resolution 6 of the Bern Convention.

Habitats

Habitats identified at the Lichk Reservoir site are listed in **Table 6-19**. They are presented according 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.

Five habitats were identified according to the habitat classification for Armenia (**Table 6-19**).

Of the five identified habitats, Armenian habitat G1.11 Riverine willow woodland = 92A0 *Salix alba and Populus alba galleries* is assessed as the Priority Biodiversity Feature according to the EBRD PR 6 criterion 12-i as it is listed both in the Resolution No. 4 of the Bern Convention and Annex I of the EU Habitats Directive. Potentially lost area of the habitat is 5.29 ha.

Map of the five identified habitats in the footprint area is shown in the **Figure 6-11**. Map of the habitat listed in Resolution No.4 of the Bern Convention and Annex I of the EU Habitats Directive is shown in the **Figure 6-12**.

Figure 6-11. Map of the habitats identified in the footprint area

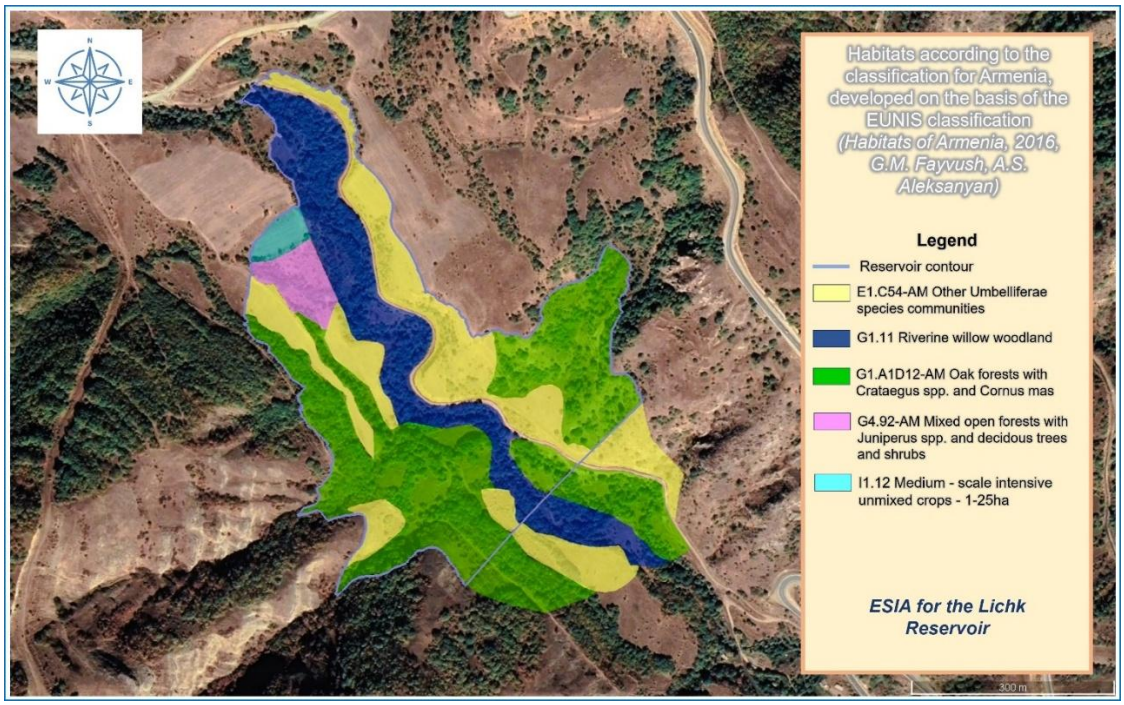


Figure 6-12. Map of the habitats in the footprint area listed in Resolution No. 4 of the Bern Convention and Annex I of the EU Habitat Directive

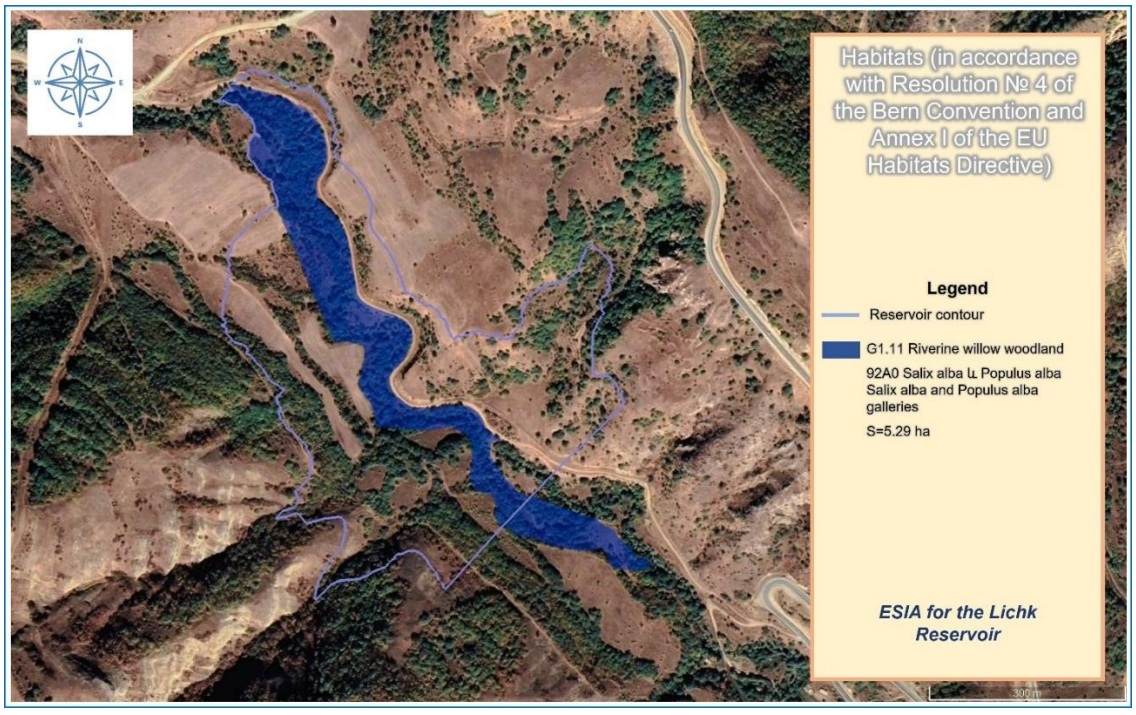


Table 6-19. Habitats identified in the Lichk Reservoir area

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
Code	*Name*	*Code*	*Name*	*Code*	*Name*	
G1.A1D12-AM	Oak forests with Crataegus spp. and Cornus mas	-	-	-	-	Habitats are presented in South Zangezur and Megri floristic regions. Crataegus pentagyna, C. szovitsii, C. meyeri, C. curvisepala, and Cornus mas usually are co-edificators in these communities.
G1.11	Riverine willow woodland	G1.11	Riverine Salix woodland	92A0	*Salix alba* and *Populus alba* galleries	Salix alba, S. excelsa, Populus alba, P. nigra, P. canescens, Lycopus europaeus, Lysimachia vulgaris and Urtica dioica.
G4.92-AM	Mixed open forests with Juniperus spp. and decidous trees and shrubs	-	-	-	-	Paliurus spina-christi, Amygdalus fenzliana, Prunus divaricata, Pyrus salicifolia, P. syriaca, etc. Habitats are rather common in Armenia. Juniperus polycarpos is a dominant in communities, and species from shibliak and arid deciduous open forests are included in the composition.
E1.C54-AM	Other Umbelliferae species communities	-	-	-	-	Bupleurum exaltatum, Astrodaucus orientalis, Conium maculatum that are often accompanied by Koeleria macrantha, Phleum phleoides, Festuca. sclerophylla, Stipa arabica. Rather common habitats, mainly in Central and South Armenia, sometimes occupy big areas. Bupleurum exaltatum, Astrodaucus orientalis, Conium maculatum are the most common dominants in these communities.
	I1.12 Medium - Scale intensive unmixed crops	-	-	-	-	Habitats well represented in Armenia. They have recently been increased in size due to the consolidation of farms.

6.2.4 Specially Protected and Internationally Recognized Areas and Forests

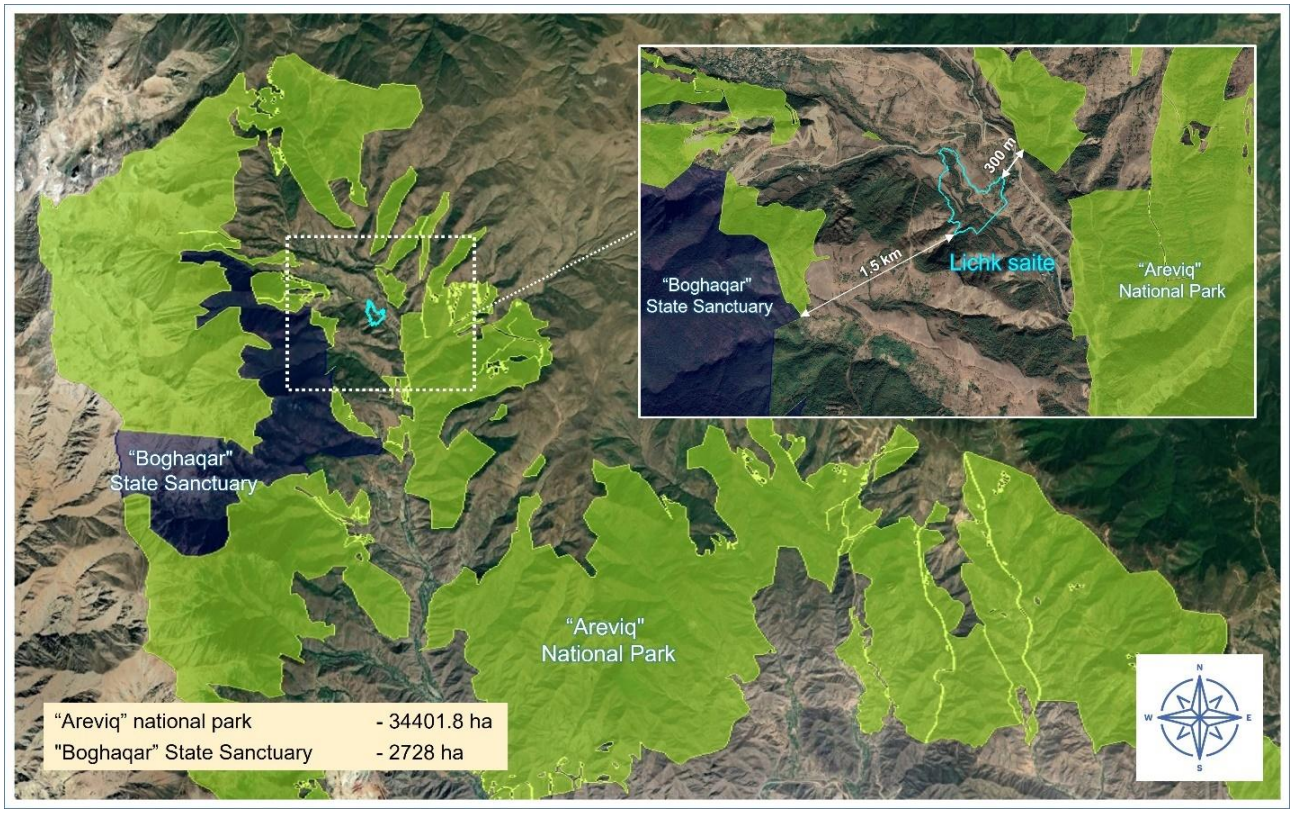
National sites

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 Lichk Reservoir site is not located within any SPAN, but it is planned approximately 300 m from the border of Arevik National Park, about 1 km from another section of the same park and around 1.5 km from the boundary of the Boghakar State Sanctuary (**Figure 6-13**).

Arevik National Pak was established by the Government of Armenia Decision No.1209-N of October 15, 2009[91]. The Park is located in the Meghri region of Syunik Marz, and extends across the southern slopes of the Meghri range of the Zangezur Mountains, within the catchment areas of the Meghri, Shvanidzor and Nrnadzor Rivers. The main objectives of the National Park are the preservation, restoration, and sustainable use of natural ecosystems, aquatic and terrestrial natural landscapes, as well as the protection of endemic and rare flora and fauna, some of which are of international conservation significance. The Park also aims to promote scientific research, environmental monitoring, eco-tourism development, and to foster ecological education and awareness.

Figure 6-13. Location of the SPANs in the vicinity of the Project site



According to the RA Government Decree №967-N "On Approving the List of Nature Monuments of the Republic of Armenia", there are 56 natural monuments located in Syunik Marz, of which:

[91]Letter from the Ministry of Environment of the Repiblic of Armenia, from 24.06.2025, №2/16.2/7145

- Geological monuments - 20 units,
- Hydrogeological monuments - 16 units,
- Hydrographic monuments - 13 units,
- Natural historical monuments - 4 units,
- Biological monuments - 3 unit.

These monuments are located a considerable distance from the planned reservoir and will not be adversely affected by its construction or operation.

Internationally Recognized Areas

Armenia signed the Bern Convention on the Conservation of European Wildlife and Natural Habitats in 2006 and ratified in 2008. Since then, the country has worked on establishing the Emerald Network of Areas of Special Conservation Interest. In line with Bern Convention Resolutions No. 4 (1994) and No. 6 (1998), Armenia has identified and listed more than 110 species that require protection and habitat conservation.

As of June 2025, Armenia has not yet officially adopted any Emerald Network sites udner the Bern Convention. However, 23 sites within the country's territory have been officially nominated as Candidate Emerald Sites. The most resent confirmation of this candidate list was made during the 44th Meeting of the Standing Committee of the Convention on the Conservation of European Wildlife and Natural Habitats (December 2024)[92].

In response to challenges identified by the Ministry of Environment (ME), the Emerald Network database in Armenia was revised and optimized under the European Union for Environment (EU4Environment) Action Program, supported by the World Bank[93]. The revised proposal includes 30 Emerald Network sites, covering a total area of 707,739.22 ha, which represents 23.8% of the national territory - almost one-third less than the previous proposal[94]. The revised network has not yet been officially adopted by the national or international authorities.

The Lichk reservoir is located inside the Candidate Emerald Site Arevik (AM 0000014) (**Figure 6-14**). The Site harbours highly valuable biodiversity, including endangered and endemic plant and animal species. The area features diverse landscapes along the southern slopes of the Zangezur mountain range, such as semi-deserts, forests, steppes, and alpine meadows. The Site's primary environmental objective is the conservation of natural ecosystems, particularly the protection of habitats for species listed in the appendices of the Bern Convention, in order to ensure population stability and reduce threats to their ecological integrity[95].

The Site covers an area of 60,804.7 ha and includes 36 habitat types listed under Resolution No. 4 of the Bern Convention. It provides habitat for 50 species listed in Resolution No. 6 of the Bern Convention, as well as 13 other species of significant conservation importance. The area supports a variety of large mammal species, including Grey Wolf, Brown Bear, Lynx, Wild Cat, Wild Goat, and Roe Deer – some of which have also been observed within the Project area. Notably, the Candidate Emerald site serves as a temporary habitat for the Persian Leopard (*Panthera pardus ssp. tulliana*), one of the rarest large cats globally, classified as Endangered on the IUCN Red List.

[92] https://rm.coe.int/pa18e-2024-draft-candidate-list-emerald-network-sites-2779-8956-4427-1/1680b27e33

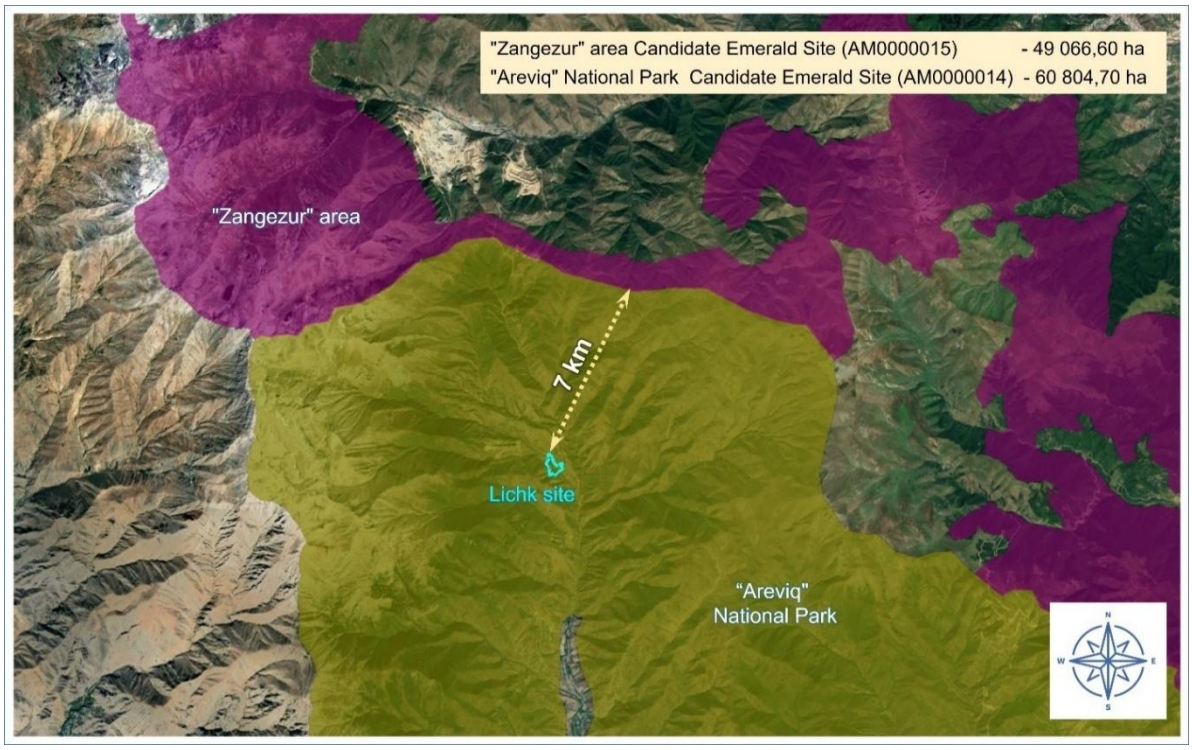
[93] EU4Environment. 2024. Recommendations for Review of the Candidate Emerald Sites in Armenia. Washington DC: World Bank. https://www.eu4environment.org/app/uploads/2024/11/Recommendations-for-Review-of-the-Candidate-Emerald-Sites-in-Armenia.pdf

[94] Ibid

[95] Letter from the Ministry of Environment of the Republic of Armenia, from 24.06.2025, №2/16.2/7145

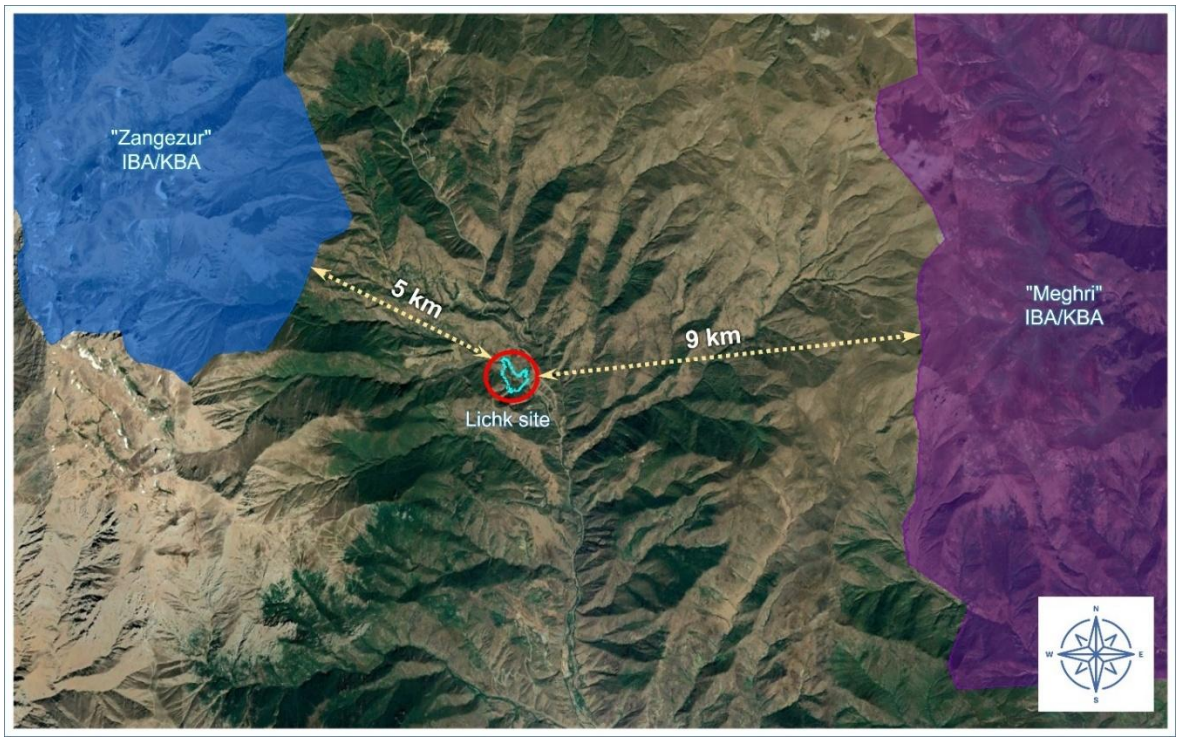
In addition, the reservoir is planned 7.5 km from the Candidate Emerald Site Zangezur (AM0000015) (**Figure 6-14**).

Figure 6-14. Location of the Lichk Reservoir area inside the Candidate Emerald site Arevik National Park



Furthermore, the planned Lichk reservoir area is located between Meghri KBA/IBA and Zangezur KBA/IBA (**Figure 6-15**). Both KBAs/IBAs partly overlap with the Arevik National Park and Boghaqar State Sanctuary.

Figure 6-15. Location of the Lichk reservoir area between two KBAs/IBAs



Within the Zangezur IBA, five bird species meeting the IBA/KBA criteria breed, including three species of diurnal birds of prey that have been recorded within the reservoir area. In the Meghri IBA, 17 bird species meeting the IBA/KBA criteria breed. Of these, eight species - including seven species of diurnal birds of prey - have been observed within the reservoir area.

6.2.5 Critical Habitat Assessment Findings

Among the five habitats, 196 flora species, and 158 fauna species identified during the biodiversity surveys, the following features (see **Table 6-20)** were assessed as triggering Priority Biodiversity Feature (PBF) or Critical Habitat (CH) according to the EBRD PR6.

PBFs include one habitat (according to the EU Habitats Directive classification) and 27 species, including one mammal species, 18 bird species, three reptile species, and five invertebrate species. CHs include ten species - six mammal species, three reptile species, and one amphibia.

Table 6-20. Priority Biodiversity Features and Critical Habitats Identified in the footprint area[96]

№	Criterion	Features (Habitats/species)
Priority Biodiversity Features as per EBRD PR6 (§12)		
i	12.i.a EAAA[97] is habitat type listed in Annex I of the EU Habitats Directive and Resolution 4 of the Bern Convention	Habitats (×1 - according to the EU Habitats Directive) 92A0 *Salix alba* and *Populus alba* galleries
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 (×17) *Pernis apivorus (LC)* *Gypaetus barbatus (NT)* *Gyps fulvus (LC)* *Neophron percnopterus (EN)* *Circaetus gallicus (LC)* *Buteo rufinus (LC)* *Aquila chrysaetos (LC)* *Clanga pomarina (LC)* *Hieraaetus pennatus (LC)* *Falco peregrinus (LC)* *Caprimulgus europaeus* (LC) *Dendrocopos syriacus* (LC) *Lullula arborea (LC)* *Ficedula semitorquata* (LC) *Lanius collurio* (LC) *Lanius minor* (LC) *Pyrrhocorax pyrrhocorax* (LC) Insects (×1) *Euphydryas aurinia*
	12.ii.d EAAA for regularly occurring nationally or regionally listed EN or CR species	Birds (×1) *Neophron percnopterus (EN)* (×1, already triggering cr.12 ii.a)

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

№	Criterion	Features (Habitats/species)
iii	12.ii.e EAAA for regularly occurring range-restricted species	Birds (×1) *Phylloscopus nitidus (LC)* Reptilia (×3) *Darevskia raddei* *Elaphe hohenackeri (LC)* *Montivipera raddei (NT)* Insects (×4) *Thaleropis ionia* *Carabus hollbergi* *Procerus scabrosus* *Dorcadion laeve*
	12.iii Significant biodiversity features identified by a broad set of stakeholders or governments	Mammals (×1, listed in the Red Book of RA as Vulnerable) *Hystrix indica (LC)* Birds (×3, listed in the Red Book of RA as Vulnerable, already triggering cr.12 ii e) *Gypaetus barbatus (NT)* *Gyps fulvus (LC)* *Circaetus gallicus (LC)* *Aquila chrysaetos (LC)* *Clanga pomarina (LC)* *Hieraaetus pennatus (LC)* *Falco peregrinus (LC)* Reptiles (×1, listed in the Red Book of RA as Vulnerable, already triggering cr.12 ii e) *Elaphe hohenackeri (LC)* *Montivipera raddei (NT)* Insects (×3, listed in the Red Book of RA as Vulnerable, already triggering cr.12 ii.e) *Procerus scabrosus*
Critical Habitats as per EBRD PR6 (§14)		
ii	14.ii.a EAAA for species and their habitats listed in Annex IV of the Habitats Directive	Mammals (×6) *Felis silvestris (LC)* *Canis lupus (LC)* *Lynx lynx (LC)* *Dryomys nitedula (LC)* *Rhinolophus hipposideros (LC) (?)* *Pipistrellus sp. (?)* Reptiles (×3) *Pseudopus apodus* *Lacerta media (Lacerta viridis)* *Coronella austriaca* Amphibians (×1) *Bufo viridis*

6.3 Social and Socio-economic Environment

The sections below are informed by the review of primary and secondary sources, such as publications and bulletins of the Statistical Committee of the RA, focus group discussions and interviews with the heads of the villages held in August 2024, and ESIA Consultant's observations during the site visits.

6.3.1 Overview of the Project area

Syunik Marz is located in the southern part of the Republic of Armenia. It borders Vayots Dzor Marz to the north, the Nakhchivan Autonomous Republic (Azerbaijan) to the west, Azerbaijan to the east, and Iran to the south. The regional center and largest city of the marz is Kapan.

Syunik occupies a strategic geopolitical position and is characterized by rich natural resources, considerable industrial capacity, and the status of being one of the largest administrative and economic regions of the Republic of Armenia. However, it remains sparsely populated and less economically developed, largely due to its remoteness from the capital and the lack of reliable transportation links.

Meghri community is an urban administrative subdivision of Syunik Marz, located in the southernmost part of the country along the border with Iran. It comprises a group of settlements, with the town of Meghri serving as the administrative centre.

Lichk is a small rural village within the Meghri community, situated approximately 24 km northwest of Meghri town and around 60 km from the marz regional center, Kapan. The village lies in a mountainous area at an altitude of 1,750-1,850 masl, near the confluence of the Meghri and Zvar rivers.

The proposed Lichk Reservoir site is located about 2 km from Lichk village, on the Arevik (Lichk) tributary of the Meghri River. The reservoir is planned to supply irrigation water to approximately 1,510.8 ha of agricultural land belonging to the settlements of Meghri, Agarak, Alvank, Shvanidzor, Nrnadzor, Lehvaz, Vardanidzor, and Karchevan. The direct distance from these settlements to the proposed reservoir site ranges between 8 and 25.5 km, and by road between 11.5 and 45.5 km, with Vardanidzor being the nearest and Nrnadzor the farthest settlement.

6.3.2 Demography[98]

As of the beginning of 2024, the population of Syunik Marz was 116,400 people, and population of the Meghri community was 12,800 people (11% of the marz's population). The population of the Project affected settlements is shown in **Table 6-21**. Meghri and Agarak are the most populous settlements, while the other settlements have significantly smaller population, with Lichk being the least populated. Women constitute around 50% of the population of the marz and the villages.

Table 6-21. Population of the Project affected settlements as of 31.12.2024, people[99]

Settlement	Meghri	Agarak	Shvanidzor	Karchevan	Alvank	Vardanidzor	Nrnadzor	Lehvaz	Lichk
Population	4,175	3,350	282	223	201	168	125	451	93

[98]Information for this sub-section was mainly extracted from the website of Armstat's publication RA Syunik Marz in figures, 2024 available at https://armstat.am/file/doc/99553363.pdf and Meghri Community Five-Year Development Plan for 2022-2026 available at https://meghri.am/Pages/DocFlow/Def.aspx?a=v&g=1995f779-cf46-4165-85f2-3c679c11701d

[99]https://armstat.am/file/Map/MARZ_09.pdf

6.3.3 Regional and Local Economy

The economy of Syunik Marz is primarily driven by industry and agriculture. The industrial sector is dominated by metal ore mining and electricity production, which are the key pillars of the region's economic activity.

The Meghri community operates under an approved five-year development plan[100], aimed at creating a well-developed, attractive, and comfortable living environment. The Plan focuses on developing mining, production, and processing of subtropical fruits, as well as promoting agro-, ecotourism and renewable energy. The community's unique geographical location, natural recreation areas, and rich historical, cultural, and ethnographic heritage provide strong potential for it to become a tourist centre, with opportunities in eco-, agro-, sports, and historical tourism. However, the community has yet to fully realize its tourism potential and requires improvements and further development of infrastructure.

Majority of the community residents are engaged in agriculture, with the area particularly known for producing figs, pomegranates, and persimmons. Animal husbandry is limited and primarily practiced for household subsistence. Most of the agricultural products are consumed locally, and the community has no business ties with foreign markets. Beekeeping is not practiced in Lichk Village; however, some beekeepers reside in the rural settlements of Nrnadzor and Tashtun.

The region is also known for one of the largest copper and molybdenum deposits. Agarak Copper-Molybdenum Combine (CJSC) is one of the largest industrial facilities in the Meghri region, and one of the major employers in the area, with over 1,000 employees, contributing significantly to local employment and regional revenues. Residents of the nearby settlements (namely, Agarak, Karchevan, Levhaz, Meghri) find employment there. No other industrial-scale enterprises are present in the area.

Public Infrastructure

The Meghri-Agarak road is the most important transport link in the area, also connecting to the Iranian border. Inter-settlement roads connecting Meghri, Agarak, Alvank, Shvanidzor, Nrnadzor, Lehvaz, Vardanidzor, and Karchevan are in poor condition, often unpaved or damaged. Intra-settlement roads in villages are mostly narrow, rural, and require repairs. At the same time, the region relies on road transport for industrial and agricultural shipments, as well as passengers travel.

No active passenger or freight railway lines currently operate in the area. The Meghri railway station, located near the Armenia-Iran border was once part of the Yerevan-Nakhchivan-Horadiz railway line, serving as a significant transit point during the Soviet era. However, the station has been abandoned and is currently non-operational. Meghri airport, completed in 1985, located near the village of Karchevan, has been closed and is no longer operational. The nearest operational airport is Syunik airport, located approximately 40 km northeast of Meghri, near the city of Kapan. Syunik airport reopened in 2023 after reconstruction and offers flights connecting Kapan to Yerevan, significantly reducing travel time compared to the five-hour drive.

The gravity-fed irrigation system using the Meghri River as a central water source was introduced in the Meghri community in 2016 to replace the outdated Soviet-era pump-based infrastructure. The gravity system improved water supply reliability and reduced energy consumption[101]. However,

[100]Meghri Community Five-Year Development Plan for 2022-2026 available at https://meghri.am/Pages/DocFlow/Def.aspx?a=v&g=1995f779-cf46-4165-85f2-3c679c11701d

[101]World Bank. For an Armenian Farmer, Water is the "Stuff of Life" (2017): Available at: https://www.worldbank.org/en/news/feature/2017/05/23/an-armenian-farmer-confirms-water-is-the-staff-of-life?utm_source=chatgpt.com

challenges remain in ensuring consistent water availability, particularly during the active irrigation season from July to September.

Drinking water supply and sanitation infrastructure is limited. The community primarily relies on surface water sources, such as the Meghri and Zvar (Ayrijur) rivers, for its drinking water supply. These rivers are part of the Voghchi and Meghri river basins, which are also home to major mining centers in the country[102]. Water from these rivers is treated at five water treatment plants (WTPs) serving the region. Despite treatment efforts, challenges persist due to the outdated technologies and poor technical conditions of the plants and water networks. Additionally, the presence of heavy metals such as aluminium, iron, molybdenum, tin, and antimony in surface waters poses potential health risks.

Furthermore, the settlements lack proper wastewater networks or modern treatment facilities. In particular, the Meghri community does not have an operational wastewater treatment plant. Existing mechanical wastewater treatment facilities in Meghri, Agarak, and Kapan are currently non-operational. Consequently, untreated domestic sewage is often discharged directly into nearby water bodies, such as the Meghri and Araks rivers, leading to pollution and potential public health risks[103].

The Meghri community has one official waste landfill located near Meghri city which serves as the primary disposal site for the community. The landfill represents an open dump rather than a sanitary landfill. The community's geographical position and the long distances between its settlements pose significant challenges in organizing an efficient waste disposal system. Therefore, a common problem in many regions, including Meghri community, is the existence of numerous small, unofficial dumpsites.

The Iran-Armenia natural gas pipeline passes through Meghri town.

The socio-economic situation in Lichk village is characterized by high male employment in the mining sector, small hydroelectric power plants, and the armed forces. Meanwhile women are primarily engaged in agriculture, cultivating gardens and selling their produce.

Key challenges identified during focus group discussions in the affected settlements include water shortages, limited access to fertilizers, and difficulties in marketing and selling agricultural products.

6.3.4 Poverty and Unemployment, Incomes and Expenditures

The average monthly nominal wage in Syunik Marz is 319,753 AMD (835 USD), which is higher than the national average 269,994 AMD (701 USD). The share of poor population in Syunik Marz increased from 6.1% in 2020 to 7.0% in 2023, but still remained lower than the national average (23.7%). Extremely poor population is not registered in the region as of the beginning of 2024.

Unemployment rate in Syunik Marz reduced from 13.1% in 2020 to 11.3% in 2023 (RA average is 12.4%). Rural unemployment rate (4.8%) is significantly lower than the urban (15%).

The average monthly nominal wage in Meghri community is around 53,000 AMD (138 USD), and 40,000 AMD (104 USD) in Lichk village. Average unemployment rate is Meghri community is 1.8%, unemployment rate in the Project affected villages is indicated **Table 6-22**.

[102] Babayan G.G., Sakoyan A.G. Heavy metals and arsenic in drinking water and health risk assessment in a region with a developed mining industry (2020). Available at: https://jdigitaldiagnostics.com/0016-9900/article/view/639718?utm_source=chatgpt.com

[103] ENV Report. When Untreated Sewage Is Dumped Into Water Resources (2023). Available at: https://evnreport.com/law-society/when-untreated-sewage-is-dumped-into-water-resources/?utm_source=chatgpt.com

Table 6-22. Unemployment rates in the Project affected villages

Settlement	Lichk	Meghri	Agarak	Alvank	Lehvaz	Karchevan	Vardanidzor	Nrnadzor	Shvanidzor
Unemployment levels	3.5%	2%	1%	4%	4%	1%	3%	5%	9%

The primary source of income for villagers is salaries, with agriculture providing supplementary income. Focus group discussions highlighted that the availability of irrigation water is crucial for producing quality crops, selling them, and securing income.

Among the main categories of expenditures of the residents are food, utility bills and other services.

6.3.5 Ethnic Minorities

Syunik Marz, Meghri community and the settlements are almost entirely populated by ethnic Armenians who belong to the Armenian Apostolic Church. There are some ethnic minorities, mainly in Meghri town and a few nearby villages of Russians and Persians/Iranians, who historically settled there due to cross-border trade and cultural ties. No detailed information was obtained on the presence of minority groups in the Project affected villages.

6.3.6 Social Infrastructure[104]

There are 53 pre-school institutions, 117 secondary schools, 82 libraries, 11 sports organizations, four museums, and two professional theatres in Syunik Marz[105].

At the community level, Meghri and Agarak have more developed social infrastructure, hosting multiple schools, a college, vocational training center, and a House of Culture. Other settlements are gradually improving their facilities through regional development projects. Most Project affected settlement have at least one school, kindergarten and a medical unit. However, according to available data, the school in Lichk village had been closed due to lack of students.

Residents of settlements have access to centralised electricity and water supply, however according to the available information, there is no centralised natural gas supply in the area.

6.3.7 Gender Issues

According to the National Statistical Committee, 52% of women in Armenia are not employed and are not seeking employment[106]. 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. The poorest households in the country tend to be women-headed households.

National gender problems such as underrepresentation in labour market and decision-making processes, gender pay gap are relevant in the Project affected village as well.

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

[104]Information for this sub-section was mainly extracted from the website of Armstat's publication Main statistical indicators of the Syunik Marz, 2019-2023. Available at https://armstat.am/file/Map/Syunik.pdf and Meghri Community Five-Year Development Plan for 2022-2026 available at https://meghri.am/Pages/DocFlow/Def.aspx?a=v&g=1995f779-cf46-4165-85f2-3c679c11701d

[105]Armstat. Main statistical indicators of the Syunik Marz, 2019-2023. Available at https://armstat.am/file/Map/Syunik.pdf

[106]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

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[107]. Women underrepresentation remains also a problem in Water Users Associations.

According to women focus group discussions, availability of irrigation water is crucial for producing quality crops, selling them and securing income. It was further mentioned, that the available land is not fully cultivated due to the water scarcity.

6.3.8 Socially Less Protected / Vulnerable Population

The Armenian government identifies vulnerability through eligibility for various social benefit programs. Key vulnerable groups include low-income families, the elderly, people with disabilities, and internally displaced persons.

There are 2,252 families in Syunik Marz receiving social benefits from the state.

According to the interview with the Head of the Lichk village, there are no families receiving state social assistance or refugees registered in the village. Statistical information for the other project affected villages is presented in **Table 6-23**.

Table 6-23. Vulnerable people in the Project affected villages

Settlement	Meghri	Agarak	Alvank	Lehvaz	Karchevan	Vardanidzor	Nrnadzor	Shvanidzor
Socially vulnerable people receiving financial assistance from government, incl.:	104	47	17	28	0	11	7	8
- recipients of social assistance	46	26	8	9	0	4	1	5
- recipients of family assistance	58	21	9	19	0	7	6	3

6.3.9 Public Health and Safety

In the Meghri community, the leading causes of death and illness align with national trends, predominantly involving non-communicable diseases (NCDs). These include cardiovascular diseases, cancers, and diabetes, which are the primary contributors to mortality in the region.

No confirmed cases of cholera and polio were registered in Armenia in this millennia. At the same time, as of 2024 Armenia is categorized as a country with a high-intermediate prevalence of Hepatitis A. Bacterial dysentery is another public health concern at the national and regional levels.

Waterborne infectious diseases occur in the Meghri community, primarily due to contamination of local water sources by agricultural runoff, mining activities, and wastewater discharge. The Lichk Reservoir will be situated upstream of the copper-molybdenum plant in Agarak and Meghri settlements and is therefore unlikely to be affected by discharges from mining operations or communal wastewater.

In Syunik Marz, the number of doctors per 10,000 population increased from 18.0 in 2020 to 21.2 in 2023, still remaining below the national average of 46.6. Similarly, the number of paramedical

[107] Ibid

personnel rose from 49.5 to 56.6 per 10,000 population during the same period (national average is 53.9)[108]. The number of hospital beds increased slightly from 33.9 in 2020 to 34.5 in 2023.

There are 16 institutions providing primary health care services in the Marz. Meghri town hosts a regional hospital, which serves as the primary healthcare centre for the municipality. There are 28 doctors and 76 paramedics in the centre, with 45 hospital beds.

There is one medical unit/post operating in each village, their equipment is largely outdated and hardly serves the needs of the residents and there is only one doctor employed.

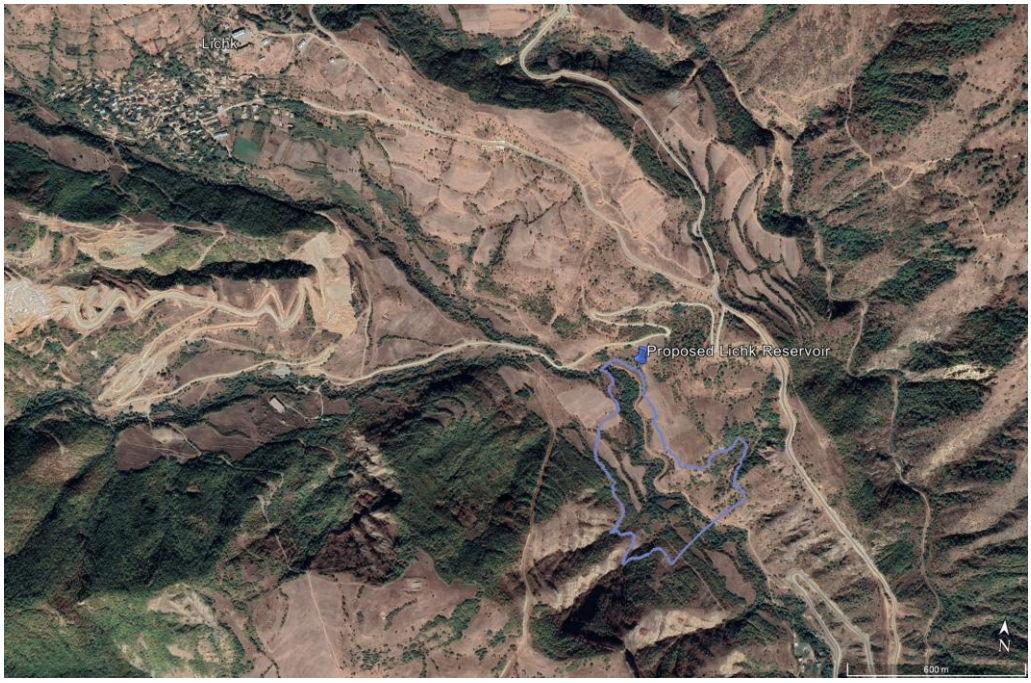
6.3.10 Land Use Issues

Territory of Syunik Marz is 450,600 ha, which is 15.2% of the territory of the RA. Agricultural land comprises of 305,941.6 ha (67.9%), of which 43,862.9 ha (14.3%) is arable land.

Territory of the Meghri community comprises of 66,066.77 ha (14.7% of the marz's territory), of which 34,567.4 ha (52.3%) is cultural heritage land, and 28,073.7 ha (42.5%) is agricultural land.

Lichk Reservoir is proposed to be constructed 1.5 km south-east from Lichk settlement (**Figure 6-16**). The lands for the construction of the reservoir are mainly occupied by shrubs and perennial plantings. Also on the territory of the buffer zone of the reservoir there are land plots allocated for mining activities (Tatstone LLC), but the operating company went bankrupt. It should be noted that Armenian legal regulations require the mining companies to remediate potential legacy contamination; alternatively, the clean-up can be paid by the special fund under the Ministry of territorial administration and infrastructure. On the territory of the reservoir, as well as the buffer zone, there is a hazelnut garden and land plots allocated for haymaking and pastures, both in private and communal property.

Figure 6-16. Location of Lichk Reservoir Relative to the Nearest Settlement



Source: prepared by the Consultant based on information from the Client

[108]Armstat. RA Syunik Dzor Marz in figures, 2024 available at https://armstat.am/file/Map/Syunik.pdf.

Table 6-24. Land resources of the villages, ha

Parameters	Meghri	Agarak	Alvank	Lehvaz	Karchevan	Vardanidzor	Nrnadzor	Shvanidzor	Lichk
Total	**3,201 ha**	**326 ha**	**8,599 ha**	**3,385 ha**	**4,180 ha**	**9,312 ha**	**11,773 ha**	**5,184 ha**	**8,411 ha**
Agricultural	1,855 ha (58%)	34 ha (10.4%)	4,511 ha (52.5%)	1,337 ha (39.5%)	2,448 ha (58.6%)	5,177 ha (55.6%)	4,696 ha (39.3%)	2,447 ha (47.2%)	2,404 ha (28.6%)
Residential	223 ha (7%)	235 ha (72.1%)	50 ha (0.6%)	57 ha (1.7%)	39 ha (0.9%)	54 ha (0.6%)	32 ha (0.3%)	65 ha (1.3%)	74 ha (0.9%),
Industrial	105 ha (3.3%)	33 ha (10.1%)	18 ha (0.2%)	4 ha (0.1%)	279 ha (6.7%)	20 ha (0.2%)	17 ha (0.1%)	3 ha (0.1%)	7 ha (0.1%),
Energy, transport, communications, utilities	18 ha (0.6%)	6 ha (1.8%)	10 ha (0.1%)	17 ha (0.5%)	50 ha (1.2%)	16 ha (0.2%)	65 ha (0.6%)	20 ha (0.4%)	26 ha (0.3%)
Cultural heritage	906 ha (28.3)	4 ha (1.2%)	3,885 ha (45.2%)	1,934 ha (57.1%)	1,249 ha (29.9%)	4,002 ha (43%)	6,637 ha (56.4%)	2,614 ha (50.4%)	5,563 ha (66.1%)
Forest	0	0	0	22 ha (0.6%)	54 ha (1.3%)	36 ha (0.4%)	0	14 ha (0.3%)	309 ha (3.7%)
Water	18 ha (0.6%)	7 ha (2.1%)	92 ha (1.1%)	14 ha (0.4%)	46 ha (1.1%)	7 ha (0.1%)	90 ha (0.8%)	19 ha (0.4%)	28 ha (0.3%)
Special purpose	76 ha (2.4%)	7 ha (2.1%)	33 ha (0.4%)	0	15 ha (0.4%)	0	236 ha (2%)	2 ha (0.04%)	1 ha (0.01%)

6.4 Cultural Heritage

6.4.1 Tangible Cultural Heritage

The historical-cultural and archaeological surveys, consisting of both desktop and field studies, were conducted in 2024 as part of the national EIA study by an expert team from the Institute of Archaeology and Ethnography under the RA National Academy of Sciences.

Desktop studies were performed based on:

1) The RA Government Decree № 628 dated 29.05.2002 "On approval of the State List of Immovable Historical and Cultural Monuments in the RA Aragatsotn Marz",
2) The RA Government Decree № 2322-N dated 29.12.2005 "On approval of the State List of Immovable Historical and Cultural Monuments in the RA Syunik Marz",
3) The RA Government Decree № 385-N dated 15.03.2007 "On Approval of the List of State-owned Immovable Historical and Cultural Monuments that are not subject to Alienation/Acquisition".

According to RA Government Decree № 2322-N, seven cultural heritage monuments located in the Lichk rural settlement of the Meghri community are registered in the State List of Immovable Historical and Cultural Monuments. These include:

- the 16th-20th century cemetery (index 8.39.1),
- the 10th-19th century Zvar village site (index 8.39.2),
- the 16th-20th century Mnashu village site (index 8.39.3),
- the 1658 church (index 8.39.4),
- the 1963 memorial fountain (index 8.39.5),
- the monument dedicated to those who died in World War II (index 8.39.6),
- the 16th-19th century *Martyrs* watermill (index 8.39.7).

All of these monuments are located at a considerable distance from the Project area, and the construction of the reservoir will not affect them in any way.

Although almost no archaeological studies have been conducted in the area of Meghri community of the RA Syunik Marz and no information on the historical and cultural landscape of the study area is available from the available reports, archival documents or publications, an archaeological survey was carried out under the North–South Road Corridor Investment Program which also covered the Lichk settlement. As a result, two newly discovered late medieval (16th-17th century) bridges over the Meghri River were documented within the administrative boundaries of the community (**Figure 6-23**). However, these structures will not be affected by the implementation of the Lichk reservoir project.

Table 6-23. Late medieval (16th-17th century) bridges over the Meghri River

A field-archaeological survey of the area was conducted in April 2024. It has covered the entire area designated for the planned Lichk reservoir, including the developed section along the Meghri River, where all walls and buildings are modern. The numerous natural and artificial cuts present on the site, consisting of alluvial deposits and boulders from the Meghri River, were also thoroughly examined (**Figure 6-25**). No historical or cultural features or their traces were documented during the survey, which can be attributed to the steep slopes of the site, as well as the effects of intensive land reclamation and agricultural activities previously carried out in the area.

In summary, the area designated by the RA Water Committee for the construction of the Lichk reservoir within the administrative boundaries of Lichk rural settlement of Meghri community does not pose any risk of negative impact on cultural heritage values as no cultural and historical monuments and artifacts have been identified in the project region.

Figure 6-24. Left and right sections of the Project area

Figure 6-25. Structures of natural and artificial cuts

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[109]:

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.

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

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 6-26**.

Figure 6-26. 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[110], 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 RA Government Decision №310-A, around ten 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.

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

The rural settlements within the Project command area are primarily engaged in agricultural activities, including orchard farming (85%), vegetable cultivation (10%) and viticulture (5%). No specific rituals or traditional celebrations have been identified in the affected settlements, except for the Vahravar Village Day, which is celebrated not only by the residents of Vahravar but also by people from other settlements within the Meghri community.

Christmas, New Year, and Easter are widely celebrated in the settlements of Meghri community. The "Trndez" ritual is also included in the national list of ICH elements. Rooted in Armenian pagan tradition, Trndez is celebrated annually on February 13. The purifying qualities of fire were central to pre-Christian Armenian beliefs. According to several sources, people believed that the strength of the fire could drive away the winter cold and ensure fertile land and a prosperous harvest. Couples, especially newlyweds, would jump over the Trndez flames for luck, prosperity, and fertility.

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

6.4.2.3 Cultural Landscape[111]

Recognized types of cultural landscapes are:

- **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 command area of the planned Lich Reservoir are characterized by a vernacular cultural landscape, while the agricultural lands represent a combination of organically evolved and working cultural landscapes (**Figure 6-27**). Currently, around 85% of irrigated agricultural land of the 1315.8 ha are covered by orchards. Project implementation may lead to an increase in fruit orchard areas due to improved access to irrigation water. For the same reason, the area under vegetable cultivation is expected to increase. These newly cultivated areas may be characterized by a combination of designed and organically evolved cultural landscapes.

Figure 6-27. Combination of vernacular, organically evolved and working cultural landscape in the Project affected rural settlements

a) Lichk village *b) Vardanidzor*

[111]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.

c) Vahravar

d) Tashtun

e) Mehgri

f) Tkhkut

g) Karchevan

h) Shvanidzor

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[112], 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,
- Governmental authorities,

[112]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.

- 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: 26.12.2023, 16:00

Location: Lichk settlement

Agenda:

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

2nd public discussions

Date: 03.04.2024, 17:00

Location: Meghri municipality

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: 06.06.2024, 17:00

Location: Meghri municipality

Agenda:

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

4th public discussions

Date: 03.09.2024, 16:00

Location: Meghri municipality

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 - Presentation of the Project objective and main components, - Environmental and social framework, - Initial consent of the affected community.					
Discussion moderator: Head of Meghri municipality The project was presented by: representatives of design company and EIA developers ('Modul' LLC and 'Consecoard' LLC)	26.12.2023 16:00	Residence of the administrative head of Lichk settlement, (Meghri community, Syunik Marz)	17 (2)	Head and deputy head of Meghri community, administrative head of Lichk settlement, representatives of "Consecoard" LLC, population	- What is the total volume of the reservoir, and does the team have any prior experience in constructing a similar facility? - Have local meteorological conditions been taken into account in the project's implementation plan? - What is the surface area of the reservoir? - Are the available regional water resources sufficient to fill and maintain the reservoir effectively? - It was proposed to take into account the potential seismic hazards of the area in the design and construction of the reservoir. - It was recommended to carry out regular cleaning and maintenance works on the reservoir. - It is important to implement measures aimed at reducing potential risks. - It was proposed to involve residents of the nearby settlement both during the construction and

Moderation and presentation	Date, time	The place	Number of participants (women)	Participants	Questions and suggestions raised
					operation phases of the reservoir. - How will issues related to land acquisition and safety be addressed? - It was proposed to hold further discussions in the Meghri municipality instead of Lichk settlement. *All concerns and questions raised were addressed by the representatives of the design and EIA companies.* ***Conclusion:** There were no objections from the participants, and the initiation and implementation of the project were welcomed.*
2nd public discussions - Key findings of the preliminary environmental impact assessment, - Draft Terms of Reference to be issued by the State Authorized Body (ME).					
Discussion moderator: First Deputy head of Meghri community The project was presented by: Representatives of the Environmental Impact Expert Examination Center (EIEEC), Project designer and EIA developer	03.04.2024 17:00	Meghri municipality, Meghri Community, Syunik Marz	15 (3)	Head and representatives of Meghri municipality, administrative head of Lichk settlement, representatives of the EIEEC, Project designer and EIA developer, population	- What are the preliminary data regarding the height of the reservoir dam? - Will excavation works also be carried out in the riverbed? - Is any blasting work planned? - Will there be any changes to the riverbed? - How will the environmental (ecological) flow be regulated? - Is the construction of a fish pass planned? - Will water be withdrawn from the dead storage volume

Moderation and presentation	Date, time	The place	Number of participants (women)	Participants	Questions and suggestions raised
					of the reservoir if necessary? - What technical standards will be applied to ensure the stability of the dam? - What types of land ownership exist within the reservoir basin? - Are there any Red Book listed flora and fauna species in the planned reservoir area and what measures are planned for their conservation? - Do the boundaries of the mine close to the planned reservoir area? - Is it possible to consider the construction of a hydroelectric power plant on the reservoir? - Have potential emergency situations been considered in the design? - What is the procedure for assessing and acquiring (alienating) land within the reservoir construction area? - Can water released from the reservoir be used by hydroelectric power plants? - Are any measures planned to improve water quality? - How will issues related to soil quality, as well as the removal and

Moderation and presentation	Date, time	The place	Number of participants (women)	Participants	Questions and suggestions raised
					preservation of topsoil be addressed? - What is the distance between the reservoir and the nearest settlement? *All concerns and questions raised were addressed by the representatives of the design and EIA companies.* ***Conclusion:** There were no objections from the participants, and the initiation and implementation of the project were welcomed.*
3rd public discussions - Key findings of the EIA studies, - Recommended mitigation and monitoring measures.					
Discussion moderator: First Deputy head of Meghri community The project was presented by: Representatives of the EIA developer	06.06.2024, 17:00	Meghri municipality, Meghri Community, Syunik Marz	15 (2)	Head and representatives of Meghri municipality, administrative head of Lichk settlement, representatives of EIA developer, population	- What is the distance between the reservoir dam and the North-South road as well as the Armenia-Iran gas pipeline? - What will be the total surface area and maximum depth of the reservoir? - What is the distance between the reservoir and adjacent lands that are not subject to acquisition (alienation)? - Will any modifications to the reservoir construction project be anticipated? - When is the construction work expected to begin?

Moderation and presentation	Date, time	The place	Number of participants (women)	Participants	Questions and suggestions raised
					All concerns and questions raised were addressed by the representatives of the design and EIA companies. ***Conclusion:*** *There were no objections from the participants, and the initiation and implementation of the project were welcomed.*
4th public discussions - Main outputs of the EIA report, - Feedback to the comments raised by the EIA process participants and stakeholders, - Draft environmental impact expert examination conclusion					
Discussion moderator: First Deputy head of Meghri community The project was presented by: Representatives of the EIEEC and EIA developer	03.09.2024, 16:00	Meghri municipality, Meghri Community, Syunik Marz	18 (4)	Head and representatives of Meghri municipality, administrative heads of settlements within Meghri community, representatives of the EIEEC and EIA developer, population	- Is juniper included among the tree species planned for planting? - Will the highway constructed within the North-South road project located near the reservoir, pose any potential issues? - How many ha of land are planned to be irrigated by the Meghri reservoir? - When is the design work expected to be completed? *All concerns and questions raised were addressed by the representatives of the design and EIA companies.* ***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

Prior to the consultations, the Consultant submitted an official letter to the head of Meghri community requesting socio-economic information and providing an introduction to the upcoming activities, including:

i) the Project and its components,
ii) current status of the Project implementation process,
iii) the scope of the environmental and socio-economic studies,
iv) potential land use limitations, land acquisition and compensation issues,
v) the list of officials and groups of Project Affected Persons (PAPs) to be consulted.

A consultation meeting with the Head, two Deputy Heads, and the Press Secretary of Meghri Municipality was held on 31 July 2024. In addition, a separate meeting was conducted with the Chief Specialist of the Urban Development, Land Use, and Property Management Division to discuss matters related to urban planning within the Meghri enlarged community, including construction permit issuance, land tenure procedures, and other related issues.

The main topics discussed with representatives of the Lichk municipality included: the overall socio-economic situation in the affected communities and rural settlements; planned socio-economic programs for the community as a whole and specifically for the affected rural areas in the coming years; the primary livelihood and income sources of the Project-Affected Persons (PAPs); the potential risks and benefits of the Project's implementation at both community and settlement levels; and the municipality's overall approach to the Project, which was positive.

With the support of the Head of Meghri municipality, a separate meeting was held on August 16, 2024, in the Lichk settlement with its administrative head. The discussion focused on the socio-economic situation in the settlement, the main activities and occupations of the population, the potential benefits for residents resulting from the Project's implementation, and land tenure issues. The response of the Lichk settlement to the Project was positive. The administrative head also supported the Consultant during interviews with residents who may be affected by the Project.

The agenda of the consultations held with residents of the Lichk community addressed a range of issues related to the village's socio-economic and environmental context, including:

- The total area of the settlement, types of land, and patterns of land use,
- Community engagement in the Environmental Impact Assessment (EIA) consultations and discussions, along with concerns regarding potential environmental impacts,
- Population dynamics, migration trends, primary occupations of residents, and the presence of vulnerable groups,
- Individuals likely to be affected by the Project's implementation, particularly in terms of economic displacement,
- Restrictions associated with protection zones around the planned reservoir area.

The overall attitude of representatives from the Meghri community and Lichk settlement toward the Project's implementation is positive. They believe the Project will generate temporary employment opportunities for local residents of enlarged Meghri community during the construction phase and create permanent jobs during the reservoir's operational phase.

7.5 Summary of Stakeholders Concerns, Questions and Recommendations

The questions and concerns raised by the participants during the public discussions have been summarized into four groups, as presented below:

1	**Technical and Design-Related Questions**
1.1	Technical characteristics of the reservoir and dam (e.g., capacity, surface area, dam height, etc.).
1.2	Technical standards to be applied to ensure the stability of the dam.
1.3	Have potential emergency situations been considered in the design, and which technical standards will be applied to address them?
1.4	Will there be any changes to the riverbed, including excavation works within the riverbed? Is any blasting work planned?
1.5	Can hydroelectric power plants (HPPs) utilize the water released from the reservoir, and is the construction of new HPPs planned based on this water release?
1.6	Is the construction of a fish pass planned?
2	**Environmental and Hydrological Aspects**
2.1	Have local meteorological conditions been considered in the project design?
2.2	Are regional water resources sufficient to fill and sustainably maintain the reservoir, and how will environmental flow be regulated?
2.3	Are any measures planned to improve water quality? How will the project address soil quality, including the removal and preservation of fertile topsoil in the project area?
2.4	Are there any animal or plant species listed in the Red Book present in the reservoir area, and what conservation measures are planned to protect them?
3	**Land Use, Ownership, and Safety Issues**
3.1	What forms of land ownership exist within the reservoir basin, and what is the procedure for assessing and acquiring (alienating) land in the construction area?
3.2	How will land acquisition and safety issues be addressed?
3.3	Do the boundaries of the existing mine in the area border the planned reservoir basin? What is the distance between the reservoir and the nearest settlement?
4	**Operational and Community Considerations**
4.1	Regular cleaning and maintenance of the reservoir were proposed.
4.2	Potential employment opportunities for residents of surrounding communities during the construction and operational phases of the reservoir project.
4.3	It was proposed that potential seismic hazards in the area be considered in the design and construction of the reservoir, with appropriate risk mitigation measures implemented.
4.4	Distance between the reservoir dam and the North-South Road as well as the Armenia-Iran gas pipeline as well as their potential cumulative impact?

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). Additionally RAP consultations will be carried out as part of the land acquisition process.

Two public consultation events are planned: one in Meghri Municipality and another in Yerevan, with the participation of relevant state authorities, NGOs, and other project stakeholders. Interested residents of Lichk Settlement, including vulnerable groups, as well as the administrative head, will be invited to participate in the public consultation. Where necessary, transportation will be provided. 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 Lichk 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 further updated through supplementary surveys and analyses conducted by the Consultant. These efforts were undertaken to align this ESIA study report with the requirements of the EBRD ESP and provisions of the applicable GIPs. This process helps ensure that the E&S information used for decision-making presents a comprehensive picture of the potential effects of the proposed Project, including issues of particular concern to affected groups and individuals. The methodology used for the 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 Lichk reservoir is not planned on transboundary water resources. The Lichk (Arevik) River is a tributary of Meghri River which in its turn is a tributary of Araks River. Hence, the reservoir will be built on a tributary of transboundary river.

The hydrological impact assessment[113] 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[114]. The main conclusion is that it is unlikely that the Project generates significant hydrological impacts.

In theory, the Lichk Reservoir could contribute to sediment impacts, as it is located furthest downstream. However, the flow ratio between the reservoir and the corresponding site (0.1%) indicates that any such impacts would be negligible. Therefore, it is highly unlikely that the project will have significant impacts on sediment load or soil stability.

The Lichk Reservoir study shows an absence of fish and aquatic habitats in the reservoir impounded rivers. Therefore, it is unlikely that the Project reservoir will result in impacts on fish resources and aquatic habitats.

A conservative evaluation of the planned reservoir' impacts has been made possible through basic hydrological modelling (SWAT+) and expert judgment. The assessment indicates that the Lichk reservoir is unlikely to have significant downstream 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.

[113]SLR Consulting. Armenia reservoirs Project: Transboundary Impact Assessment Report, Revision A, June 2025.
[114]Ibid

8.2.2 GET Assessment[115]

8.2.2.1 Introduction

The Project is assessed as aligned with the goals of the Paris Agreement[116] based on the directly financed methodology. Specific assessments for climate adaptation and climate mitigation have been undertaken for the Lichk 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[117]. 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

[115]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

[116]https://unfccc.int/sites/default/files/english_paris_agreement.pdf

[117]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 CO_2 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[118] / 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[119] (**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. This provides an overview of the climate hazards relevant at a national level in Armenia in addition to more specific trends in current and future climate conditions in proximity to the reservoir. A summary of the current and future climate conditions for Armenia is provided in **Table 8-1**.

[118]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

[119]*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 Armenia

Climate hazard	Baseline	Projected change[120]		
		2020-2039	2040-2059	2060-2079
Average temperature	↑ Between 1901 and 2020, the average surface air temperature in Armenia has increased from 7.67ºC to 8.41ºC, totalling a 0.74-degree rise. The average surface air temperature hit a peak in 2010 with a reading of 9.53ºC.	↑ For both the SSP2-4.5 and SSP5-8.5 scenarios average temperatures are projected to increase.		
Extreme high temperatures	↑ The average maximum surface air temperature for Armenia has increased from 13.56 ºC in 1901 to 14.33ºC in 2020, representing a 0.77ºC increase. The average maximum surface air temperature hit a peak in 2010 with a reading of 15.42ºC.	↑ For both the SSP2-4.5 and SSP5-8.5 scenarios the number of hot days is projected to increase.		
Extreme low temperatures	↓ The average minimum surface air temperature for Armenia has increased from 1.8ºC in 1901 to 2.51ºC in 2020, representing a 0.71-degree rise. The lowest annual average temperature recorded was in 1972 at -0.31ºC.	↓ For both the SSP2-4.5 and SSP5-8.5 scenarios the number of ice days is projected to decrease.		
Wildfire & Forest Fires	The wildfire hazard rating for Armenia is assigned as high with a greater than 50% change of encountering weather that could support a significant wildfire.	↑ Modelled projections indicate a likely increase in the frequency of fire weather in Armenia.		
Extreme wind	Data available on wind is limited, an average wind speed of 7.77m/s is reported for the top 10% of windiest areas in Armenia.	Changes in wind speed as a result of climate change are difficult to predict and are affected by high levels of uncertainty.		
Average precipitation	↓ Average annual precipitation for Armenia has decreased from 608.23mm to 550.28mm between 1901 and 2020. The average annual precipitation has fluctuated between 491 and 647mm before a steadier decline from 2007 onwards.	↓ For both the SSP2-4.5 and SSP5-8.5 scenarios the mean annual precipitation is projected to decrease.		
Heavy precipitation and flooding	River flood hazard and urban flood hazard ratings for Armenia are assigned as high, meaning that potentially damaging and life-threatening river and urban floods are expected to occur at least once in the next 10 years.	↑ For both scenarios, the maximum number of consecutive wet days and average largest 5-day cumulative precipitation are projected to increase.	↑ For the SSP2-4.5 scenario, the maximum number of consecutive wet days is projected to increase. ↓ For the SSP5-8.5 scenario, the maximum number of consecutive wet days is projected to decrease. ↑ For both the SSP2-4.5 and SSP5-8.5 scenarios, the average largest 5-day cumulative precipitation is projected to increase.	
Drought	The drought hazard rating for Armenia is assigned as low, meaning there is up to 1% chance droughts will occur in the next 10 years.	↑ The current low hazard rating for Armenia is projected to increase due to the effects of climate change.		
Erosion	Erosion rates are influenced by numerous factors including climate, land use change and terrain. A global map of countries' soil erosion indicates that compared to other countries, Armenia has lower erosion rates..	Changes in rainfall and temperatures as a result of climate change are projected to trigger occurrence of erosion. Due to the influence of other factors (such as terrain and land use change) on erosion, it is challenging to predict how erosion rates will change as a result of climate change.		

[120]Preparation of design and cost estimation documents for construction of Lichk reservoir in Syunik Marz of the Republic of Armenia, Explanatory Note, 2024

Climate hazard	Baseline	Projected change[120]		
		2020-2039	2040-2059	2060-2079
Mass movement[121]	The landslide hazard rating for Armenia is high meaning that there are conditions that contribute to making localised landslides a frequent 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.		

Step Two: Definitions of exposure of impacts to climate change

Table 8-2 outlines the definitions used to rate the exposure of the Lichk 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 assessment, the mass movement hazard is not considered further for the Lichk Reservoir.

Table 8-2. Exposure ratings for the Lichk 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 Lichk 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 Lichk Reservoir

Climate hazard	Sensitivity rating		
	Reservoir and Dam	Spillway	Guard house and instrumentation
Extreme high temperatures	Medium	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	Low	Low	Low
Erosion	Medium	Medium	Low

Table 8-4 outlines the definitions used to rate the sensitivity of receptors located downstream of Lichk Reservoir to relevant climate hazards and considering the potential impact that the Project will

[121]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

have on these downstream receptors. 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 Lichk 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
Erosion	Low	Low	Medium

Heavy precipitation and flooding

Design information for the Lichk Reservoir has been limited. There is also conflicting information on the spillway safety check flood referring to both a 1 in 1000-year return period and to a 1 in 10000-year return period. No evidence has been provided that climate change has been taken into account in the selection of the potential safety check floods.

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 Lichk 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 Lichk 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 Lichk 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	Low	Low	Low
Erosion	Medium	Medium	Low

Table 8-6 outlines the risk ratings for receptors located downstream Lichk 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 Lichk 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
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.

As part of the risk-based approach, undertake 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 report 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 assessment of upstream catchment and reservoir datasets.

Table 8-7. G-res data inputs for the Lichk Reservoir

Upstream catchment		
Catchment area	42.2	km^2
Population in catchment	911	persons
Catchment annual runoff	58	mm. yr
Landcover and mineral soils		

Upstream catchment					
Bare areas	0.82%	**Croplands**	8.21%	**Forest**	11.82%
Grassland/ shrubland	79.15%	**Settlements**	0%	**Waterbodies**	0%
River area before impoundment	10.8 km				
Area to be inundated by reservoir					
Climate zone	Temperate				
Reservoir area	30.0		ha		
Reservoir volume	3.93		MCM		
Water level	1560		masl		
Maximum depth	60.2		m		
Annual wind speed	2.0		m/s		
Mean air temperature	5.1		°C		
Reservoir					
Primary service	Irrigation				
Secondary service	Flood control		Environmental flow		
Earth removed	1500		m^3		

The outputs indicate the post-impoundment emissions rate of CH_4 as 12 tCO2e/yr and pre-impoundment emissions rate of CO2 as 12 tCO2e/yr (**Table 8-8**).

Table 8-8. G-res outputs for the Lichk Reservoir

Total net GHG footprint		
Total reservoir emissions per year	12	tCO2e/yr
Total reservoir emissions at year 1	101.7	tCO2e/yr
Total reservoir emissions at year 50	29.7	tCO2e/yr
Reservoir net GHG footprint by pathway		
Emission rate of which CO_2	12	tCO2e/yr
Emission rate of which CH_4	12	tCO2e/yr

GET assessment

Table 8-9 outlines the GET outcomes anticipated for the Lichk reservoir.

Table 8-9. GET Climate Resilience Outcomes (CROs) for the Lichk reservoir

GET Outcome	Valorisation of GET CRO[122]	CRO ratio (CRO/Capex)
Increased agricultural potential (€/year)	€24,998,78 [123] Excluding consideration of Capex	11.8%
Increased water availability (€/year)	€1,762,414	8.3%

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. 11.8% for the Lichk reservoir.

[122]Cumulative Results Overview

[123]Please note this figure accounts for the fact that in the absence of the project there would be an 11% reduction in agricultural potential by 2030 compared to baseline.

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 Lichk 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.

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[124] 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 total GHG emissions in the shape of CH4 from the planned reservoir at year 1 are estimated 101.7 tCO2e/yr, while at year 50 - 29.7 tCO2e/yr (**Table 8-8**).

8.2.4 Impact on Air Quality

Construction phase

During the construction stage the following activities / operations are considered as potential sources (stationary and mobile) of air emissions:

- Site clearance,
- Access road construction and temporary facilities setup,
- Excavation of reservoir basin and spillway channels,
- Dam construction (backfill and concrete works),
- Grading and compaction of soil,
- Loading, transportation and unloading of friable materials,

[124] Intergovernmental Panel on Climate Change

- Drilling works (for the installation of OTL pillars),
- Welding and painting works,
- 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[125] 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 g/sec and ton/year) from the reservoir construction activities are provided in **Table 8-10**.

Table 8-10. Calculated volumes of air emissions

№	Name of emitted substance	Emissions	
		g/sec	ton/ construction phase
1	Dust	10.29	160
2	Nitrogen dioxide	0.57	8.88
3	Carbon oxide	0.49	7.64
4	Hydrocarbons	0.113	1.76
5	Solid particles	0.058	0.9
6	Sulphur anhydride	0.054	0.84
Total		**-**	**180.02**

Approximately 89% of the total air emissions from construction activities consist of dust particles (PM2.5 and PM10). Instrumental measurements conducted within the Project site during the baseline data collection study (**Table 6-11**) indicate that PM2.5 and PM10 concentrations were approximately 4 to 10 times lower than the maximum permissible concentrations (MPC) established by both national environmental standards and IFC/WHO guidelines.

Given that the Project construction is expected to span 45 months, and assuming that appropriate mitigation measures outlined in **Table 8-12** are effectively applied, it is unlikely that peak dust emissions during the construction phase will significantly affect ground-level dust concentrations. A similar conclusion applies to gaseous emissions, which are also projected to remain within acceptable limits and pose minimal risk to ambient air quality.

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	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

[125]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
or chemicals in the surrounding environment.		ground-level ozone and other secondary pollutants.
Ammonia (NH_3)		
Ammonia can be emitted from water reservoirs, especially if the water quality is influenced by agricultural runoff or other sources of nitrogenous compounds.	Ammonia is often released as a result of the breakdown of organic nitrogen in the water. It can also evaporate from surface waters where nitrogen-rich fertilizers or waste runoff have been deposited.	Ammonia can be toxic to aquatic life at high 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 odour 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	N_2O emissions can result from the nitrification and denitrification processes, where nitrogen from agricultural runoff or wastewater undergoes	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

Source	Cause	Impact
nitrogen compounds are present.	biological transformations. This process often occurs under anaerobic conditions in sediment or water, producing N_2O as a byproduct.	amounts than methane, it still plays a role in climate change.
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, 2) Perform regular technical maintenance of used construction machinery and heavy vehicles, 3) Cover friable materials with tarpaulin during the transportation, 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, 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 with due regard to prevailing wind directions, 7) Apply regular dust suppressions on-site and off-site dirt roads, especially during the excavation and other earthworks, 8) Minimise the period between excavation and backfilling works, 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*** 1) Use modern construction machinery equipped with engines that comply with at least Euro IV standards, featuring emission control systems and low-noise characteristics, 2) Perform regular technical maintenance of all construction machinery, 3) If maintenance services are outsourced, contractors will be required to use modern, well-maintained equipment that complies with all applicable technical requirements. ***The following cost-efficient and technically feasible measures should be included in the tendering specifications, Project design documentation, reservoir operation and maintenance plans:*** 1) Installing aeration systems to oxygenate water and suppress anaerobic methane production, 2) Installing surface aerators or diffused air systems to increase dissolved oxygen, 3) Removing decaying vegetation, crop residues, or debris from the reservoir and inflows, 4) Keeping banks and inflow channels clear to reduce organic loading, 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 Project area is visible from the M2 road (**Figure 8-1**). The landscape is characterized by a narrow, lagoon-shaped valley through which the Arevik (Lichk) River flows. The valley is bordered by moderately to steeply inclined slopes that define the natural basin and will form the future reservoir's shoreline. This topography, together with the contrast between the river corridor and the surrounding uplands, creates a visually distinctive and dynamic landscape setting within the Meghri region. In the distance, above the projected water level of the planned reservoir, remnants of an

abandoned mine, pillars of the overhead transmission lines and residential buildings of Lichk village are visible.

Figure 8-1. View of the Project site from M2 highway

Figure 8-2. Aerial view of the Project area

The following activities will progressively alter the visual appearance of the Project area during the construction phase:

1) Removal of 2,300 trees from the site,
2) Excavation and other earthworks, including the stockpiling of topsoil, clay and gravel,
3) Construction of earthen roads linking the construction site with the stone borrow pit and various sections of the site,
4) Operation of construction machinery and the movement of heavy trucks,
5) Establishment of the construction camp, among other activities.

The Project area will be visible from the Lichk settlement, particularly its southern part, as well as to visitors and drivers traveling along the M2 highway. It will also be seen by local villagers who cultivate agricultural land around the reservoir and by the occasional shepherd using nearby grazing areas. While the visual impact on these groups is unavoidable, it will be temporary and limited to the construction period.

Another construction camp will be located near the stone borrow-pit and will require temporary landtake. This will not result in involuntary resettlement but 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. Any new permanent land acquisition, not know at this stage, will need to comply with RF and RPs.

According to calculations conducted during the national EIA study, 2,300 trees will be cut and 8,100 trees will be planted as a compensatory measure. This will be carried out in accordance with the Tree Management Plan, which will be prepared by the construction contractor and implemented toward the end of the construction phase.

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 steppe terrain, rivers flow and cultivated plots 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, 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 195 ha of agricultural land using reservoir water is expected to have an indirect positive effect on the visual amenity of the Project region by promoting greener and more cultivated landscapes.

The Project implementation may also have a positive impact on the cultural landscape. The orchards, vineyards and other cultivated land in the Project command area are an integral part of the combined rural vernacular, organically evolved and designed landscape.

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
Impact on natural landscape			
CONSTRUCTION PHASE			
Visitors, drivers, villages	Moderate	***Pre-construction phase***	Low

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
and shepherds of Lichk village		1) Develop Tree Management (TMP) and obtain approval from the affected community and Supervising engineer. ***Construction phase*** 2) Place construction machinery in less visible areas of the site, using topography or natural screening features to shield them from the M2 highway, Lichk village and other viewpoints, 3) Ensure that stockpiles of topsoil, clay, gravel or other materials are kept in designated areas and are covered or shielded to minimize their visual impact, 4) Regularly maintain a tidy construction site to avoid visual clutter, which can make the site appear more obtrusive, ***Post-construction phase*** 5) Plant 8,100 tree seedlings in areas designated in consultation with the head of Meghri municipality, and ensure their aftercare for a period of two years (aftercare may extend into the reservoir operation phase). 6) The proposed types of trees to be planted are: • *Quercus macranthera Fisch. et Mey.,* • *Quercus iberica Stev.,* • *Carpinus betuleus L.,* • *Acer hyrcanum Fisch. et Mey.,* • *Acer ibericum M. Bieb.,* • *Acer campestre L.,* • *Fraxinus excelsior L.,* • *Pyrus salicifolia Pall.,* • *Crataegus pentagyna Waldst. et Kit.,* • *Ulmus minor Mill.,* • *Celtis planchoniana K. I. Chr,* • *Malus orientalis Uglitzkich,* • *Populus nigra L.,* • *Salix excelsa S.G. Gmel,* • *Salix caprea L.,* • *Salix purpurea L.* • *Recommended tree species for planting:* • *Quercus macranthera Fisch. et Mey.,* • *Quercus iberica Stev.,* • *Carpinus betuleus L.,* • *Acer hyrcanum Fisch. et Mey.,* • *Acer ibericum M. Bieb.,* • *Acer campestre L.,* • *Fraxinus excelsior L.,* • *Malus orientalis Uglitzkich,* • *Prunus divaricate Ldb.,* • *Salix excelsa S.G. Gmel.,* • *Salix purpurea L.*	

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
OPERATION PHASE			
Population, visitors and drivers	Moderate	Ensure maintenance and aftercare of the planted trees for two years. *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.* *If well integrated with the natural landscape, the reservoir may contribute positively to the area's overall visual character.*	Low Can be positive (after 3-5 years)
Impact on cultural landscape			
Population, landowners, visitors, tourists	Neutral	***Construction and operation phases*** Consult the heads of affected settlements and landowners who will gain access to irrigation water as a result of the project implementation, regarding the design solutions for establishing orchards and vineyards based on modern cultivation and irrigation technologies. *This may transform the organically evolved cultural landscape, characterized by traditional vineyards and orchards, into a designed cultural landscape.*	Positive

8.2.6 Impact on Geology

Construction phase

The main impacts on the geological structure within the Project area are associated with various construction activities. These include: (i) vegetation clearance and the removal of topsoil, which may disturb surface stability and increase susceptibility to erosion; (ii) excavation and earthworks, involving the extraction, temporary storage, and reuse of materials such as sandy clay, gravel, cobble-pebble and tuff breccia, may alter the natural geomorphological balance; and (iii) soil erosion is expected within the construction footprint and in areas designated for the temporary storage of topsoil and spoil materials.

The impact of vegetation clearance and topsoil removal is minor and is unlikely to generate significant erosion processes as these works deal with the ground surface layer (up to 0.2 m) only.

Excavation and earthworks will involve the movement of a certain amount of ground materials (including sandy clay, gravel, cobble-pebble and tuff breccia), which may potentially trigger landslides, mass movements, and other erosion processes. Improper practices in the storage of topsoil and ground materials, particularly:

- Excessive height of stockpiles and steep slope gradients,
- Location of storage sites near watercourses and roads,
- Open storage without vegetation cover or protective sheeting,

can negatively affect the topography 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 geomorphology 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 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) Embankment erosion around the entire perimeter of the reservoir due to water encroachment during the initial years of operation.

Water infiltration aspects were examined as part of the Project's engineering-geological study (**Section 2.6**). According to this study, water infiltration losses from the dam foundation and adjacent bypass zones are estimated at 1,016,448.4 m^3/year, indicating the need for anti-infiltration measures. These measures are described in detail in the Project's design documentation.

The implementation of the proposed anti-infiltration measures is expected to reduce water infiltration losses from the reservoir to approximately 3,484.7 m^3/year, which falls within the acceptable range of losses.

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 processes during the early years of reservoir operation. These measures (**Table 8-14**) are optional, 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	1) Diversion ditches or berms: redirect surface runoff away from disturbed areas, 2) Proper grading: ensures slopes are stable and directs water flow in controlled paths, 3) Slope breakers: break long slopes into smaller segments to reduce erosion potential, 4) Phased construction: limits the area of exposed soil at any one time, 5) Avoid earthworks during rainy seasons, where feasible, to reduce erosion risk.	Low
Monitoring: - Regular site inspections: Especially after rainfall, to check for erosion signs and repair damaged controls, - Maintenance of sediment control measures: Ensure ditches, berms and drains are functioning properly.			
OPERATION PHASE			
Soil resources	Moderate	***Optional measures:*** 1) Bioengineering / Vegetative Measures - Planting native grasses, shrubs, and trees to stabilize soil through root systems and reduce erosion, - Biodegradable or synthetic mats that support vegetation growth while preventing initial soil loss. 2) Embankment Stabilization Measures - Placing layers of large, durable stones along vulnerable shorelines to dissipate wave energy and prevent erosion, - Sloped structures placed on banks to absorb and deflect the energy of incoming water. 3) Reservoir Operation Management - Gradually filling the reservoir to allow the slope soils to stabilize and minimize sudden saturation that can lead to collapse, - Avoiding large, rapid fluctuations in water level during early years to reduce destabilization of new shorelines. 4) Erosion Monitoring and Adaptive Management	Low Negligible (after 3-5 years of operation)

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		- 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.	
Monitoring: - Using drones, surveys, or satellite imagery to detect early signs of erosion and assess the effectiveness of mitigation measures, - Revising and enhancing embankment protection measures based on ongoing monitoring results, - 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

The analysis of water samples taken from the Arevik (Lichk) tributary of Meghri River in June 2024 within the national EIA study shows that the water quality meets the standards for Class 1 (Excellent) and Class 2 (Good) established by the RA Government Decree №75-N.

However, according to the data provided in the *2024 Bulletin on Surface Water Quality in the Republic of Armenia*[126], the water quality of the Meghri River was classified as 'poor' (Class 5) both upstream of Meghri town and at its mouth. The poor water quality observed upstream is primarily associated with elevated manganese (Mn) concentrations. At the river mouth, however, increased levels of manganese (Mn), cobalt (Co), and iron (Fe) are the principal pollutants. The elevated concentrations of Co and Fe near the river mouth are likely linked to discharges from Meghri town, whereas the high Mn levels upstream of Meghri are attributed to the naturally elevated manganese content in one of its tributaries (see **Section 6.5.1**).

Mining water and leachate from the tailings pond of the Agarak Copper-Molybdenum Combine have the potential to contaminate the Meghri River. However, these sources will not affect the Lichk Reservoir, as it will be located upstream of the Combine and its tailings pond. For the same reason, communal wastewater from the town of Meghri will also not impact the water quality of the reservoir.

During the construction phase, contamination of the Arevik (Lichk) tributary and the Meghri River may occur due to dust and exhaust emissions from construction machinery and heavy trucks, spills of hazardous materials, and improper management of storage areas. Surface water quality could also deteriorate as a result of soil erosion and runoff generated by rainfall or snowmelt.

[126] https://armmonitoring.am/public/admin/ckfinder/userfiles/files/texekanq/tarekan/Water%20report%202024%20-%20WEB.pdf

Earthworks, together with the improper handling, transportation, or storage of topsoil, loose construction materials, and oil products, as well as loading and unloading operations, may lead to pollutants entering nearby surface watercourses or infiltrating into groundwater, thereby degrading overall water quality. In addition, potential spills or leakages of oil and lubricants from construction machinery may be transported by runoff into downstream surface waters.

Removal of topsoil, excavation, and other earthworks will disturb soil and vegetation cover within the Project area, potentially triggering or exacerbating soil erosion. The resulting erosion could cause sediment to migrate into waterways through surface runoff, increasing turbidity and sedimentation and leading to further deterioration of surface water quality.

It is assumed that the implementation of mitigation measures outlined in **Sections 8.2.4**, **8.2.6**, and **8.2.8**, together with the additional measures proposed in **Table 8-15**, will significantly reduce the potential impacts of construction activities on water quality.

Operation phase

During the operation phase, water quality of the Arevik (Lichk) tributary of Megri River upstream 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 taken into account: soil erosion along the perimeter (shoreline) of the reservoir, particularly during the early years of operation, as well as stormwater and agricultural runoff into the river and reservoir must be minimized. In addition, any manmade inflows from domestic or mining activities[127] into the reservoir must be minimised.

8.2.7.2 Changes to Hydrological Regime

The following parameters are characterizing the hydrological regime of the reservoir:

1) Flow Regulation

Before the start of construction works, the Arevik (Lichk) River flows naturally with seasonal variations, with high flows during snowmelt or rainy seasons, and low flows during dry periods. After construction, the reservoir operation will regulate the 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.

[127] from the abandoned mine located upstream the reservoir

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 Arevik (Lichk) tributary of the Meghri 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, dam, irrigation offtake and channels. Calculations of water infiltration from the reservoir body and the dam, along with proposed anti-infiltration measures, 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 (3,484.7 m^3/year).

The irrigation water will be conveyed from the Lichk Reservoir to the Meghri gravity head along the Meghri River, a distance of approximately 13 km. During this transfer, around 1.0 mln. m^3 water losses will occur. Therefore, the construction of 13 km closed pipeline connecting Lichk Reservoir with the Meghri gravity head will annually save around 1.0 mln. m^3 water hence extending the irrigated agricultural land in Meghri enlarger community and enhancing resilience to climate change.

It is planned to convey irrigation water from the Lichk Reservoir to the Meghri gravity head along the Meghri River, covering a distance of approximately 13 km. During this transfer, about 1.0 mln. m^3 of water will be lost annually. The construction of a 13 km closed pipeline connecting the Lichk Reservoir to the Meghri gravity head will prevent these losses, saving approximately 1.0 mln. m^3 of water each year. This improvement will allow for the expansion of irrigated agricultural land within the Meghri enlarged community and strengthen the region's resilience to climate change.

Consequently, water losses from the irrigation system are expected to occur only in the event of incidents or technological breakdowns. This underscores the need for 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, Irrigation water users	Moderate	***Construction phase - Water Contamination*** 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, 2) Limit excavation and other earthworks near the Arevik (Lichk) tributary of the Meghri River during the rainy season, 3) Prohibit the discharge of any untreated wastewater effluent into surface water bodies, 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, ***Operation phase - Water Contamination*** 5) Minimize potential stormwater and agricultural runoff release to the Arevik (Lichk) tributary of the Meghri River through the following measures: - Identify all potential manmade inflows to the planned Lichk Reservoir arising from mining activities (including mine discharges and mine water) and nearby settlements, - Analyse potential discharges into the reservoir and assess whether these inflows could significantly deteriorate the quality of water intended for irrigation, - If required, construct a wastewater diversion channel along the upstream perimeter of the reservoir to prevent contaminated inflows from entering the reservoir body, - Negotiate with the mining company owners regarding the joint implementation of the proposed measures.	Low
Monitoring: According to the Air, water and soil quality monitoring plan			
OPERATION PHASE			
Water resources, irrigation water users, ecosystems	Significant	***Pre-operation phase - Hydrological Regime*** 1) Develop irrigation water and environmental flow releases management plan to: - Ensure reliable and efficient delivery of irrigation water to agricultural areas,	From moderate to low

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
downstream the reservoir		- Maintain minimum environmental flows to support the health of downstream aquatic and riparian ecosystems, - Prevent over-extraction and degradation of water resources, - Comply with national water use regulations and environmental protection standards. ***Operation phase - Hydrological Regime*** 2) 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, 3) 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: - Real-time monitoring to adjust schedules based on demand and supply conditions, - Monthly reports on water releases for irrigation and environmental purposes must be submitted to the Water Committee, - Regular ecological monitoring downstream to evaluate the adequacy of flow for habitat maintenance.			
Water resources, irrigation water users	Low	***Pre-operation phase - Water losses*** Develop Reservoir Operation and Maintenance Plan, ***Operation phase - Water losses*** 1) Carry out technical maintenance of the reservoir's supporting infrastructure to eliminate incidents and breakdown in accordance with the Reservoir Maintenance Plan, 2) Consider the opportunity to construct a 13 km closed pipeline connecting the Lichk Reservoir to the Meghri gravity head to prevent water losses, saving approximately 1.0 mln. m^3 of water each year.	Negligible

8.2.8 Impact on Soil

8.2.8.1 Topsoil Management

Construction phase

Construction works will commence with vegetation clearance and topsoil removal. According to the Project design study, approximately 25,205 m^3 of topsoil will be stripped from the construction site. Of this amount, about 10,705 m^3 will be used to cover the lower bief of the dam, while the remaining topsoil will be utilized for the reclamation of the stone borrow pit that will supply construction materials for the dam.

If not properly managed, the removed topsoil can be damaged through mixing with other ground materials, such as sandy clay, gravel, cobble-pebble, etc. Additionally, the topsoil may lose its physical and biological properties due to compaction by the construction machinery and heavy trucks

within the construction site. Losses may also occur during transportation to the temporary stockpile areas, as well as through wind and water erosion while in storage. Furthermore, the quality of the topsoil may deteriorate if the stockpiles are not properly maintained 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 from the construction site, as well as its transportation, storage, and reuse, shall be carried out by the construction contractor in accordance with the requirements of the above-mentioned documents and the supplementary mitigation measures outlined in **Table 8-17**. The stripped topsoil will subsequently be used for covering the lower bief of the dam and for the reclamation of the stone borrow pit. In addition, the construction contractor shall develop and implement a Topsoil Management Plan (TsMP).

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 Project design document, the materials to be excavated from the construction site namely sandy clay, gravel, cobble-pebble and tuff breccia will be used for the construction of the dam and reservoir body. Therefore, no spoil materials are expected to be generated, or the amount will be so minimal that it can be considered negligible.

Therefore, no permanent Spoil Disposal Areas (SDAs) are envisioned by the Project design document (see also **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).
5	Explosives	Blasting during reservoir construction.	High risk if not properly managed, requires strict storage and usage protocols.

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) and Blasting Safety Management Plan (BSMP). 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

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 8-3, a)**). Excavated topsoil shall be stored and managed in accordance with the procedures outlined in **Sub-section 8.2.8.1**.

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 8-3, b)**). 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 8-3. 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*** 1) Develop Topsoil Management Plan (TsMP) and obtain approval from the Supervising engineer, 2) Obtain required permit for topsoil transportation and storage operations,	Low

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		3) Develop Hazardous Materials Management Plan (HMMP) and obtain approval from the Supervising engineer, 4) Develop Spill Prevention and Management Plan (SPMP) and obtain approval from the Supervising engineer. ***Construction phase - Topsoil management*** 1) Carry out the removal, transportation, storage, and use of topsoil in accordance with RA Government Decrees №1396-N and №1404-N, 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, 3) Locate topsoil stockpiles at least 50 m away from watercourses to prevent water siltation, 4) Avoid placing topsoil stockpiles near planned excavation areas, 5) Limit the height of stockpiles to a maximum of 3 m, and ensure the slope gradient does not exceed 25º, 6) Clearly label all topsoil stockpiles to ensure easy identification, 7) Cover topsoil stockpiles to prevent soil erosion, where natural revegetation has not occurred, 8) Fence off topsoil stockpiles to prevent unauthorized access and compaction by Project vehicles, 9) Reuse the stored topsoil for landscaping the disturbed areas and/or tree planting within the Project area and vicinities near the end of the construction phase. ***Construction phase - Hazardous materials*** 1) Store all hazardous materials in clearly labelled, secure and ventilated areas, 2) Hazardous materials containers to be clearly labelled according to contents and hazards, 3) Equip sites with spill response kits and train workers on emergency response, 4) Maintain Material Safety Data Sheets (MSDS) for all hazardous materials on-site, 5) Incompatible hazardous materials must not be stored together, 6) Hazardous materials storage areas will be equipped with eye wash kits and fire extinguishers, 7) Use appropriate PPE. ***Construction phase - Soil contamination*** 1) Transport friable materials using trucks equipped with waterproof canvas covers,	

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		2) Store construction and other friable materials in separately designated areas that are fenced and covered with waterproof tents, 3) Store oil products and chemicals separately, in special drums or tanks placed on secondary containment systems or trays having 110% of the volume of the container, 4) Carry out refueling of oil, fuel, and other chemicals only in dedicated areas with impervious surface and equipped with protective berms, 5) Equip storage facilities for oil and chemicals, as well as heavy trucks transporting these materials, with appropriate spill kits, 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, 7) Train all staff on the safe execution of construction works and on response procedures for environmental incidents such as spills and leaks, 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 operational reservoirs to contractors who are equipped with modern, well-maintained equipment and have relevant experience and qualified personnel.	Negligible

8.2.9 Waste Generation and Management

Construction phase

Typically, the construction of the reservoir, dam, and associated components is accompanied by the generation of industrial and household wastes, including:

- 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.

According to the Project design document, around 50 m^3 of construction waste will be generated during the Project implementation phase. The main sources of the construction waste will be old and/or partially demolished structures that need to be dismantled and cleared from the construction site. These wastes can be disposed of in a landfill. The Consultant recommends that the construction waste generated by the Project be disposed of in the landfill proposed by Meghri municipality in the construction permit issued to the Project in accordance with the RA Government Decree 596-N[128] dated 19.03.2015 "On approval of procedure for issuance of permits and other documents with the purpose of construction in the Republic of Armenia".

However, in line with the waste management hierarchy, it is preferable, where technically feasible, to crush and reuse the construction waste as backfill material for dam construction or for the reclamation of the stone borrow pit. This approach is optional and should be considered by the construction contractor if deemed relevant.

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 140 workers (see **Section 2.7.8**) will be engaged in construction activities, it can be assumed that the monthly amount of household waste will be 18.25 × 140 = 2,555 kg (or approximately 2.55 tonnes). Over the entire construction period (45 months × 2.55 tonnes), around 114.75 tonnes of household waste will be generated and disposed of in the municipal landfill. 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[129]	Recommended management actions
1	Construction waste	IV	91200601 01 00 4	Use as a backfill material for the reclamation of the stone borrow-pit, the residual part will be disposed of in the landfill
2	Used oil and lubricants: - Industrial oil - Engine oil - Hydraulic oil - Diesel oil	III	54100205 02 03 3 54100201 02 03 3 54100213 02 03 3 54100203 02 03 3	Store under special conditions and transfer to the licensed companies specialised in oil refining
3	Oily rags	III	58200600 01 01 4	Store under special conditions and transfer to the licensed companies for the treatment
4	Soil contaminated with oil products	III	31402303 01 03 4	
5	Used tires	IV	57500200 13 00 4	Periodically transfer to the licensed companies for the treatment

[128] https://www.arlis.am/hy/acts/206688

[129] 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[129]	Recommended management actions
6	Used lead-acid batteries	II	92110100 13 01 2	Store under special conditions and transfer to licensed companies for the recycling
7	Ferrous metal scrap, empty metallic containers of fuel, oil products and chemicals	IV	35131100 01 00 4	Can be periodically transferred to specialised companies for the recycling
8	Welding electrode slag	IV	31404800 01 99 4	
9	Non-ferrous metal scrap: - Copper scrap - Aluminium scrap	III V (non-hazardous)	35310301 01 01 3 35310105 01 99 5	Can be transferred to specialised companies for the recycling
10	Used packaging materials: - Cardboard - Paper	V (non-hazardous)	18710202 01 00 5 18710300 01 00 5	Can be transferred to specialised companies for the recycling
11	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 **Sub-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 Lichk 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 Lichk Reservoir, most likely "Jrar" CJSC under the MTAI. Taking into account that "Jrar" CJSC also manages other first and second category reservoirs[130] 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*** 1) Obtain all required permits and normative documents regulating waste management in Armenia, as a minimum including: - hazardous waste passports, - waste generation norms, and their disposal limits, - waste generation register, etc., - waste primary registration log-books. 2) Prepare and put into effect the Waste Management Plan (WMP) for the Project. ***Construction phase - General*** 1) Train the workers engaged in waste management on provisions of the WMP, 2) Apply waste hierarchy approach (prevention, minimization, reuse, recycling, energy recovery, disposal) while implementing the construction activities, 3) Elaborate and implement waste handling procedures for the construction operations,	Low

[130] *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
		4) Equip the construction site and construction camps with the waste separate collection / storage containers and locations, 5) Furnish the waste storage / collection facilities with fences, fire extinguishers, secondary containment trays, oil and chemicals spill clean-up kits, etc., 6) Store liquid waste leak-proof, sealed containers. 7) Sign contracts with the licensed waste handling (recycling, treatment, disposal) companies to hand them over the generated wastes. ***Construction phase - Waste transportation*** 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, 2) Ban fly tipping waste on the route and/or their disposal in unauthorized locations, 3) Choose the routes involving the least risk for the transportation of waste from the area of its generation to its storage and recycling / disposal area, 4) Instruct the waste truck drivers on waste transportation safety rules, 5) Include waste transportation streams in the Traffic Management Plan (TMP). ***Construction phase - Household waste management*** 1) Equip the construction site with household collection containers / bins, 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			
OPERATION PHASE			
Workers of the reservoir operator	Low	1) Obtain all required permits and regulatory documents relevant to the operation of reservoirs in Armenia, as required by local waste-related legislation (can be done at the corporate level), 2) Develop and implement WMP for the operation and maintenance of the reservoir (can be done at the corporate level), 3) Apply waste hierarchy approach (prevention, minimization, reuse, recycling, energy recovery, disposal) for the generated waste, 4) Equip the site with 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, 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 phase 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 excavations, loading and unloading of soil and construction materials,
5) Blasting operations (if required).

The dominant routine source of noise from most construction equipment is the engine, which typically runs on diesel and may lack adequate muffling. However, in some cases, noise generated by construction processes may exceed that produced by the equipment itself. Noise levels during construction will vary depending on the specific activities, schedule, and combination of equipment in use.

Based on the noise emission levels of 90-100 dBA for excavators and bulldozers as well as in accordance with BS 5228-1:2009+A1:2014, WHO Environmental Noise Guidelines (2018) and the Control of Pollution Act 1974, a protection buffer zone of 100-250 m is recommended between such equipment and sensitive receptors (e.g., residential buildings, schools, hospitals). This distance helps ensure compliance with the 55 dBA daytime threshold, minimizing the risk of significant community noise impacts.

The BS 5228-2:2009+A1:2014 'Vibration Limits' standard provides specific recommended limits for Peak Particle Velocity (PPV) and the distances at which they should be maintained to protect buildings, structures, and human comfort.

Table 8-20. Table of Vibration Limits (BS 5228-2)

Receptor Type	Vibration Limit (PPV)	Distance (to maintain limit)
Residential Buildings	1.0 mm/s	30-50 m (depending on activity)
Sensitive structures (e.g., churches, monuments)	0.3 mm/s	50-100 m (depending on activity)
Non-Sensitive Buildings	3.0 mm/s	~100 m
Blasting	20-50 mm/s	100 - 200 m

As outlined in **Section 6.1.9** of this ESIA report, the nearest residential properties are located at the following distances from the Project site:

- 1.55 km in Lichk village,
- 2.6 km in Tashtun village,
- 4.3 km in Vank village,
- 6.0 km in Tkhkut village,
- 350 m - summer houses downstream the reservoir.

The nearest sensitive receptors are summer houses located 350 m from the reservoir dam. Given this distance, these receptors are unlikely to be impacted by noise or vibration emissions from the construction site. Additionally, construction vibrations are not expected to affect the seismic stability of existing buildings and structures.

However, it is recommended to inform the nearby population, as well as the shepherds and farmers using the surrounding land, about the scheduled blasting days and hours to minimize disruption.

Minor noise impacts may occur for residents of settlements along the M2 highway due to the transportation of construction materials. However, as the M2 highway is a part of the logistical route connecting Iran with Georgia, which already experiences heavy truck traffic, the Project's traffic is unlikely to constitute a significant increase.

It is clear that typical noise and vibration levels generated by construction equipment exceed the Threshold Limit Values (TLVs) set by national hygienic standards. As such, several mitigation measures should be implemented, including the provision of Personal Protective Equipment (PPE) for workers (**Table 8-21**). These measures, along with other mitigation strategies, will help minimize noise exposure for construction personnel.

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 8-21**.

Table 8-21. 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, habitats of summer cottages, shepherds and farmers	Moderate *(in case of blasting)* Low *(in case of operation of construction machinery)*	1) Keep all diesel-powered vehicles and equipment (such as generators and air compressors) at a high level of maintenance. This will particularly include the regular inspection and, if necessary, replacement of intake and exhaust silencers, 2) Machinery/vehicles that are used intermittently will be shut down or throttled back during periods when not in use, 3) Whenever possible: enclose noisy equipment, restrict non-stop operation of noisy equipment, avoid simultaneous operation of noise generating equipment,	Low

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		4) Avoid unnecessary idling times, 5) Minimising the need for equipment to reverse. This will reduce the frequency at which disturbing but necessary reverse warnings will occur, 6) Avoid unnecessary horn hooting from the used construction machinery, 7) Limit truck speeds - not to exceed 40 km/h, when driving through local community roads, 8) Inform residents of summer houses located downstream the reservoir dam of the schedule and duration of blasting operations, 9) Movement of heavy trucks along the communal roads (if any) will be strictly prohibited between 10 PM and 6 AM near residential areas.	
Construction workers	Moderate	In addition to the measures listed above: 1) Enforce the use of PPE and in particular, the protective devices capable to reduce the sound level at the ear to acceptable levels, 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			
OPERATION PHASE			
Maintenance workers	Negligible	No action required	

8.2.11 Traffic Impacts

Construction phase

Access to the planned reservoir area will be via earthen roads connected with the M2 highway without entering the nearby settlements. As a result, it is unlikely that the Project traffic will have a significant impact on the settlements within the Meghri enlarged community. However, it will contribute to increased traffic density along the M2 highway, which is already heavily used by freight trailers and heavy trucks transporting materials for the North-South road construction project. Therefore, it is proposed to develop a Traffic Management Plan (TMP), to be approved by the Supervision Engineer, the Client, and the relevant regional authorities, including the road police. The TMP will also address the placement of road safety signs and posters, cattle crossings (if necessary), and other relevant measures (see **Sections 8.3.2** and 8.**3.5**).

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 8-22**.

Table 8-22. Summary of traffic impacts and mitigation measures for the Project construction and operation phases

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Drivers traveling along the M2 highway	Significant	***Pre-construction phase*** 1) Develop a Traffic Management Plan, that will be approved by the Supervising engineer as well as relevant regional authorities and road police, 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 affected settlement. 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. *The TMP shall also cover measures outlined in Sections 8.3.2, 8.3.5 and 8.5.2.* ***Construction phase*** 3) Construct the access roads as envisioned in the Project design document, 4) Implement the Traffic Management Plan, 5) Train drivers of heavy vehicles on the key requirements of the Traffic Management Plan, 6) Inform local residents of anticipated construction traffic impacts at least two weeks prior to the start of construction and provide information about the Grievance Mechanism (GM), 7) Display the GM contact details on project vehicles, Equip roads used by Project vehicles with appropriate road safety signs and posters, 8) Provide additional crossings for cattle where necessary.	Low

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.

The impacts of the Project will occur within the footprint areas (dam and reservoir), temporary roads and sites (including construction roads, camps, and areas for storage of excavated topsoil, etc.), as well as within a potential zone of influence extending 500 m around the footprint areas. It should be noted, however, that noise impacts from blasting may extend several kilometres from the dam site and along the Lichk River valley.

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. In addition, the potential ecological consequences of blasting activities[131] have been evaluated to the extent possible.

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 (**Section 6.2**), 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 (vegetation clearance, excavation, top-soil removal and transportation, reservoir filling),
    - Flora species loss (vegetation clearance, including trees cutting, excavation, top-soil removal and its transportation, reservoir filling),
    - Disturbance of fauna species by blasting, 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 and large 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 breeding, foraging and wintering habitats of invertebrates and a risk of death of their overwintering stages (vegetation clearance, excavation, removal of topsoil and its transportation, reservoir filling),
    - 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 construction and flooding of the reservoir footprint area.

Some positive impacts on biodiversity 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.

[131]Blasting may be used to loosen the rocks; its application is not yet confirmed; nevertheless, potential impacts are included in this assessment based on a conservative approach.

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

Destruction (loss) of habitats

Currently, all habitats are undisturbed and are in their natural state. Land clearance, excavation, topsoil removal and blasting will completely destruct the habitats within the dam and reservoir footprint (with a total area of 28.1 ha according to the Project description)[132]. Initially, habitats will be destructed during clearance of the dam footprint area, followed by topsoil removal, blasting and dam construction. Subsequently, habitats located in the flooded part of the river valley will be lost during the reservoir filling.

Priority habitat of this area is the riverine habitat:

- G1.11 Riverine willow woodland (92A0 Salix alba and Populus alba galleries)[133].

  Lost area of the habitat is 5.29 ha.

The riverine habitat will be fully destructed by the reservoir filling; however, a similar habitat will restore along the reservoir coasts.

Flora species loss

Land clearance, excavation, topsoil removal and blasting will result in vegetation clearance in the same areas where habitats will be destructed (see above). According to the national EIA report, 2300 trees will need to be cut during the construction of the reservoir. There are 16 species of affected threes:

- *Quercus macranthera Fisch. et Mey.,*
- *Quercus iberica Stev.,*
- *Carpinus betuleus L.,*
- *Acer hyrcanum Fisch. et Mey.,*
- *Acer ibericum M. Bieb.,*
- *Acer campestre L.,*
- *Fraxinus excelsior L.,*
- *Pyrus salicifolia Pall.,*
- *Crataegus pentagyna Waldst. et Kit.,*
- *Ulmus minor Mill.,*
- *Celtis planchoniana K. I. Chr.,*
- *Malus orientalis Uglitzkich,*
- *Populus nigra L.,*
- *Salix excelsa S.G. Gmel.,*
- *Salix caprea L.,*
- *Salix purpurea L.*

There are no protected plant species (nationally or internationally) registered in the Project area.

[132]The actual area of the destructed habitats will be larger as habitats are located on the slopes of the river valley
[133]in brackets - code and name of habitat in accordance with Annex 1 of the EU Habitats Directive

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 four groups based on size and 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, such as predators, mainly canids and martens, and roe deer. The third group includes animals that are very rarely recorded in the area, such as Lynx and Indian crested porcupine. Lastly, the fourth group comprises flying mammals - bats. Several individuals were observed during the field survey but species were not identified. Bats appear to use the area along the river for foraging, and the presence of their shelters in the area cannot be ruled out.

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.

Other two mammal groups of temporary and rare visitors usually move away or avoid disturbance areas. Bats will also move away because the noise of the sonic spectrum has a deterrent effect on them[134].

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 caused by trees clearance, as well as 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[135, 136]. As a result, the dam footprint area and parts of the reservoir footprint area, and adjoined territories (about 500 m around) will be abandoned by most animals.

Blasting generates impact factors such as fly rocks, air pollution, ground vibration, and air blast, with their force intensity depending on the explosion power, soil composition, and geological structure. The first three factors manifest at a distance of up to several hundred meters. Since most animals in the dam area are expected to leave the area at the start of construction works[137], these impacts will not affect them.

[134]Domhnall Finch, Henry Schofield, Fiona Mathews, Traffic noise playback reduces the activity and feeding behaviour of free-living bats, Environmental Pollution, Volume 263, Part B, 2020, 114405, ISSN 0269-7491, https://doi.org/10.1016/j.envpol.2020.114405

[135]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

[136]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

[137]We assume that the blasting will not be part of the first / site preparatory stage of the works; otherwise, some animals may die as they will not have time to leave

Air-blast (sound wave) can extend up to several kilometres along the river valley, especially reflecting from the valley slopes. Accordingly, the most sensitive species, such as predators, will move even further away from the dam and reservoir area.

After blasting is completed, the construction process will involve dam filling, during which impact factors such as vibration, noise, dust, and lighting will occur. Since most animals will have already left the area by this time, these factors are expected to affect only an insignificant number of animal individuals.

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. Blasting may further impact any individuals that remained.

A similar negative impact may occur during the filling of the reservoir, as shelters could be flooded, resulting in death of most animals. Additionally, shelters of the Forest dormouse (*Dryomys nitedula*) located in trees may be destroyed during tree clearance within the reservoir area.

The following seven biodiversity values were identified among sedentary species:

Mammals

- Forest dormouse (*Dryomys nitedula*), CH,

Reptilia

- Pallas's glass lizard *Pseudopus apodus*, CH,
- Medium Lizard *Lacerta media*, CH,
- Smooth snake *Coronella austriaca,* CH,
- Transcaucasian rat snake *Zamenis hohenackeri*, PBF, RDB of RA, range-restricted species
- Armenian viper *Montivipera raddei*, PBF, RDB of RA, range-restricted species
- Darevskia raddei *Darevskia raddei,* PBF, range-restricted species

Amphibia

- Variable toad/ green toad *Bufo viridis*, CH (the flooded area will increase the periphery of the coastline and thus, will increase the habitat of the species).

The first mitigation step for the species, which are negatively affected by the construction, is the pre-construction survey in the dam and reservoir footprint areas to be held at the beginning (March-April) or end (September) of the species' activities season. Such survey allows to estimate an approximate number of individuals of each species and their locations.

It is recommended to begin planting indigenous species of wild plum and pear to compensate the habitat loss of the Forest Dormouse. Immediately before reservoir flooding, it is advised to capture as many individuals as possible and relocate them to the new habitats.

To compensate for the reduction of habitats for the six reptile species mentioned, it is recommended to create additional rocky outcrops near the flooded area, increase the number of native bush

species, and, prior to flooding, capture and relocated as many individuals of these species as possible. It is also suggested to introduce sustainable grazing practice in the areas that surround the planned reservoir, as the improved habitats quality can enhance food supply for the species, thereby supporting an increase in the population density of these snake and lizard species.

Permanent residents of the first group of mammals, as the badger and red fox, do use burrows; however, they can leave them when disturbed and relocate to other habitats. To prevent harm to these animals, it is necessary to relocate their burrows before the start of construction works 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 and large mammals

Animals belonging to two mammal groups (namely, temporary and rare visitors) are expected to move away or avoid the area once site clearance and construction activities begin. The primary deterrent factor is noise; for the Indian crested porcupine, vibration is also a significant disturbance.

The following four biodiversity values were identified among these groups:

- Wild Cat, *Felis silvestris* - CH,
- Gray wolf *Canis lupus* - CH,
- Lynx *Lynx lynx* - CH,
- Indian Creasted Porcupine *Hustrix indica* - PBF.

The first three species (Wild cat, Grey Wolf, and Lynx) pass through the area, and may occasionally hunt there. The development of the waterbird population at the filled reservoir might increase food availability for the Lynx. The Indian Crested Porcupine is very rare in this area, and it is unlikely that a den exists within the project area. There are no significant impacts predicted for these species, and, therefore, no mitigation measures are required. Nevertheless, to be sure no dens of these species are located in the area, the pre-construction survey is recommended.

Loss of breeding and foraging habitats for birds

From 81 identified species, 18 are assessed as the PBF according to the EBRD PR6 criterion 12: seventeen species as they are listed in the Resolution No. 6 of Bern Convention and Annex I of the EU Birds Directive, and one species, *Phylloscopus nitidus*, as regularly occurring range-restricted species (see the Baseline Chapter).

Due to the anticipated flooding of the territory, the loss of breeding habitats[138] is expected for the following numbers of the species (breeding pairs), protected under the Bern Convention (marked as Res 6):

1. Syrian Woodpecker *Dendrocopos syriacus* 1 pair (Res 6),
2. Wood Lark *Lullula arborea* 8-13 pairs (Res 6),
3. Red-backed Shrike *Lanius collurio* 5-7 pairs (Res 6).

The flooding of the reservoir will affect only the edge of the habitat of the sole recorded restricted-range species:

1. Green Warbler *Phylloscopus nitidus.*

[138]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.

The flooding will reduce the available individual breeding territories for the following numbers of species protected under the Bern Convention (marked as Res 6):

1. Eurasian Nightjar *Caprimulgus europaeus* 1-2 pairs (Res 6).

The impact on this species is expected to be negligible. Even if the breeding sites are located within the flooding zone, the species is anticipated to shift its breeding sites to areas above the reservoir. At the same time, the presence of the reservoir is expected to increase the population of dipterous insects, thus increasing the food supply for Eurasian Nightjar.

The flooding will not affect the majority of the large ranged and colonial species, protected under the Bern Convention and Red Book of RA:

1. European Honey-buzzard *Pernis apivorus,*
2. Bearded Vulture *Gypaetus barbatus,*
3. Griffon Vulture *Gyps fulvus,*
4. Egyptian Vulture *Neophron percnopterus,*
5. Short-toed Snake-eagle *Circaetus gallicus,*
6. Northern Goshawk *Astur gentilis,*
7. Long-legged Buzzard *Buteo rufinus,*
8. Lesser Spotted Eagle *Clanga pomarine,*
9. Booted Eagle *Hieraaetus pennatus,*
10. Golden Eagle *Aquila chrysaetos,*
11. Peregrine Falcon *Falco peregrinus.*

The absence of negative impacts is supported by the following: the area does not appear to play a critical role as a foraging range for these large-ranged species. Existing observations indicate that they use the area opportunistically rather than intensively.

Also, the flooding will not affect the migratory and wintering species, protected under the Bern Convention and the Red Book of RA, including those which make relatively high congregations during the migration:

1. Semi-collared Flycatcher *(Ficedula semitorquata*).

The absence of the negative impacts is justified by the following: the Semi-collared Flycatcher makes stopover points in the bushes along the river, and will similarly be able to use the vegetation along the reservoir shoreline for stopovers.

The following mitigation measures are suggested for the Priority Species:

1. Planting additional indigenous species of Poplar, Willow, and Walnut trees for the Syrian Woodpecker downstream of the Lichk reservoir site to provide additional breeding habitats for these species,
2. Consider introduction of sustainable grazing practices in Lichk community, which can improve the quality of grassland habitat, increase the number and diversity of invertebrates, and support the necessary food supply for the Wood Lark, Red-backed Shrike, and Red-billed Chough, thus increasing their population density,
3. Restore fragmented sections of the surrounding deciduous woodlands to increase the breeding habitats of some priority species, such as Green Warbler and Northern Goshawk.

If this an approach is approved, the following quantitative parameters[139] of the restored habitats should be taken into account:

1. Syrian Woodpecker *Dendrocopos syriacus*, additional 1-2 ha are needed,
2. Wood Lark *Lullula arborea*, the preliminary estimation is 1-2 ha of mosaic habitat, grasslands plus woodlands per breeding pair are required.
3. Red-backed Shrike *Lanius collurio*, the preliminary estimation is 1-3 ha of mosaic habitat, grasslands plus woodlands per breeding pair are required.

For the Green Warbler, the sole recorded restricted-range species, restoration of the fragmented forests in the vicinity of the reservoir could provide a suitable mitigation measure, preliminary considering 1-2 ha of forest habitat per breeding pair.

Accordingly, a total of approximately 26 ha of mosaic habitats for these species should be created or conserved along the reservoir shoreline and up the slopes, based on the maximum number of Wood Lark pairs and the required area per pair (13 pairs × 2 ha = 26 ha). These habitats should include forest plots with trees and shrubs, as well as rocky plots on the valley slopes that will remain unflooded. The required area may be partially or fully incorporated into the buffer/protection zone around the reservoir.

Loss of breeding, foraging and wintering habitats of invertebrates and a risk of death of their overwintering stages

The planned reservoir will partially destroy the habitats of five species – restricted-range (RR), included in the Resolution No. 6 of the Bern Convention (Res 6) and listed in the Red Data Book of the RA (RDB):

1. Thaleropis ionia (RR),
2. Euphidrias aurinia (Res.6),
3. Carabus hollbergi (RR),
4. Procerus scabrosus (RR, RDB),
5. Dorcadion leave (RR).

If the construction works start between May and August, the butterflies (the first two species) will leave the disturbed areas to find alternative sites for foraging and breeding, making it essential to create suitable habitats nearby. However, if the construction works start between October and April, the overwintering stages of the butterfly (caterpillar or pupa) maybe directly affected by the works, potentially leading to mortality.

The following mitigation measures are suggested for the Priority Species (including estimation of the net loss and development of the offsets:

1) Count the number of *Celtis sp.* trees that will be lost (i.e. estimate the net loss) and plant an equivalent number on the open slopes of degraded surrounding areas, to compensate for the habitat loss of *Thaleropis ionia*).
2) Quantify the lost grasslands and establish similar grassland areas within the mosaic and degraded surrounding areas to compensate for the habitat loss of *Euphidrias aurinia* and *Dorcadion leave*.

[139]These quantitative indicators are very preliminary and additional study will be required to clarify them

3) Quantify the woodland areas that will be lost and restore fragmented sections of the surrounding deciduous woodlands to increase habitats of *Carabus hollbergi* and *Procerus scabrosus*, thus compensating for their habitat loss.

4) Introduce sustainable grazing practices in Lichk community, that can improve the quality of grassland habitat.

Impact on protected areas and internationally designated areas

The "Arevik" National Park consists of several plots (fragments) with jagged edges; the reservoir site is located among the couple fragments of the National Park (**Figure 6-13**). Accordingly, we do not assume any direct impact on the plots of the National Park, excluding noise from construction work that may reach the nearest plot (300 m to the east), and from blasting that may reach both plots. But the reservoir site is bordered from the east by a partly disturbed area located between the two plots, including intercity and dirt roads, an open pit, and a settlement. Noise from the roads and open pit already scare away most of animals inhabiting in the national park, and construction work - particularly blasting - will exacerbate this impact.

The Arevik Candidate Emerald Site largely consists of a single territory encompassing fragments of the Arevik National Park. The reservoir site is located inside the Candidate Emerald site and bordered by disturbed areas to the east and north. To the west and south, however, forested mountains and rocky slopes form a continues native habitat together with the Lichk River valley.

The reservoir construction will change the eastern edge of this native area - the river valley. About 28 ha of native habitats will be lost due to the reservoir footprint. This includes 5.29 ha of the priority habitat G1.11 Riverine willow woodland (92A0 *Salix alba* and *Populus alba galleries*), which is one of the 34 habitats of the Arevik Candidate Emerald Site listed in Resolution No. 4 of the Bern Convention[140].

The reservoir site will expand already artificially altered area, which includes roads, an open pit and a settlement. This expansion will further contribute to the fragmentation of the Arevik Candidate Emerald Site.

The reservoir construction works will destroy animals' habitats and may be the cause of death of the sedentary species of mammals and reptiles. The lost habitats also serve as foraging areas for certain bird and mammal species; as a result, these species will avoid or leave the area during construction. The affected species and potential impacts are described in the relevant sub-chapters above.

Some of the eight bats species identified at the Emerald Site may potentially inhabit the reservoir area, and if so, their habitats could be impacted during construction. As there are no exact data on which bat species occur within the reservoir area (see **Section 6.2**), a targeted bat field study should be conducted during the pre-construction phase, from spring to early autumn, which corresponds to the bats' active season.

The reservoir area is located between two KBA/IBAs - Meghri IBA (9 km) and Zangezur IBA (5 km) (**Figure 6-15**). The potential impact on these areas is limited to the loss of foraging habitats for far-ranging bird species, particularly birds of prey. However, the Project area does not appear to play a critical role in their foraging, as existing observations indicate that these species use it opportunistically rather than intensively (see above sub-chapter 'Loss of breeding and foraging habitats for birds'). Therefore, this impact is considered minor or negligible.

[140] https://natura2000.eea.europa.eu/Emerald/SDF.aspx?site=AM0000014

8.2.12.3 Operation phase

Emergence of new habitats (water, riparian)

The flooding will create additional water and riparian habitats, which can be colonized by some water birds, as well as water invertebrates. Therefore, it can be expected that the bird fauna may be enriched with such species as Green Sandpiper *(Tringa ochropus),* and possibly some species of ducks.

Furthermore, additional foraging opportunities will be created for some of the existing Priority Species, such as:

1. Northern Goshawk *Astur gentilis,*
2. Booted Eagle *Hieraaetus pennatus,*
3. Peregrine Falcon *Falco peregrinus.*

Certain birds of prey from the Meghri and Zangezur KBA/IBAs will migrate to the new foraging habitats.

Increased access to the area

Increase in waterbird diversity and numbers can attract hunters; this is more likely because the Lichk settlement 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 on biodiversity during the construction and operation phases are summarized in **Table 8-23**. According to the mitigation hierarchy[141] 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 below.

Table 8-23. 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: Develop a Biodiversity Action Plan (BAP)[142] 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 the Riverine Habitats Construction Plan. 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*** 1) Study the Priority Habitat Features (PBF) in the Project area, its plant composition and ecological structure, and determine its precise extent,	Moderate (after offset - no net loss / a net gain)

[141]Guidance Notes to the EBRD PR 6 (March, 2023)
[142]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
		2) Develop a Riverine Habitats Construction Plan to guide the development, construction, and maintenance of the following priority habitat (PBF) along the reservoir banks: • G1.11 Riverine willow woodland (92A0 Salix alba and Populus alba galleries), *Preliminary quantitative assessment* *The total lost area of the riverine habitat G1.11 is 5.29 ha. The reservoir perimeter potentially suitable for riverine habitat creation is estimated at approximately 2 km. About 0.95 ha of the natural riverine habitat located downstream and upstream of the reservoir, within the protection/buffer zone outside that the flooded area, can be conserved. Taking these figures into account, to achieve "no net loss" (multiplier = 1), the width of the shoreline strip for the riverine habitat construction should be about 22 m ((5.29 ha - 0.95 ha) × 10000/2000=21.7 m). To achieve a "net gain", additional areas of natural riverine habitats should to be conserved downstream and upstream.* *Proposals for the construction and conservation of the habitats, including multipliers, should be developed in the BAP.*	
OPERATIONAL PHASE			
Habitats	No new impact, but the mitigation continues:	1) Implement the Riverine Habitats Construction Plan: construct and maintain the following habitat (PBF) along the reservoir's banks: • G1.11. Riverine willow woodland (92A0 Salix alba and Populus alba galleries).	-
Monitoring: according to the Riverine Habitats Construction Plan			
PRE-CONSTRUCTION AND CONSTRUCTION PHASE			
2. Flora	Significant	***Pre-construction phase*** 1) Study plant composition and structure of the priority riverine habitat, 2) Develop a Riverine Habitat Construction Plan using indigenous plant species as the basis for habitat creation, 3) Develop a Tree Management Plan (TMP). ***Construction phase*** 4) Plant 8100[143] trees and ensure their aftercare for a period of two years (aftercare may be carried out during the reservoir operation phase). The proposed[144] species of trees to be planted include:	Moderate (after offset - no net loss / a net gain)

[143]According to calculations conducted in the frames of the national EIA study, these trees shall be planted as a compensatory measure; there were used 1:1 ratio when cut tree trunk diameter (D) <10 cm and 1:5 ratio when D>10cm. Number of trees to be planted are 850 × 1 + 1450 × 5 = 8100. Total multiplier is 3.52 (8100/2300). Meanwhile, as the species to which the 2300 loosing trees belong are not priority species, “no net loss” and “net gain” approaches are not mandatory to be applied.
[144]Proposed in the national EIA study

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		- *Quercus macranthera Fisch. et Mey.,* - *Quercus iberica Stev.,* - *Carpinus betuleus L.,* - *Acer hyrcanum Fisch. et Mey.,* - *Acer ibericum M. Bieb.,* - *Acer campestre L.,* - *Fraxinus excelsior L.,* - *Malus orientalis Uglitzkich,* - *Salix excelsa S.G. Gmel.,* - *Salix purpurea L.* - *Prunus divaricate Ldb.*	
OPERATION PHASE			
Flora	No new impact, but the mitigation continues:	Construct and maintain the riverine habitat along the reservoir's banks based on indigenous plant species (see above - this Table, Section 1. Habitats).	Low
Monitoring: according to Riverine Habitats Construction Plan, TMP			
PRE-CONSTRUCTION AND CONSTRUCTION PHASE			
3. Fauna (other than those listed below)	Significant	***Pre-construction phase*** 1) Develop the Worker Code of Conduct for employees of the construction company to prevent poaching, 2) Survey the Project area to identify species of bats and, if present, their roosts (which may be found in trees, hollows, crevices, foliage, or caves) and estimate their numbers. If bat roosts are confirmed, identify existing forest and rocky habitats near the flooded area potentially suitable for bat roosting (first of all, within the reservoir buffer/protection zone). Construct bat boxes and install them on trees to enhance the habitat capacity for bats. ***Construction phase*** 1) Before beginning the construction activities (including tree cutting) and reservoir filling, use sonic-spectrum noise to scare away bats, monitor their resettlement, 2) From the start of tree cutting, monitor bats leaving the area and track their resettlement nearby, 3) Plan and commence construction works (including tree cutting) starting from one edge of the dam area progressing along the valley; this approach will allow animals to leave the area, 4) Begin the construction works before or after the breeding season - prior to April or after August; this will protect lives of animals, including offspring, 5) Limit explosive charges to the minimum required for construction works; implement all necessary safety measures during blasting to minimize the impacted area,	Low

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		6) Monitor compliance with the Worker Code of Conduct by the construction company workers to prevent poaching.	
OPERATION PHASE			
Fauna	Moderate	1) Develop the Worker Code of Conduct for the operator of the reservoir to prevent poaching, 2) Monitor compliance of the reservoir's operator with the Worker the Code of Conduct to prevent poaching during operations, 3) Monitor bats living around the reservoir area.	Negligible
Monitoring: according to the Biodiversity Management Plan			
PRE-CONSTRUCTION AND CONSTRUCTION PHASE			
4. Sedentary animals	Significant	***Pre-construction phase*** 1) Survey the footprint area to map local habitats and estimate the number of Forest dormouse and individuals of the Priority Species of lizards and snakes, 2) Identify existing forest and rocky habitats which are suitable for relocation of Forest dormouse, snakes, and lizards in the vicinities of the flooded area (first of all, in the reservoir buffer/protection zone). *Proposed season: late spring to early autumn (May to September)*, 3) Plant indigenous tree species (for example, wild plum and pear) to compensate for the loss of Forest dormouse habitats, 4) Create additional rocky outcrops in the vicinity of the flooded area to increase the number of native bush species to enhance habitats for snakes and lizards. 5) Survey the area to map inhabited burrows of badger and other burrowing animals. ***Construction phase*** 1) Before tree cutting in the reservoir area, inspect trees for Forest dormouse and priority species of lizards and snakes, capture any individuals found and relocate them to safe habitats identified during the pre-construction phase, 2) Before filling the reservoir, survey the site and capture as many individuals as possible, including Forest dormouse (if remained), snakes, and lizards, and relocate them to the safe habitats identified and/or arranged during the pre-construction phase, 3) Before filling the reservoir, inspect the mapped residential burrows of badger and other animals; if any individuals remain, capture them and relocate the to the safe habitats.	Low
OPERATION PHASE			

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
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 reptilians, thus supporting an increase in the population density of the protected snake and lizard species, 2) Maintain forest and rocky habitats which are habitats for relocation of Forest dormouse, snakes and lizards in the vicinities of the flooded area. *Preliminary quantitative assessment* *Total area of the buffer/protection zone is 30.15 ha. Agriculture lands and roads cover about 4,33 ha of the buffer zone. Also, at least 5.29 ha of the zone has to be arranged for construction of the riverine habitat (see above). Accordingly, there are 20.5 ha of native (forest, grassland and rocky) habitats in the buffer/protection zone remain that may be conserved for inhabiting Forest dormouse, priority species of lizards and snakes.* *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 (monitoring chapter)			
PRE-CONSTRUCTION AND CONSTRUCTION PHASE			
5. Medium and large mammals	Moderate	***Pre-construction phase*** 1) Survey the footprint area to confirm or rule out presence of Indian Crested Porcupine dens; if any den(s) are found, capture and relocate the animals to the safe habitats away from the reservoir area, 2. Survey the footprint area to confirm/deny presence of the dens of Wild Cat, Lynx, Gray Wolf; if such den(s) found, take measures to scare away animals from the reservoir area. *The both surveys should be conducted before or after breeding season.*	Negligible
Monitoring: according to the Biodiversity Management Plan			
PRE-CONSTRUCTION AND CONSTRUCTION PHASE			
6. Birds	Moderate	***Pre-construction phase*** 1) Plant additional indigenous species of poplar, willow, and walnut trees for Syrian Woodpecker downstream from the reservoir area to provide additional breeding habitats, 2) Restore fragmented parts of the surrounding deciduous woodlands to increase the breeding habitats of such priority species as Green Warbler and Northern Goshawk. *The spots should be included into the constructed habitats under the Riverine Habitats Construction Plan*	Low

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		and the conserved habitats within the buffer/protection zone. *<u>Preliminary quantitative assessment</u>* *The total area of the protection/buffer zone suitable for the constructed habitats under the Riverine Habitats Construction Plan and conserved habitats is approximately 26 ha.* *The minimum area (multiplier = 1) for compensation of the lost habitats of the priority bird species, based on a "no net loss" approach is also 26 ha (see sub-section Loss of breeding and foraging habitats for birds - above). Accordingly, the buffer area is sufficient to achieve "no net loss" outcome.* *To achieve a "net gain" outcome, additional area would be required.* *If sustainable grazing practices are applied in the grasslands surrounding the buffer area, they will help to maintain the necessary food supply for several priority species (see Operation phase).* *Two KBA/IBAs (Zangezur and Meghri) are located 5-9 km from the Project site and can be used for conservation of the additional areas necessary for the birds.* *Proposals for the use of constructed and conserved habitats within the protection/buffer zone, as well as for the conservation of additional habitats, including multipliers and related calculation, should be developed as part of the BAP.* ***Construction phase*** 1) Maintain the restored parts of deciduous woodlands.	
OPERATION PHASE			
Birds	No new negative impact, but the mitigation continues Positive impact could manifest	1) Introduce/support sustainable grazing practices in the Lichk community to improve the quality of grassland habitat, increase the number and diversity of invertebrates, and support the necessary food supply for Wood Lark, Red-backed Shrike, and Red-billed Chough, thereby contributing to a potential increase in their population density, 2) Maintain the restored parts of deciduous woodlands for at least the first two years of operation.	Low
Monitoring: according to the Biodiversity Management Plan			
PRE-CONSTRUCTION AND CONSTRUCTION PHASES			
7.Invertebrates	Significant	***Pre-construction phase*** 1) Count the number of *Celtis sp.* trees that will be lost, and plant an equivalent number on the open slopes of	Low

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		degraded surrounding areas, to compensate for the habitat loss of *Thaleropis ionia*, 2) Quantify the lost grasslands and establish similar grassland areas within the mosaic and degraded surrounding areas to compensate for the habitat loss of *Euphidrias aurinia* and *Dorcadion leave*, 3) Quantify the woodland areas that will be lost and restore fragmented sections of the surrounding deciduous woodlands to increase habitats of *Carabus hollbergi* and *Procerus scabrosus*, thus compensating for their habitat loss. *These habitats should be included in the constructed habitats under the Riverine Habitat Construction Plan, conserved habitats in the buffer/protection zone and restored habitats in areas surrounding the reservoir site.* ***Construction phase*** 1) Maintain developed habitats, primarily the species forage plants.	
OPERATION PHASE			
Invertebrates	Moderate	1) Introduce/support sustainable grazing practices in the Lichk community around the reservoir site, that can improve quality of grassland habitat, 2) Maintain developed habitats with the priority species forage plants.	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 closest settlement to the planned construction site is Lichk village of Meghri community. The distance between the planned construction site and Lichk village is 1.55 km. The residents might be positively impacted by the new employment opportunities during the Project construction stage, thereof increasing the households' income. Considering that the current population of Lichk village is low, limited employment opportunities in the Project is still expected to bring positive impacts.

Local and regional businesses may join the project supply chain - in areas including transportation, and provision of goods and services. It should be noted that relevant capacities and practices have already been established in the region during the implementation of large-scale road construction under the North–South Road Corridor project.

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

The Meghri Community Five-Year Development Plan[145] highlights the importance of a regular and reliable irrigation water supply in the local economy, namely to support gardening and agriculture in the community. Thus, the construction of the reservoir will positively affect agricultural productivity in the region. The proposed reservoir will service eight communities, providing irrigation for 1510.8 ha of land that currently generate 8,429.3 mln. AMD in gross agricultural output, predominantly consisting of vegetables, melons, orchards, and vineyards.

According to the economic and financial analysis[146], the Project demonstrates a strongly positive Net Present Value (NPV) over both the 20-year and 50-year horizons, even under the most pessimistic cost and benefit scenarios. The analysis also indicates considerable upside potential if project costs are lower or benefits exceed the assumptions used in the model. Furthermore, even with substantially reduced benefits or a 20% increase in costs, the Project would continue to exhibit favourable economic and financial performance indicators.

The Project is strongly supported by both community leadership and local population. Its implementation, particularly the accumulation of extra volume of water for irrigation will create new opportunities for landowners within the command area to cultivate additional agricultural land, diversify crops and increase agricultural production, thereby enhancing economic opportunities for the local community.

At the same time, residents engaged in agriculture are concerned regarding the high interest rates on agricultural loans and the limited access to consumer markets for agricultural products. Once the new highway, part of the North–South Road Corridor, connecting the settlements of the Meghri community with the Kapan administrative centre and the capital of the Republic of Armenia, Yerevan, is constructed, the local population will gain quicker access to regional markets across Armenia

8.3.2 Impacts on Public Facilities and Infrastructure

Construction phase

An additional pressure on local infrastructural facilities including power lines, roads, and healthcare facilities might occur due to the Project construction activities. A Traffic Management Plan should be developed, and transportation routes should be disclosed to the public.

Regarding the healthcare facilities, the medical centre in Lichk village has limited capacities, both in terms of the personnel and equipment, to serve the Project workforce. Therefore, Meghri Regional Medical Centre, located 25 km away from Lichk village, should be considered for emergency situations. In addition, the need for a constant presence of the ambulance at the construction site or an agreement with the Meghri Medical Centre to ensure emergency medical response availability

[145]Meghri Community Five-Year Development Plan for 2022-2026 available at https://meghri.am/Pages/DocFlow/Def.aspx?a=v&g=1995f779-cf46-4165-85f2-3c679c11701d
[146]Armenia Water Reservoirs - Technical, Economic and Green Due Diligence Gap Analysis, Draft Final Report, 2023-2024, Ove Arup & Partners.

shall be considered by the Project and construction contractor. This should take into account the 25-30 minutes ambulance response time.

Operation phase

The operation of the reservoir will have mixed impacts on public infrastructure. On the positive side, it will enhance water security and improve irrigation systems. However, it may also create negative effects by increasing pressure on local roads, electricity supply, and waste management services.

Impact assessment and mitigation measures

The assessment and mitigation of impact on public facilities and infrastructure as well as traffic impacts during the construction and operation phases of the reservoir are summarised in **Table 8-24**.

Table 8-24. Summary of impact assessment 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	***Pre-construction phase*** 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, ***Construction phase*** 2) Oblige the construction contractor to set up a medical post at least at one of the labour accommodation camps, 3) Consider the need for a constant presence of the ambulance at the construction site or sign an agreement with the Meghri Medical Centre to ensure emergency response when medical services are required for the contractor's workers.	Low
OPERATION PHASE			
Local and regional public facilities and infrastructure	Positive Low to Moderate	1) Maximise water use efficiency by introducing modern irrigation technologies (e.g., drip systems) promoted under the RoA Government Decree № 1695-L dated 14.10.2021[147] and commuciate with farmers about the benefits of drip irrigation benefits, including the government's financial compensation for water use payments when drip irrigation is adopted (to be organised by the WCRA and supported by the communities and regional authorities), 2) Encourage community participation in water user associations to improve governance, maintenance, and fair access to irrigation services.	Moderate
	Negative Low to Moderate	3) Conduct regular inspections and maintenance of access roads, power lines, and waste systems to anticipate and address infrastructure strain,	Low

[147] https://www.arlis.am/hy/acts/168164

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		4) Maintain embankments, spillways, and outlet structures to ensure controlled water releases and avoid downstream flooding that could damage public infrastructure.	

8.3.3 Land Tenure Impacts

Construction Phase

Estimated land needs for Lichk reservoir are 582,501.6 m^2, of which 17,490.5 m^2 (3%) is private land, 531,848.70 m^2 (91.5%) is community land and 33,162.40 m^2 (5.5%) - state land.

Lichk Reservoir will affect state, communal and private land and assets.

According to focus group discussions the majority of livestock graze on high-mountain pastures, while grazing in the planned reservoir area is only occasional. Therefore, the alienation of pasture land for the reservoir is not expected to have a significant impact on livestock farming. Additionally, no leased land plots are located within the reservoir territory. Beekeeping is not practiced in Lichk village. Some beekeepers reside in the rural settlements of Nrnadzor and Tashtun; however, these settlements are located at a considerable distance from the construction site and are unlikely to be affected.

Within the reservoir area, there are land plots currently used as pastures and hayfields; however, their size is insignificant compared to the total area of land to be alienated.

The assessment and mitigation of land tenure impact during the construction and operation phases of the reservoir are summarised in **Table 8-25**.

Table 8-25. Summary of land tenure impact assessment and mitigation measures

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION AND OPERATION PHASE			
Residents of Lichk village	Low	***Pre-construction phase*** Ensure that all users (if any) of the agricultural and pasture land to be withdrawn for the Project needs are provided with alternative land of equal or better quality for cultivation and cattle grazing as per the RF/RP.	Low to Negligible

8.3.4 Impact on Vulnerable Groups

The construction of the reservoir will have positive effect on the families' standards of living, including socially vulnerable households. The Project implementation will support food security in the households engaged in the subsistence agriculture and might enable accumulation of a larger surplus for sale. At the same time, the price of the irrigation services should account for the affordability to the low-income households.

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

The improvement of the irrigation system and construction of the reservoir will expand cultivated lands, increase agricultural income and contribute, to some extent, to poverty reduction in the community.

According to the women's focus group discussions, the construction of the reservoir will contribute to increase in the number of farms engaged in agriculture, increase household income, and improve overall living standard in the community.

Impact assessment and mitigation measures

The assessment and mitigation of impact on vulnerable groups during construction and operation of the reservoir are summarised in **Table 8-26**.

Table 8-26. 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, 2) Ensure that vulnerable households have access to the Project related information and RP implementation processes.	Low
Women	Low	3) Equal employment opportunities and payment for men and women should also be ensured during the Project construction stage.	Low
OPERATION PHASE			
Vulnerable households of the affected villages	Moderate	1) Implement subsidies or reduced fees for low-income households to access irrigation water or reservoir-related services, 2) Ensure transparent and equitable allocation of water to all farmers, prioritizing disadvantaged users, 3) Ensure emergency response plans explicitly consider vulnerable groups, including designated evacuation routes and assistance during floods or dam releases, 4) 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 reservoir construction, community health and safety may be affected by increased heavy vehicle traffic and machinery use, raising the risk of road accidents. Noise and dust from excavation and transport activities could cause respiratory discomfort and disturb daily life, particularly for

vulnerable groups such as children and the elderly. Open excavations, heavy machinery, and unsecured construction areas present physical safety hazards, while mishandling of fuels, oils, or construction materials may contaminate water and soil.

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

During the operation of the reservoir, public health and safety risks include potential waterborne and vector-borne diseases due to contamination of the irrigation system as a result of poor management or equipment failure. Furthermore, reservoirs present physical hazards - accidental drownings and injuries from the reservoir or irrigation channels, particularly for children or unauthorized visitors, due to deep water, steep banks, or slippery surfaces. Failures in dam structures or associated infrastructure could cause flooding, while poor water management may lead to odours or reduced water quality. These impacts pose risks to nearby communities, particularly children and other vulnerable groups.

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 8-27**.

Table 8-27. 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*** 1) Supplement the TMP (in addition to the measures proposed in **Sections 8.2.11** and **8.3.2**) with the following: - Optimised 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, - Identification of the sensitive receptors (schools, hospitals, residential areas, other social infrastructure) along the transportation routes and development of the mitigation measures where necessary, 2) Maintain machinery to reduce noise and limit work to daytime hours, 3) Screen worker influx for communicable disease and provide treatment, as appropriate, to reduce exposure to local population, 4) Secure construction zones with fencing, barriers, and warning signage. 5) Develop and implement Emergency Preparedness and Response Plan (*see **Section 8.4***).	Low

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		6) Inform local residents about construction schedules, risks, and safety precautions. ***Construction stage*** Implement Emergency Preparedness and Response Plan (*see* ***Section 8.4***).	
OPERATION PHASE			
Residents of the villages	Moderate	1) Monitor the technical conditions of the reservoir, provide timely maintenance, 2) Conduct community awareness campaigns on drowning risks, especially targeting children. 3) In case if heavy machinery or large number of vehicles is needed for the performance of the maintenance works, a Traffic Management Plan should be developed, accounting for the recommendation outlined above, 4) Conduct professional training for employees hired for the operation of the reservoir, focusing on their key roles and responsibilities, 5) Develop and implement an Emergency Response Plan (*see* ***Section 8.4***) for operation phase.	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, blasting operations (if this option is chosen), use of the construction machinery and equipment, and delivery of construction materials to the site. Exposure to dust, fuels, oils, and other hazardous materials can cause respiratory or skin problems, while temporary electrical installations pose electrocution risks. Additionally, manual handling of heavy materials, noise, vibration, and extreme weather conditions can affect worker health, but these risks are manageable with proper safety measures.

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,

- 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

If blasting operations are applied during the reservoir construction phase, Blasting Safety Management Plan shall be developed by the Construction contractor (see also **Sub-section 8.2.8**) to ensure that blasting is carried out safely, efficiently, and in compliance with legal and environmental standards.

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

During the operation of the reservoir, workers face occupational health and safety risks from exposure to waterborne pathogens while maintaining the reservoir and irrigation channels. Confined spaces, such as valves, culverts, or inspection tunnels, pose hazards including oxygen deficiency or toxic gas exposure. Maintenance activities may involve chemicals, mechanical equipment, and electrical systems, which carry risks of burns, injuries, or electrocution. There is also a risk of drowning or falls near the water or steep banks. With proper training, protective equipment, and safety procedures, these risks can be effectively managed.

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 8-28**.

Table 8-28. 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*** 1) Develop an Occupational Health and Safety Management Plan (OHSMP), covering the key elements of the OHS performance management during the construction stage, including: - Allocation of OHS roles and responsibilities - Identification of OHS risks and hazards, - Briefing, training and knowledge check, - OHS procedures and regulations, - Medical examination, - Emergency response, - Management of hazardous materials, explosive materials (if used), chemicals and oil / fuel, - Fire safety and emergency response, - Performance of high hazard tasks - Use of PPE, - Supervision of sub-contractors,	Low

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		- Investigation of safety accidents, - Responsibilities for non-compliance, etc. 2) Develop a Blasting Safety Management Plan (BSMP), including: - Roles and responsibilities, - Explosives management, - Blast design and planning, - Seasonal restrictions for blasting activities - Safety and exclusion zones, - Blasting procedures, - Monitoring and control. ***Construction phase*** 1) Implement the provisions of the Occupational Health and Safety Management Plan, 2) Conduct regular audits of the construction site to monitor the OHS performance of the contractors.	
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[148]).*			
OPERATION PHASE			
Workers performing technical maintenance	Moderate	1) Develop and implement OHS procedure/instruction for the maintenance and repair works, 2) Comply with the requirements of the relevant national OHS legislation.	Low

8.3.7 Workers' Rights and Working Conditions Related Impacts

Construction phase

Contractors should be required, through contractual clauses, to comply with national labour regulations and EBRD PR2. The compliance with the EBRD PR2 shall be included in the tendering documentation and contract with the construction contractor and its subcontractors. Worker practices on site should be monitored, including work schedules, shift durations, rest days, paid sick leave, and wages above the legal minimum. Conditions in labour accommodation camps should also be checked, covering freedom of movement, sanitation facilities, private space, and dining arrangements. Contractors must maintain a grievance mechanism for workers, including the option for anonymous complaints. Where necessary, the Project Implementation Unit (PIU) should extend its grievance mechanism to contractor workers, while responsibility for responding remains with the direct employer.

Operation phase

During the operation phase, workers' rights may be at risk due to informal employment, unfair wages, and long or irregular working hours. Workers may also face barriers to grievance reporting, union participation, career advancement, or equitable employment due to gender or disability bias.

[148]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.

Implementing formal employment contracts, regulated working hours, grievance mechanisms, equal opportunity policies, and training programs can help protect workers' rights.

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 8-29**.

Table 8-29. Summary of workers' rights and working conditions related impacts assessment and mitigation measures

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Project workforce	Moderate	***Pre-construction phase*** 1) Include requirements related to the compliance with the national labour regulations and EBRD PR2 in the contractual clauses with the Construction contractor, 2) Develop a Labour and Working Conditions Management Plan (at least a month before the construction) and implement it, including internal audits, 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 (No. 115), and gender-specific provisions. ***Construction phase*** 1) Set up and maintain grievance mechanisms available to all project workforce, including the opportunity for anonymous complaints, 2) 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.	Low
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.[149]).*			
OPERATION PHASE			

[149]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
Operation phase staff	Moderate	1) Ensure formal contracts for all workers specifying wages, roles, and duration of employment, 2) Implement regulated working hours with adequate breaks and rest periods, 3) Establish transparent grievance and complaint mechanisms for all staff, 4) Promote gender equality and inclusivity of persons with disabilities in recruitment, training, and promotion, 5) Provide regular training on operational procedures, safety, and skills development.	Low

8.3.8 Gender-Based Violence and Harassment

Construction phase

As one of the construction camps is planned within the boundaries of Lichk village, local women might be exposed to the risks and impacts from labour influx.

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 8-30**.

Table 8-30. Summary of GBVH impact assessment and mitigation measures

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Female residents of Lichk village	Moderate	***Pre-construction phase*** Develop GBVH Policy and assign focal points responsible for handling GBVH incidents within the workforce and external communities. ***Construction phase*** 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,	Low

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
		2) Maintain a grievance mechanism, which includes a specific mandate on GBVH, 3) Organize information and awareness raising campaigns for community members, specifically women and girls, 4) Provide information to communities on how to use the grievance mechanism to report GBVH issues.	
OPERATION PHASE			
Female residents of Lichk village	Moderate	1) Monitor access to the irrigation infrastructure following the Project completion to ensure that there is no gender-based discrimination occurs, 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. According to the World Bank's Good Practice Note on Dam Safety (2020)[150], such emergencies include uncontrolled water releases that threaten downstream life, property, or economic activities, as well as intentional or accidental water release and potential dam failure. For High Dams like the Lichk reservoir, an Emergency Preparedness Plan (EPP) and Emergency Response Plan (ERP) must be developed. The EPP should be prepared at least one year before reservoir filling and provide clear guidance on early emergency detection, classification, and response actions. It must also be coordinated with national and regional emergency management agencies and downstream communities to ensure effective preparedness and response.

For this Project, it is proposed to develop a comprehensive Emergency Preparedness and Response Plan (EPRP) that integrates the key provisions of both the EPP and ERP.

Operation stage

In addition, the World Bank's Good Practice Note requires an Operation and Maintenance (O&M) Plan for the reservoir. This plan should outline operational procedures, ensure structural dam safety through periodic inspections and dam safety reviews, and establish procedures for downstream notification and early warning.

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 8-31**.

[150]Good Practice Note on Dam Safety and Technical Notes (WB 2020). Available at: https://www.worldbank.org/en/topic/watersupply/publication/good-practice-note-on-dam-safety-new-guidance-on-managing-risks-associated-with-dams

Table 8-31. Summary of emergency situations impact assessment and mitigation measures

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Construction workers	Moderate	***Pre-construction phase*** Prepare site-specific emergency response procedures for incidents such as landslides, machinery accidents, or hazardous material spills. ***Construction phase*** 1) 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, 2) Implement Emergency Preparedness and Response Plan (*see also* ***Section 4.3.5***).	Low
Residents of the downstream communities	Moderate	3) Conduct Dam Integrity Risk Assessment, 4) 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 requirement of regular maintenance and emergency evacuation drills. 5) Establish traffic and access management plans to reduce accident risks for workers and local residents.	Low
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, 2) Protect workers by enforcing PPE use, confined space entry protocols, and safety training on electrical and mechanical hazards, 3) Develop and implement an Emergency Response Plan including early warning systems, evacuation routes, and periodic drills with local authorities and communities (both for staff and local residents), 4) Develop and implement an Operation and Maintenance Plan.	Low

8.5 Cultural Heritage Impact

8.5.1 Impact on Tangible Cultural Heritage

Construction phase

None of the seven cultural and historical monuments located in Lichk settlement and officially registered in the State List of Immovable Historical and Cultural Monuments of the Syunik Marz of the Republic of Armenia, fall within the Project's impact area (see **Section 6.4.1**).

Desktop studies, based on available archaeological reports, archival documents, publications and surveys conducted within the North-South Road Corridor Investment Program in the Lichk settlement and its surrounding areas have revealed the discovery of two newly identified late medieval (16th-17th century) bridges over the Meghri River. However, these structures will not be impacted by the Project's implementation.

Additionally, no historical or cultural features, or traces thereof, were documented during the field-archaeological survey of the Project area conducted in April 2024 by an expert team from the Institute of Archaeology and Ethnography, part of the RA National Academy of Sciences.

The conclusion is that the residual impact of the Project on cultural heritage sites will be negligible, provided that the mitigation measures outlined in **Table 8-31** are implemented.

Operation phase

No adverse impacts on tangible cultural heritage sites or units are anticipated during the Project's operational phase. On the contrary, the presence of the reservoir may generate positive synergistic effects by enhancing the area's attractiveness and potentially increasing visitor interest in the historical monuments located in the settlements of Meghri enlarged community.

Impact assessment and mitigation measures

The assessment and mitigation of the tangible cultural heritage impact during the construction and operation phases of the reservoir are summarised in **Table 8-32**.

Table 8-32. Summary of tangible cultural heritage impact assessment and mitigation measures

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Local communities, site visitors	Moderate	***Pre-construction phase*** 1) Hire a qualified cultural heritage expert from an authorized institution to be present during the construction works and implement archaeological surveillance for all construction sites, as well as to help implement all heritage focused mitigations and reporting to Client/Bank, 2) Prior to construction works, develop a Chance Finds Procedure (CFP)[151] for the Project and train the relevant workers in applying it (so that they can identify the chance finds, stop the works and notify the management); keep the training log up to date and include reporting on it in monitoring reports, ***Construction phase*** 1) Implement CHP, 2) Deliver regular briefing to all workers involved in implementing heritage focused mitigations.	From low to negligible

[151]A template of this procedure can be found in the 2023 EBRD's guidance note for PR8 at https://www.ebrd.com/documents/environment/guidance-note-performance-requirements-8-cultural-heritage.pdf. In addition, the regulations with regards to 'chance finds' are defined by the RA Law №HO-261 (1998) "On the protection and use of immovable historical and cultural monuments and historical environment". Particularly, according to Article 11 of the Law, if during the construction, agricultural and other works, the unknown historical and cultural monument/heritage is discovered, the above-mentioned works must be stopped and the authorized state body must be immediately informed by the local self-government bodies.

Receptor	Assessed Impact	Mitigation / management measures	Residual impact
OPERATION PHASE			
Local communities, 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 will not have any negative impact on intangible cultural heritage elements registered in both the UNESCO and national lists of ICH. During the construction phase, the local population of Lichk will need to plan celebrations such as Christmas, New Year, Easter, and Trndez, as well as weddings and baptisms, with consideration for increased traffic along the community roads as well as M2 highway. However, this impact is expected to be temporary and negligible provided that the provisions of the Traffic Management Plan are communicated with the local residents.

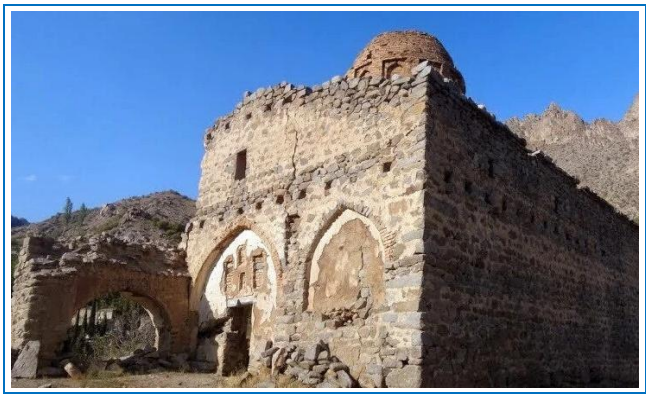
On the other hand, the settlements of Meghri enlarged community located close to the reservoir and along the M2 highway are rich in historical and cultural monuments (**Figure 8-4**). Therefore, the Lichk Reservoir could become a sightseeing destination alongside attracting not only the local population, but also visitors and cultural custodians arriving to Armenia to explore the country's rich heritage.

Additionally, elements of intangible cultural heritage, such as Lavash baking, duduk crafting and performance, and Armenian letter art with its cultural expressions, can be promoted to support the development of tourism and local trade in the Project region.

To enhance this potential, consultations should be held with the relevant staff of Meghri municipality, the administrative heads of at least Lichk, Vardanidzor, Tashtun, Vank, Kaler, Karchevan villages, as well as with local cultural NGOs, tourism organizations and other relevant stakeholders. These discussions should focus on the development of tourist routes that include visits to cultural heritage sites triggered by the availability of the Lichk reservoir visible from the M2 highway.

To maximize this potential, consultations should be conducted with representatives of the Meghri Municipality, the administrative heads of at least Lichk, Vardanidzor, Tashtun, Vank, Kaler, and Karchevan villages, as well as with local cultural NGOs, tourism organizations, and other relevant stakeholders. These discussions should focus on developing tourist routes that incorporate visits to nearby cultural heritage sites, capitalizing on the visibility and attraction of the Lichk Reservoir from the M2 highway.

Figure 8-4. Cultural and historical monuments in the area of Meghri enlarged community



Meghri castle

Church of the Holy Mother of God in Meghri town

Church in Vardanidzor village

Church in Tashtun village

Passenger bridge (officially registered historical monument) towards Vank and Kaler villages

Church in Karchevan village

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 8-33**.

Table 8-33. Summary of intangible cultural heritage impact assessment and mitigation measures

Receptors	Assessed Impact	Mitigation / management measures	Residual impact
CONSTRUCTION PHASE			
Local residents	Low	Communicate the provisions of the Traffic Management Plan to the population of Lichk rural settlement 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, heads of affected settlements	Neutral	Conduct consultations with representatives of the Meghri Municipality, the administrative heads of Lichk, Vardanidzor, Tashtun, Vank, Kaler, and Karchevan villages, as well as with local cultural NGOs, tourism organizations, and other relevant stakeholders. These consultations should focus on developing tourist routes within the Meghri community that include visits to cultural heritage sites, leveraging the visibility and attractiveness of the Lichk Reservoir to draw visitors.	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)[152], 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)[153], 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,

Step 5 - Assessment of significance for the predicted cumulative impacts,

Step 6 - Management of the cumulative impacts.

[152] https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/publications_handbook_cumulativeimpactassessment.

[153] 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).

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 the summer houses located closest to the reservoir dam, who could experience disturbances due to construction noise (especially from blasting),
  - Occasional visitors (namely, shepherds) of the vicinities of the Project sites affected by noise and vibration and visual effects of the construction works,
  - Residents along the roads used for transportation of construction materials and equipment to the Project sites, especially vulnerable groups, affected by the emissions and noise from heavy vehicles,
  - Residents of the affected villages, particularly the elderly and children, exposed to increased road safety risks related to Project-related traffic crossing through settlements during construction phase,
  - Local communities affected by the increased risk of exposure to diseases including socially significant diseases related to migrant worker influx during the construction phase,
  - Female residents of the villages exposed to security risks related to male migrant worker influx during the construction phase,
  - Local population exposed to safety risks related to use and storage of explosives at the reservoir construction site,
- **Irrigation water users** in the Project benefiting villages, who would be positively impacted by the sustainable supply of irrigation water for agriculture production.
- **Residents of the downstream communities** exposed to the risk of dam collapse and accidental flow release which will threaten downstream life and property.
- **Users of M2 highway** affected by the increased traffic density and increased risks of traffic accidents during the construction phase.
- **Construction workers** exposed to:
  - Occupational safety risks associated with:
    - performing high-hazardous works at the construction sites (earthworks, works at height, with high voltage, blasting, outdoors works in extremely hot weather conditions, works on or close to the open waterbodies, works with pressurized systems),
    - Handling of chemical and materials including hazardous ones (e.g. explosives) at the construction sites,
    - Risks of traffic accidents during construction phase.
  - Occupational health risks associated with:

  - 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.

- **Maintenance workers** during operation exposed to OHS associated with e.g. outdoors works at extremely hot weather conditions, works on or close to the open waterbodies,
- **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.
- **Candidate Emerald Site Arevik (AM 0000014),** since the reservoir site will expand already artificially altered area, which includes roads, an open pit and a settlement.
- **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 Arevik (Lichk) tributary and the Meghri River) in terms of:
  - Potential negative impact on the water quality from contaminated surface runoff, dust, and waste from the construction sites,
  - Positive impact on the river water quality downstream of the reservoir due to natural self-purification process during the operation phase,
  - Change of the hydrological regime of the Arevik (Lichk) tributary of the Meghri River once the reservoir is completed.
- **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 at construction sites and two construction camps,
  - Local healthcare facilities - by influx of migrant workers and potential increase in demand for medical services,
  - Roads comprising the main Project transportation route - M2 highway, and an earthen road from Lichk village to the reservoir construction site - 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,
- Users of the pastureland withdrawn for the Project needs,
- Wildlife / flora of the Project site during operation phase,
- Groundwater resources,
- Tangible and intangible cultural heritage.

The CIA **spatial boundaries** are assumed to coincide with the boundaries of Syunik Marz.

The CIA **temporal boundaries** are assumed to include Project construction and operation phases. The estimated duration of the construction phase is 45 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. **Associated facilities (**see **Section 2.8** for details):
   - 1.1 A power supply line which will service the operational reservoir and its components. At the time of this assessment, neither the connection point to the power grid nor the route of the proposed power line had been determined.
2. **Concurrent projects in the Project area:**
   - 2.1 North-South Road Corridor Project, Sisian-Kajaran, Kajaran-Agarak road sections.
   - 2.2 Construction of Customs and Logistics Centre in Shaki village, Syunik Marz.
   - 2.3 Planned mining projects in the town of Meghri: geological research works at Meghri sand-gravel mixture mine (EIA report dated April 2024), and mining of Meghri diorite and quartz diorite deposit (EIA report dated October 2023).
3. **Local and regional development projects/programmes:**
   - 3.1 Meghri Community Five-Year Development Plan for 2022-2026.
   - 3.2 Resilient Syunik Program, which foresees investments in the drinking water, health and education infrastructure in the Marz.

3.3 Recovery, Resilience, Development for Syunik project (R2D Syunik), Component 2 focused on small-scale infrastructures that are within the domain and responsibility of local (regional) communities.

The power line will be built during the Project construction phase to be ready for the start of Project operation. Therefore, there will be both spatial and temporal overlaps between the Project and this associated activity. Implementation of the North-South Road Corridor Project may have both spatial and temporal overlaps with the Project (both road sections are implemented in Syunik Marz, with Kajaran-Agarak section directly affecting Lichk, Lehvaz, and Meghri settlements among others).

The planned construction of Customs and Logistics Centre in Shaki village, which was announced in mid-2025 may have temporal overlaps with the Projects. Construction and reconstruction of social and communal infrastructure in Syunik under the local and regional development projects and programmes can have temporal overlaps with the Project, while the spatial overlap cannot be identified since specific locations of infrastructure objects / sites have not been announced.

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, construction of the associated facilities (power lines), 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 across all Project facilities and the route of the proposed power line, except for those related to road safety.
  - Cumulative adverse impacts resulting from dust emissions from the construction site combined with dust generated by mining activities,
  - Cumulative adverse impacts on fauna, including invertebrates, sedentary animals, birds and large mammals, resulting from disturbance, destruction of foraging and/or breeding habitats as a result of construction works.
  - Impacts on internationally designated protected areas, namely the Candidate Emerald Site Arevik.
  - Cumulative adverse impact on the water quality of the Arevik (Lichk) tributary of the Meghri River due to surface runoff from the reservoir construction site, the planed power line route, and potentially from concurrent infrastructure development projects.
  - 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:

- Impact on local communities, in particular residents whose houses are located along delivery routes during construction phase due to potentially significant combined traffic increase, causing air pollution and noise.
- 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 for skilled, semi-skilled, and unskilled construction labour.
- 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

The operation of the Project will coincide with that of the North-South Road Corridor, with the primary cumulative impact arising from combined traffic of road users and reservoir maintenance vehicles, causing noise and disturbance and increasing risk of road accidents.

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 Lichk Reservoir is planned to be fed by the Arevik (Lichk) tributary of the Meghri River, which is the main watercourse in the Project area and, in turn, a tributary of the Araks River. A conservative assessment of the reservoir's potential impacts, conducted using basic hydrological modelling (SWAT+) and expert judgment, indicates that the Lichk Reservoir is unlikely to have any significant downstream impacts. This conclusion is primarily based on the reservoir's upstream position relative to existing lakes and reservoirs, as well as the relatively small size of the rivers it will impound.
2) 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 101.7 tCO2e/year, while at year 50 - 29.7 tCO2e/year.
3) Approximately 89% of total air emissions from construction activities are expected to consist of dust (PM2.5 and PM10). Based on air emission calculations, the maximum dust emission rate during the construction phase is estimated at 10.29 g/s, which is unlikely to cause a significant increase in ground-level particulate concentrations within nearby residential areas. 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 generated by construction machinery and operations, are not expected to adversely affect the local population. However, some minor negative impacts on workers employed by contractors at the construction site 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.
4) The Project area will be visible from the M2 highway to visitors and drivers traveling along the road as well as from the Lichk settlement, particularly its southern part. It will also be seen by local villagers who cultivate agricultural land around the reservoir and by the occasional shepherd using nearby grazing areas. While the visual impact on these groups is unavoidable, it will be temporary and 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. The main impacts include: Permanent change in land cover, New visual elements, Potential aesthetic value and Landscape alteration. 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.

5) None of the seven cultural and historical monuments located in the Lichk settlement and officially registered in the State List of Immovable Historical and Cultural Monuments of Syunik Marz of the Republic of Armenia fall within the Project's impact area. Furthermore, additional desktop and field archaeological surveys conducted in and around the Project area in April 2024 by a team of experts from the Institute of Archaeology and Ethnography of the National Academy of Sciences of the Republic of Armenia confirmed that no historical or cultural features, or traces thereof, were identified within the surveyed zones.

6) The implementation of the Project will not have any negative impact on intangible cultural heritage elements registered in both the UNESCO and national lists of ICH. The settlements of Meghri enlarged community located close to the reservoir and along the M2 highway are rich in historical and cultural monuments. Therefore, the Lichk Reservoir could become a sightseeing destination alongside attracting not only the local population, but also visitors and cultural custodians arriving to Armenia to explore the country's rich heritage.

   Project implementation may also have a positive impact on the cultural landscape. This may transform the organically evolved cultural landscape, characterized by traditional vineyards and orchards, into a designed cultural landscape.

7) Excavation and earthworks involve the movement of certain amount of sandy clay, gravel, cobble-pebble, topsoil, etc. 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. These impacts necessitate the implementation of appropriate mitigation measures.

8) 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 3,484.7 m^3 per year.

9) During the construction phase, pollution of the Meghri River or its Arevik (Lichk) tributary 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 Arevik (Lichk) tributary. While these changes can improve water availability for irrigation, they may reduce streamflow to downstream ecosystems and affect groundwater dynamics. To mitigate adverse effects, the implementation of an irrigation water and environmental flow release management plan is recommended.

10) A total of 25,205 m^3 of topsoil will be removed from the area designated for the reservoir, dam, and supporting infrastructure. Of this volume, 10,705 m^3 will be used to cover the lower bief of the dam, while the remaining 14,500 m^3 will be used for the reclamation of the stone borrow pit.

Approximately 1,020,397.1 m^3 of stone will be transported from the stone borrow pit, located about 5 km from the Project site, and used in the construction of the dam.

A total of 2,916,253.6 m^3 of ground material, consisting of sandy clay, gravel, cobble-pebble, tuff breccia, and other materials, will be excavated from the area allocated for the reservoir, dam, and supporting infrastructure. The majority of these materials will be used for the construction of the reservoir dam and body, while the remaining 468,131.8 m^3 will be used for the remediation of the stone borrow pit.

11) The negative impacts on biodiversity occur mainly during the construction phase; they are caused by the dam construction and flooding of the reservoir footprint area. Some positive impacts on biodiversity 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) 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. Blasting may further impact any individuals that remained.

    Permanent residents of the first group of mammals, as the badger and red fox, do use burrows; however, they can leave them when disturbed and relocate to other habitats. To prevent harm to these animals, it is necessary to relocate their burrows before the start of construction works and monitor if the animals vacate them; if they do not, special measures to safely drive them away should be implemented.

13) Five habitats were identified according to the habitat classification for Armenia. Of the five identified habitats, Armenian habitat G1.11 Riverine willow woodland = 92A0 *Salix alba and Populus alba galleries* is assessed as the Priority Biodiversity Feature according to the EBRD PR 6 criterion 12-i as it is listed both in the Resolution No. 4 of the Bern Convention and Annex I of the EU Habitats Directive. Potentially lost area of the habitat is 5.29 ha.

14) The "Arevik" National Park consists of several plots (fragments) with jagged edges; the reservoir site is located among the couple fragments of the National Park. Accordingly, any direct impact on the plots of the National Park is not expected, excluding noise from construction work that may reach the nearest plot (300 m to the east), and from blasting that may reach both plots.

15) The reservoir site is located inside the Arevik Candidate Emerald site consists of a single territory encompassing fragments of the Arevik National Park. The reservoir site will expand already artificially altered area, which includes roads, an open pit and a settlement. This expansion will further contribute to the fragmentation of the Arevik Candidate Emerald Site.

16) The reservoir area is located between two KBA/IBAs - Meghri IBA (9 km) and Zangezur IBA (5 km). The potential impact on these areas is limited to the loss of foraging habitats for far-ranging bird species, particularly birds of prey. However, the Project area does not appear to play a critical role in their foraging, as existing observations indicate that these species use it opportunistically rather than intensively. Therefore, this impact is considered minor or negligible.

17) The Project impacts on the socio-economic receptors of the Project area are mostly positive during both construction and operation phases. The residents of Meghri community might

be positively impacted by the new employment opportunities during the Project construction phase, thereof increasing the households' income. The residents and local businesses will have an opportunity to be engaged in the service sector, namely meal preparation and delivery, as well as housekeeping and other services. Local and regional businesses may join the project supply chain - in areas including transportation, and provision of goods and services.

18) Reliable water supply from the Lichk Reservoir will incentivise farmers to invest in modern irrigation systems and water-saving technologies, making the irrigation system more sustainable. In addition, stable water availability will lead to cultivation of additional land, diversification of crops, increase of agricultural produces thereby enhancing economic opportunities for the local community.

19) The construction of the reservoir will have positive effect on the families' standards of living, including socially vulnerable households. The Project implementation will support food security in the households engaged in the subsistence agriculture and might enable accumulation of a larger surplus for sale.

20) Seventy-five land plots covering a surface area of 582,501.60 m² will be affected in Lichk settlement as a result of the Project implementation, including: 7 private land plots totaling 17,490.50 m^2, 58 community land plots totaling 531,848.70 m^2 and 10 state land plots totaling 33,162.40 m^2. Within the reservoir area, there are land plots currently used as pastures and hayfields; however, their size is insignificant compared to the total area of land to be alienated.

21) Physical factors such as air and noise emissions, soil contamination, and wastewater discharge are unlikely to affect the health and safety of Lichk village residents. 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.

22) 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.).

23) 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.

24) The Cumulative Impact Assessment prepared for the Project did not identify any cumulative impacts of moderate or high adverse significance.

25) 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 shall 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** – Meghri municipality, administrative head of Lichk rural settlement.

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 / 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,
- Tree Management Plan,
- Topsoil Management Plan,
- Hazardous Materials Management Plan,
- Blasting Safety Management Plan,
- Spill Prevention and Management Plan,
- Waste Management Plan,
- Occupational Health and Safety Management Plan,
- Labour and Working Conditions Management Plan,
- Construction Camp Management Plan, including Sub-plans for Camp Code of Conduct and Camp Management,
- Worker Code of Conduct,
- Local Employment and Procurement Plan,
- Emergency Preparedness and Response Plan,
- Borrow Pit Management Plan,
- Riverine Habitats Construction Plan,
- Chance Find Procedure,
- Air, Water, and Soil Quality Monitoring Plan,
- Noise and Vibration Monitoring Plan.
- Resettlement Framework and Resettlement Action Plan.

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:

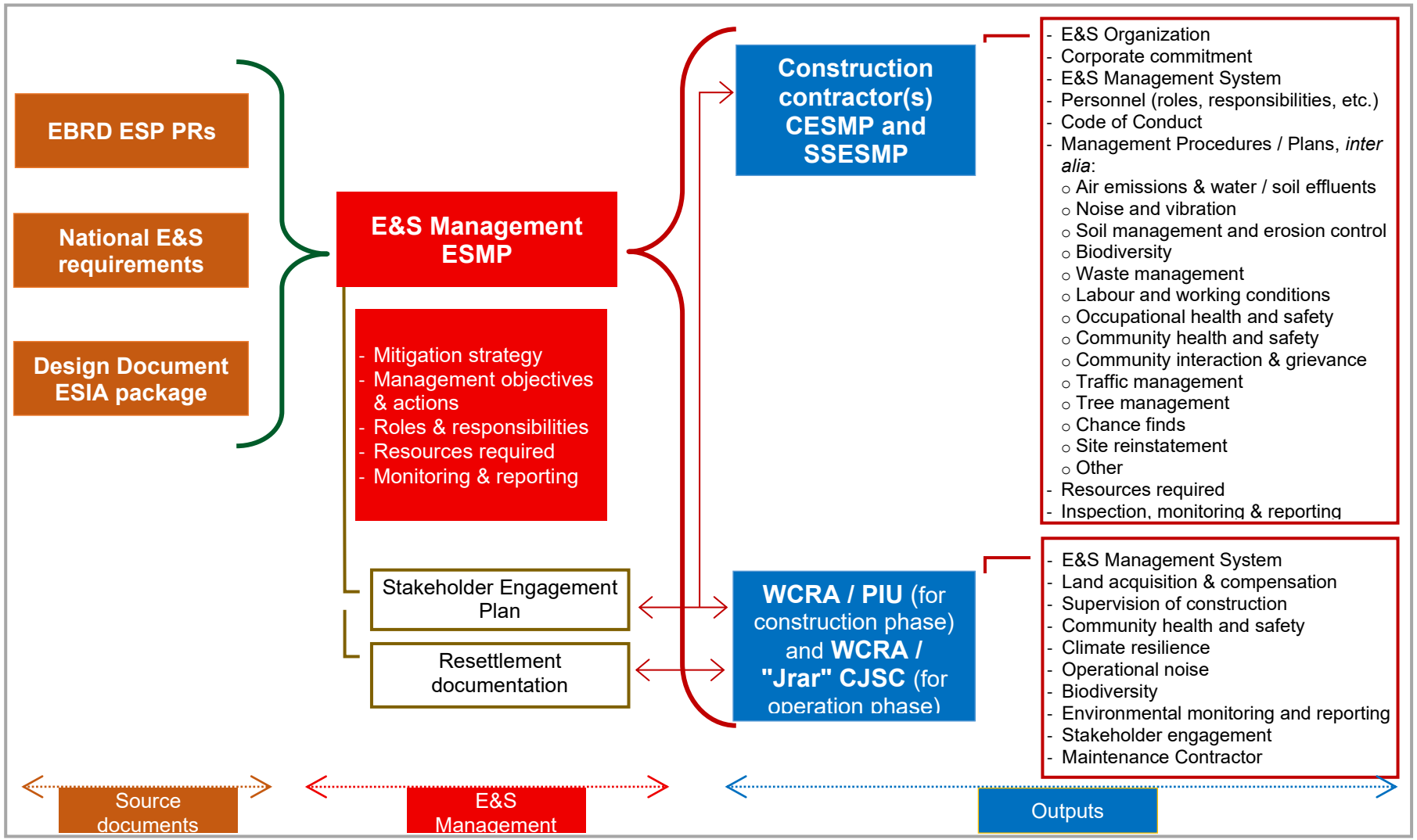
- National legal act and regulations,
- EBRD ESP, applicable EU directives and GIPs,
- Design documents - to be prepared to meet national regulations as well as the best international practice,
- ESIA report (this document) and the accompanying documents (ESIA package), and upcoming updates.

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

« 16 » 10 2024թ.

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ԲՓ № 215 - 24

Նախաձեռնող՝ ***«Քոնսեկոարդ» ՍՊԸ***
ք Երևան, Սեբաստիայի փողոց 31/2

Գործունեությունը՝ ***Լիճքի ջրամբարի կառուցում***
Սյունիքի մարզ

Առդիր՝ 9 թերթ

ՊԵՏԱԿԱՆ ՓՈՐՁԱՔՆՆԱԿԱՆ ԵԶՐԱԿԱՑՈՒԹՅՈՒՆ

ՇՐՋԱԿԱ ՄԻՋԱՎԱՅՐԻ ՎՐԱ ԱԶԴԵՑՈՒԹՅԱՆ ՓՈՐՁԱՔՆՆՈՒԹՅԱՆ

ԲՓ № 215 - 24

«16» հոկտեմբերի **2024թ.**

Սյունիքի մարզի Մեղրի համայնքում Լիճքի ջրամբարի կառուցման շրջակա միջավայրի վրա ազդեցության գնահատման հաշվետվություն

Նախաձեռնող՝	«Քոնսեկոարդ» ՍՊԸ
Ներկայացված նյութեր՝	Շրջակա միջավայրի վրա ազդեցության գնահատման հաշվետվություն, նախագիծ
Գործունեության տեսակ՝	«Ա» կատեգորիա
Տեղադրման վայրը՝	Սյունիքի մարզ, Մեղրի համայնք, Լիճք բնակավայր

Ներածական մաս. «Քոնսեկոարդ» ՍՊ ընկերության /այսուհետ՝ Ընկերություն/ կողմից փորձաքննության ներկայացված նախագծային փաթեթով նախատեսվում է Սյունիքի մարզի Մեղրի համայնքի Լիճք բնակավայրի վարչական տարածքում կառուցել Լիճքի ջրամբարը: Ներկայացվող ծրագրի պատվիրատուն ջրային կոմիտեն է, որը ֆինանսավորվում է Վերակառուցման և զարգացման եվրոպական բանկի /ՎԶԵԲ/-ի կողմից :

Համաձայն «Շրջակա միջավայրի վրա ազդեցության գնահատման և փորձաքննության մասին» (ՀՕ-150-Ն) օրենքի 12-րդ հոդվածի 3-րդ մասի 11-րդ կետի ա ենթակետի նախատեսվող գործունեությունը հանդիսանում է «Ա» կատեգորիայի գործունեության տեսակ: Նախատեսվող գործունեության համար հիմք են հանդիսացել պատվիրատուի հայտը, Սյունիքի մարզի Մեղրի համայնքի ղեկավարի կողմից 06/12/2023թ-ին տրված № 35 ճարտարապետահատակագծային առաջադրանքը:

Նկարագրական մաս. ՀՀ Կառավարությունը ԵՄ աջակցության «Վերականգնում, դիմակայունություն և բարեփոխում. Արևելյան գործընկերության առաջնահերթությունները 2020թ-ից հետո» նախաձեռնության «Լրացուցիչ «Բ» նախաձեռնության» շրջանակներում նախատեսում է կառուցել 17 ջրամբարներ: Ծրագրի իրականացման արդյունքում ոռոգման համակարգերը մեխանիկականից կփոխարինվեն ինքնահոսի՝ ինչը կնպաստի 1 մ^3 ոռոգման ջրի ինքնարժեքի զգալի նվազեցմանը, որն իր դրական ազդեցությունը կունենա գյուղատնտեսական արտադրության վրա: Լիճքի ջրամբարը նախատեսվում է կառուցել Սյունիքի մարզի Մեղրի համայնքի Լիճք բնակավայրի վարչական տարածքում՝ Մեղրի գետի վրա՝ Մեղրի, Ագարակ, Ալվանք, Շվանիձոր, Նռնաձոր, Լեհվազ, Վարդանիձոր և Կարճևան բնակավայրերի շուրջ 1510.8 հա գյուղատնտեսական հողատեսքերը ոռոգման ջրով ապահովելու նպատակով: Տարածաշրջանի ոռոգման ջրի պահանջի ապահովումն ունի նաև ռազմավարական նշանակություն:

Ներկայացվող ծրագիրն իրականացվում է Կառավարության քաղաքականության և որոշումների հիման վրա, ուստի քննարկվել են ջրամբարի ցուցանիշների և կառուցման եղանակների տարբերակները: Ինչպես վերը նշվել է, ջրամբարը նախատեսվում է կառուցել Մեղրի գետի վտակ Լիճք գետի վրա 1529-1602 բացարձակ նիշերի սահմաններում: Ջրամբարը ծառայելու է գետի հեղեղային ելքերը կուտակելու և սակավաջուր ամիսներին յուղատնտեսական հողատեսքերը ոռոգման ջրով ապահովվելու նպատակով: Ջրամբարի հիմնական հիդրոտեխնիկական կառույցը՝ պատվարն է, որի համար դիտարկվել է պատվարի կառուցման մեկ տարբերակ՝ քարահողային պատվար ավազակավե միջուկով, քանի որ նախատեսվում է պատվարն իրականացնել տեղի շինանյութերով: Ջրամբարի պատվարի մարմնի շինարարության համար անհրաժեշտ ավազակավի, ճալաքարի և քարի օգտագործման նպատակով նախատեսվում է վերցնել ջրամբարի թասի հիմքից, իսկ պատվարի պրիզմաների համար պահանջվող քարը վերցվում է պատվարի մարմնի հիմքի, կառուցվածքների և Հյուսիս-Հարավ ավտոճանապարհների շինարարության ընթացքում հանված քարային զանգվածները: Նախագծի իրականացմանը զուգահեռ դիտարկվում է պատվարի բարձրության իջեցում՝ ի հաշիվ թասի միջից շինարարական նյութերի օգտագործման արդյունքում: Վերը նշված տարբերակի համար կազմվել է նախնական խոշորացված նախահաշիվ, որի դեպքում ջրահամակարգի կառուցման նախահաշվային արժեքը կազմում է մոտ 8966.0 մլն ՀՀ դրամ:

Ջրամբարի լրիվ ծավալը 3.93 հազ մ^3 է, օգտակար ծավալը՝ 3.76 հազ մ^3, մեռյալ ծավալը՝ 25 հազ մ^3,պատվարի բարձրությունը՝ 64 մ: Լիճքի ջրամբարի, պատվարի և նրա օժանդակ կառուցվածքների տակ ընկնում է մոտ 33.0 հա հողատարածք, այդ թվում ջրամբարի տակ՝ 28.1 հա: Ջրամբարի և դրա թասի մեծ մասն իրենից ներկայացնում է անտառապատ տարածք 20-25սմ հաստությամբ բներով: Ջրամբարի ջրածածկման տարածքի կորդինատները՝ ARM WGS-84 կորդինատային համակարգով հետևյալն է՝

Հ/Հ	X [մ]	Y [մ]
1	4324002.4479	8603469.7706
2	4324262.0629	8603717.1099
3	4323990.1746	8603291.0123
4	4324099.4074	8603233.5982
5	4324335.1115	8603188.3706
6	4324531.8281	8603226.7072
7	4324674.4628	8603142.1272
8	4324718.5214	8603199.3966
9	4324678.4800	8603285.8229
10	4324434.7531	8603400.9460
11	4324350.6296	8603475.9594
12	4324482.8040	8603666.6447
13	4324302.3772	8603674.7453

Մեղրի խոշորացված համայնքում ոռոգման հիմնական աղբյուր է հանդիսանում Մեղրի գետը, ոռոգման դեֆիցիտի ժամանակաշրջանում օգտվում են Արաքս գետից: Վերջին տասնամյակում Մեղրի գետի վրա կառուցվել է Մեղրիի ինքնահոս համակարգը, որի միջոցով մեխանիկական ոռոգման համակարգերից անցել են ինքնահոսին, սակայն Մեղրի գետում ջրի դեֆիցիտի ամիսներին՝ օգոստոս, սեպտեմբեր, Արաքս գետից մեխանիկական վերամբարձի միջոցով ոռոգման ջուրը տրվում է բնակավայրերին:
Խոշորացված համայնքի ոռոգման սխեման կարելի է բաժանել երկու մասի՝ Մեղրիի ինքնահոսից սնվողներ և Մեղրի գետից սնվողներ: Մեղրիի ինքնահոս համակարգը նոր է կառուցված, որն իրենից ներկայացնում է փակ խողովակաշարային ցանց, որում կորուստները շատ փոքր են, իսկ մյուս ոռոգելի հողատարածքների ոռոգումն իրականացվում են երկաթբետոնե և բետոնե ջրանցքներով, հողային առուներով, որոնց կորուստը շատ մեծ է:

Նախատեսվող ջրամբարի տարածքը գտնվում է բնական վիճակում, որոշ տարածքներ օգտագործվել են որպես բնական արոտավայրեր: Տարածքը հիմնականում քարքարոտ է, մասնատված, տեղ-տեղ հանդիպում են երկրաբանական հետազոտությունների համար կատարված հորատանցքեր: Մեղրի համայնքը բնութագրվում է բարդ ռելիեֆով, խիստ կտրտվածությամբ և մասնատվածությամբ: Գեոմորֆոլոգիական տեսանկյունից, հետազոտվող տեղամասը զբաղեցնում է Զանգեզուրի և Մեղրիի լեռնաշղթաների հարավ-հարավ-արևելյան լանջերը: Շրջանի ողջ տարածքը բնութագրվում է որպես տիպիկ լեռնային շրջան՝ կտրտված ռելիեֆով: Ռելիեֆը ձորակային է, հատված է Մեղրիգետ, Տաշտուն և Այրիգետ գետերի գետային ցանցով և ժամանակավոր ջրահոսքերով, ունի դեպի հարավ-արևելք կողմնորոշված ընդհանուր թեքություն: Ձևաչափական դասակարգմամբ, տեղանքը կարելի է դասել խիստ մասնատված տեսակի: Նախագծվող Մեղրրի ջրամբարի շրջանի երկրաբանական կառուցվածքում մասնակցում են ստորին Էոցենի ինտրուզիվ ապարները, որոնք ներկայացված են քվարցային գաբրո-դիորիտներով, ինտրադացիտներով և քվարցային մոնցոնիտներով, հրաբխանստվածքային ստվարաշերտը (տուֆավազաքարեր, տուֆաշերտաքարեր, ավազաքարեր, տուֆեր, տուֆափշրաքարեր /բրեկչիաներ/) միջին Էոցենին է պատկանում: Դրանք ծածկված են ժամանակակից էլյուվիալ, դելյուվիալ և պրոլյուվիալ նստվածքներով:

Մեղրի գետն անցնում է Հայաստանում առկա գրեթե բոլոր կլիմայական գոտիներով, սակայն նախագծային ջրհավաք ավազանը գտնվում է ավելի քան 1500 մետր բարձրությունների վրա՝ Զանգեզուրի լեռների հարավային հատվածի արևելյան լանջերին:
Ավազանի 1500-1700 մետր բարձրություններում, որոնք կազմում են փոքր տարածք, տարածվում է բարեխառն գոտին, որում ամբողջ տարին համեմատաբար խոնավ կլիման ձևավորվում է լեռնալանջերին: Բարեխառն կլիման՝ մեղմ ամառներով և համեմատաբար ցուրտ ձմեռներով, ձևավորվում է մինչև 2200 մ բարձրությունների վրա: Չափավոր ցուրտ կլիման՝ կարճատև զով ամառներով և ցուրտ ձմեռներով, ձևավորվում է 2200-3000 մ բարձրությունների վրա: Ցուրտ կլիմայական գոտում՝ 3229 մ բարձրության վրա (Արագած բ/լ), միջին տարեկան ջերմաստիճանը կազմում է -2.6°C: Տարվա ամենացուրտ ամիսը հունվարն է, միջին ամսական ջերմաստիճանը՝ -10°C-ից ցածր: Հուլիս-օգոստոս ամիսներին միջին ջերմաստիճանը ՝ 9-15°C: Բացարձակ առավելագույն ջերմաստիճանները 20°C է (Արագած բ/լ), իսկ նվազագույն ջերմաստիճանը՝ մինչև -34°C (Արագած բ/լ): Հարաբերական խոնավությունը տարվա ընթացքում մեծ է և գիշերվա ժամերին հասնում է 80-90%: Տեղումների քանակը հասնում է մինչև 1000 մմ (Արագած բ/լ): Ըստ Քաջարան օդերևութաբանական կայանի տվյալների՝ օդի միջին տարեկան ջերմաստիճանը կազմում է 7°C, հունվար ամսին՝ -3°C: Ձմռանը կայուն ձնածածկույթ առաջանում է ոչ ամեն տարի, իսկ առաջացման դեպքում միջին տասնօրյակային բարձրությունը կազմում է 5-6 սմ,

առավելագույն տասնօրյակայինը՝ 91 սմ: Մթնոլորտային տեղումների տարեկան քանակը հասնում է մինչև 600մմ: Ըստ Մեղրի օդերևութաբանական կայանի տվյալների՝ օդի միջին տարեկան ջերմաստիճանը կազմում է 14,5°C, հունվար ամսին՝ 1.7 °C: Մթնոլորտային տեղումների տարեկան քանակը հասնում է մինչև 300 մմ, նախագծային տարածքում տեղումների առավելագույնը դիտվում է մարտ-մայիս ամիսներին, նվազագույնը՝ օգոստոսին: Չնայած տեղումների մեծ ծավալին՝ ուշ աշնանային, վաղ գարնանային և ձմեռային ժամանակահատվածում թափված տեղումները, հատկապես լեռնային և բարձր լեռնային գոտիներում դիտվում է ձյան տեսքով:

Ջրամբարի տեղամասում հիդրոլոգիական հաշվարկների կատարման համար՝ բազային հիմք են ընդունվել Մեղրի գետի Լիճք դիտակետի տվյալները, քանի որ վերջինս ունի շուրջ 56 տարվա դիտարկումների շարք, ուստի գնահատվել է սույն դիտակետի դիտարկումների շարքի հուսալիությունը: Լիճք դիտակետում առավելագույն ելքերը հասանելի են 1946 թվականից և հաշվարկների համար օգտագործվել է 56 տարվա տվյալների: Դիտակետում գրանցված առավելագույն ելքը եղել է 7.35 մ3/վ (1953թ.), դիտակետում նվազագույն ելքի միջին արժեքը 0.07մ3/վ: Բնապահպանական թողքը Լիճք դիտակետում և պատվարի տեղամասում հետևյալն է՝

Բանապահ-պանական թողք	թողքը, մ³/վ, ըստ ամիսներ											
	1	2	3	4	5	6	7	8	9	10	11	12
Լիճք դիտակետ	0.011	0.010	0.016	0.068	0.271	0.485	0.239	0.093	0.048	0.017	0.016	0.016
Պատվարի տեղամաս	0.023	0.021	0.033	0.143	0.570	1.019	0.502	0.194	0.101	0.036	0.034	0.034

Նախատեսվող գործունեության տարածաշրջանում հանդիպում են անտառային դարչնագույն կրազերծված տափաստանացված հողերը, որոշ մասերում մարգագետնատափաստանային տիպիկ մնացորդային չհագեցած հողային տիպերը: Ռելիեֆի տիպերը հիմնականում ուղիղ լանջերով են, աստիճանակերպ կատարով, V-աձև հովիտներով և կիրճերով խորը մասնատված են: Հողերի էրոզվածության աստիճանը տեղ-տեղ III, տեղ-տեղ VI կարգի են:

Բուսահողը կավավզային կազմի է, խճի, խճավազի պարունակությամբ: Անմիջապես գործունեության տարածքում հողաբուսական շերտը հիմնականում քարքարոտ է: Ըստ նախնական հաշվարկների՝ հանվող հողագրունտի ծավալը կկազմի 2-2.5 մլն. մ³, որն ամբողջությամբ տեղադրվելու է պատվարի մարմնում, ավելցուկային բնահողը կօգտագործվի ռեկուլտիվացիայի համար: Լիճքի ջրամբարի կառուցման համար նախատեսվող տարածքը հարևանում է «Արևիք» ազգային պարկին, սակայն նրա հետ չունի ընդհանուր սահման: Ջրամբարի շինարարության ազդեցության գոտում չկան պատմամշակութային հուշարձաններ:

Նախատեսվող գործունեությունն իր ազդեցությունները կունենա շրջակա միջավայրի վրա, որոնք կկրեն ժամանակավոր բնույթ:

Շինարարության փուլում մեծ ծավալի հողային գրունտ կհանվի և կտեղափոխվի: Հողային աշխատանքներ իրականացնելիս՝ կառաջանա փոշի, որը կարող է ցրվել քամու միջոցով փորման աշխատանքների տեղամասից 100 մ տարածքի վրա: Օդի որորշակի աղտոտում տեղի կունենա նաև շինարարական նյութերի փոխադրման ընթացքում՝ մանրախճով պատված մոտեցող ճանապարհներով, բեռնատար մեքենաների տեղաշարժից: Շահագործման փուլում օդի որակի վրա ազդեցություն չի լինի:

Մեխանիզմների և տրանսպորտային միջոցների աղմուկի մակարդակը շինարարության ընթացքում էականորեն տարբերվում է և կախված է առաջացող աղմուկի տեսակից և գործունեության մակարդակից: Շահագործման փուլում աղմուկի ազդեցությունը կլինի աննշան:

Շինարարության փուլում ջրային ռեսուրսների վրա (մակերևութային/ստորերկրյա ջրեր) կլինեն հետևյալ հնարավոր բացասական ազդեցությունները՝

- ստորգետնյա ավազանի աղտոտում՝ շինհրապարակից հոսող կեղտաջրերի միջոցով,
- մակերևութային ջրերի հոսքի և դրանց որակի փոփոխություններ՝ աղտոտիչների արտահոսքի պատճառով,
- գետի ջրի որակի փոփոխություն ոչ պատշաճ կերպով պահված շինարարական նյութերի և թափոնների, կենցաղային թափոնների արտանետումների, վառելիքի արտանետումների, յուղերի և քսանյութերի արտահոսքից:

Շինարարության փուլում հողի աղտոտման պատճառ կարող են հանդիսանալ նավթամթերքի արտահոսքը, նավթամթերքի ոչ ճիշտ պահեստավորումը, նավթի և վառելիքի չհեռացված թափոնները՝ ներառյալ օգտագործված յուղերի, հիդրավլիկ թունավոր հեղուկների, դատարկ նավթի տարաների ոչ պատշաճ հեռացումը: Թափոնների վատ կառավարումը կարող է հանգեցնել հողի աղտոտման: Բույսերի կորուստը շինհրապարակի մաքրման հետևանքով կարող է հանգեցնել բնական միջավայրի և կենդանական աշխարհի տեսակների կորստի: Թռչունների և փոքր կենդանիների անհանգստացնելը կարող են հանգեցնել բնակության վայրի կորստի:

Շինարարական աշխատանքների իրականացման ժամանակ ջրամբարի թասի տարածքում հատվելու են մոտավորապես 2300 ծառ: Հասցված վնասը փոխհատուցելու նպատակով՝ հատված ծառերի փոխարեն համայնքապետարանի կողմից տրամադրված վայրերում կիրականացվի ծառատունկ՝ մեկը երկուսի հարաբերակցությամբ: Տնկվող ծառերի քանակը հաշվարկվել է հետևյալ կերպ՝ մինչև 10 սմ բնի հաստությամբ հատվող ծառերի դիմաց տնկել 1 : 1 հաշվարկով, իսկ 10 սմ գերազանցող դեպքում՝ 1 : 5 հաշվարկով: Այսպիսով նոր տնկվող ծառերի թիվը կկազմի՝ մինչև 10 սմ բնով հատվող ծառերի թիվը՝ 850 հատ, 10 սմ գերազանցող՝ 1450 հատ, ընդհանուր առմամբ կտնկվի 8100 տնկի: Ընդամենը տնկելու համար անհրաժեշտ կլինի 3.5 – 4 հա տարածք, ըստ ընտրված ծառատեսակների և հաշվի առնելով օժանդակ տարածքները: Ծառատունկի և դրանց խնամքի համար ծախսերի խոշորացված հաշվարկը կազմելու է 40,293,000 ՀՀ դրամ:

Ջրամբարի կառուցման շինարարական աշխատանքների ընթացքում նախատեսվում է իրականացնել **բնապահպանական ազդեցությունները մեղմող հետևյալ միջոցառումները՝**

Շինարարական հրապարակում առաջացած փոշու և աղմուկի նվազեցման նպատակով նախատեսվում է՝

- շինարարական նյութերի և թափոնների տեղափոխման համար անհրաժեշտ է օգտագործել փակ կամ ծածկով բեռնատար մեքենաներ.
- հողային աշխատանքներն ըստ հնարավորության, կատարել փոշեորսիչով կահավորված տեխնիկական միջոցներով և սարքավորումներով.
- տրանսպորտային միջոցները և տեխնիկան պարբերաբար ստուգել, կարգավորել և ապահովել ձայնի խլացուցիչներով.
- շինարարական տարածքը և մոտեցնող ճանապարհները պետք է պարբերաբար ջրել, իսկ խիճը, պահեստավորված և տեղափոխվող հողային զանգվածները խոնավացնել՝ փոշին նվազեցնելու նպատակով (բացի ձմեռային և տեղումներով առատ ամիսներից):

Ջրային ռեսուրսների վրա հնարավոր բացասական ազդեցությունները շինարարության ընթացքում մեղմելու կամ կանխարգելելու, վնասակար նյութերի արտահոսքը բացառելու համար նախատեսվում է՝

- փոշենստեցման համար ջրցանը կատարել ըստ անհրաժեշտության, հնարավորինս չառաջացնելով մակերևութային հոսքեր,
- քսահուղերի և այլ նյութերի համար հատկացված վայրերի հատակները բետոնապատել,
- անձրևաջրերի և արտադրական հոսքաջրերի հեռացման և հավաքման համար նախատեսել ժամանակավոր պարզարաններ,
- շինարարական տրանսպորտային միջոցների և սարքավորումների սպասարկումը կատարել մոտակա մասնագիտացված կետերում,
- ավտոտրանսպորտային միջոցների անիվների լվացումը կատարել փրփուռային եղանակով՝ կանխելու համար աղտոտված արտահոսքի ներթափանցումը ջրային ռեսուրսներ,
- որպես ափապաշտպան միջոցառում՝ շինարարական գալերեայի ելքամասում և հեղեղային ջրհեռի վերջում, ջրի էներգիան մարելու և գետի հունը ողողումից պաշտպանելու նպատակով, նախատեսված են ջրծեծ հորեր, որոնց շեպերն ու հատակն ամրացվում են քարով,
- դեպի Մեղրի գետ կեղտաջրերի արտահոսքը կանխելու նպատակով՝ շինարարության փուլում աշխատողների համար տարածքում կտեղադրվեն կեղտաջրերի հավաքման հոր կամ բիոզուգարան, որի մաքրումը կատարելու է համապատասխան մասնագիտացված կառույցների կողմից՝ պայմանագրային հիմքունքներով:

Կենսաբազմազանության վրա ազդեցությունը մեղմելու նպատակով նախատեսվում է՝

- ըստ հնարավորության՝ բացառել ծառահատումները, առկա թփերի մաքրումը կատարել մասնագետների մասնակցությամբ,
- գործունեության և հարակից տարածքներում ՀՀ Կարմիր գրքերում գրանցված բուսատեսակների նոր պոպուլյացիաների կամ կենդանիների բնադրավայրերի հայտնաբերման դեպքում դադարեցնել շինարարական աշխատանքները,
- շինարարական աշխատանքներն իրականացնել ցերեկային ժամերին՝ որոշ կենդանիների կենսակերպի վրա ազդեցությունից խուսափելու համար,
- հնարավորինս նվազեցնել տարածքի գիշերային լուսավորությունը՝ կենդանիների որոշ տեսակների բնականոն վարքին չխանգարելու նպատակով:

Շինարարական աշխատանքների ժամանակ ՀՀ Կարմիր գրքում գրանցված բուսատեսակների պոպուլիացիաների հայտնաբերման դեպքում դրանց պահպանության նպատակով նախատեսվում է.

- Կարմիր գրքում գրանցված բուսատեսակների նոր պոպուլյացիաների կենսունակության ապահովման նպատակով առանձնացնել պահպանվող գոտիներ և իրականացնել հատուկ պահպանում:
- ժամանակավորապես սահմանափակել առանձնացված պահպանվող գոտիներում տնտեսական գործունեության որոշ տեսակներ, երե դրանք կարող են բերել նշված բուսատեսակների աճելավայրերի վիճակի վատթարացման ու պոպուլյացիաների կենսունակության խաթարմանը, տեղափոխել պահպանվող բույսերի առանձնյակները տվյալ տեսակի համար նպաստավոր բնակլիմայական պայմաններ ունեցող որևէ բնության հատուկ պահպանվող տարածք կամ բուսաբանական այգիների տարածք, կամ Կարմիր գրքում որպես տվյալ բույսի աճելավայր գրանցված որևէ տարածք, իսկ բույսերի սերմերը տրամադրել համապատասխան մասնագիտացված կազմակերպությանը՝ գենետիկական բանկում պահելու և հետագայում տեսակի վերարտադրությունը կազմակերպելու

նպատակով: Աշխատանքները կիրականացվեն՝ ՀՀ կարմիր գրքում գրանցված բուսական աշխարհի օբյեկտների պահպանության և բնական պայմաններում վերարտադրության նպատակով դրանց օգտագործման կարգը սահմանող որոշման (31 հուլիսի 2014 թվականի N 781-Ն) դրույթներին համապատասխան:

Շինարարական և հողային աշխատանքների ժամանակ իրականացվելու է ջրցան՝ փոշենստեցման նպատակով, ինչն աղտոտումից կպահպանի օդային ավազանը և բնական էկոհամակարգերը, մասնավորապես՝ տեղի բուսականությունը: Ջրամբարի շինարարությունից հետո նախատեսվում է իրականացնել կանաչապատման աշխատանքներ՝ հատո

Նախատեսվող շինարարական աշխատանքների իրականացման ընթացքում, ծրագրի ազդակիր տարածքում առաջացող տարբեր տեսակի թափոնները կարող են բացասաբար անդրադառնալ շրջակա միջավայրի վրա, մասնավորապես՝ առաջացնելով լանդշաֆտի փոփոխություն, աղտոտել ջրային և հողային ռեսուրսները և մթնոլորտային օդը, ինչպես նաև ազդել մարդկանց առողջության վրա: Իրականացվող ծրագրի տեղամասերում աշխատանքների մեկնարկն իրականացվելու է հնագետի հսկողությամբ: Շինարարական աշխատանքների ընթացքում որևէ անհայտ հնագիտական շերտի, անհայտ ծագման իրերի, բնության հուշարձանի հայտնաբերման դեպքում շինարարական ախատանքներն անմիջապես դադարեցվելու են և տեղեկացվելու է համապատասխան պետական մարմնին՝ հետագա գործողությունները ՀՀ գործող օրենսդրության համաձայն կազմակերպելու համար: Շինարարական աշխատանքերի ընթացքում, առաջացող թափոնատեսակներն են՝ կենցաղային աղբ /ծածկագիրը՝ 9120040001004/, որը կհավաքվի աղբամաններում, շինարարական աղբ /ծածկագիրը՝ 9120060101004/, կհավաքվի համապատասխան կոնտեյներներում և չաղտոտված հող /ծածկագիրը՝ 3140110008995/: Շինարարական թափոնները և կենցաղային աղբն ամբողջությամբ կանոնավոր կերպով կտեղափոխվի համայնքի կողմից հատկացված աղբավայր: Հաշվի առնելով տարածքի զգայուն էկոհամակարգը՝ շինարարական տեխնիկայի և ավտոտրանսպորտի բոլոր սպասարկման աշխատանքները, քսայուղերով և վառելիքով լիցքավորումը կիրկանացվի մասնագիտացված կայաններում, ինչը թույլ կտա բացառել վտանգավոր թափոնների առաջացումը:

Հողային ռեսուրսների պահպանության հիմնական միջոցառումը բերրի հողաշերտի պահպանումն է: Ջրամբարի թասից դուրս՝ պաշտպանիչ գոտում կազմակերպվելու է բերրի հողի պահեստներ՝ ծածկի տակ շրջանցող առուներով: Բերրի հողն ամբողջությամբ օգտագործվելու է տարածքի բարեկարգման և կանաչապատման նպատակով:

Հողային ռեսուրսների վրա հնարավոր բացասական ազդեցությունները և վերջինիս մեջ վտանգավոր նյութերի և քսայուղերի ներթափանցումը կանխելու նպատակով նախատեսվում է՝

- ճանապարհից դուրս տեղակայվող սարքավորումների վայրում փռել ավազ կամ մանրախիճ,
- բուն գործունեության տարածքում յուղի, վառելիքի կամ այլ վտանգավոր հեղուկների պահման տեղամասեր չնախատեսել,
- շինարարական նյութերը տեղադրել հատուկ տակդիրների վրա,
- հողային գրունտը տարածքում պահպանել ծածկված վիճակում՝ անջրթափանց թաղանթով,
- առաջացող շինաղբը տեղափոխել համայնքի կողմից նախատեսված աղբավայր,
- հանվող հողային զանգվածն օգտագործել որպես հետլիցք և տարածքի բարեկարգման համար,

- շինարարության փուլում օգտագործվող տրանսպորտային միջոցների լիցքավորումը և տեխնիկական սպասարկումը կատարել տարածքից դուրս՝ հատուկ մասնագիտացված կազմակերպություններում:

Ռիսկերի նվազեցումը կարելի է ապահովել՝ իրականացնելով մի շարք բնապահպանական և սոցիալական միջոցառումներ, որոնց արդյունավետության ապահովման նպատակով պետք է կազմակերպել աշխատանքների մշտադիտարկումներ:

Հաշվի առնելով նախատեսվող ջրամբարի տարածքի ռելիեֆային և բնահողային պայմանները, նախատեսվող պատվարի բարձրությունը (64 մ), ինչպես նաև ճկնաբանի կողմից իրականացված ուսումնասիրությունները և տրված եզրակացությունը (որոնք առկա են գնահատման հաշվետվության մեջ,) և այն հանգամանքը, որ ջրամբարը նախատեսվում է կառուցել ոռոգման նպատակով, հետևաբար ջրի հորիզոնը կլինի փոփոխական, ուստի նախագծող կազմակերպության կողմից հիմնավորվել է ճկնուղի լինելու անհնարիությունը:

Պատճառաբանական մաս. ՀՀ օրենսդրությանը համապատասխան՝ հանրային ծանուցումը և քննարկումները կատարվել են Սյունիքի մարզի Մեղրի համայնքի Լիճք բնակավայրում: Մեղրի համայնքի ղեկավարի նստավայրում, անցկացված հանրային լսումներում գործունեության իրականացումը մասնակիցների կողմից արժանացել է հավանության: Հաշվետվության վերաբերյալ փորձաքննական գործընթացում ստացվել են կարծիքներ՝ առողջապահության, ներքին գործերի, կրթության, գիտության, մշակույթի և սպորտի նախարարություններից, քաղաքաշինության կոմիտեից, կադաստրի կոմիտեից, ինչպես նաև շրջակա միջավայրի նախարարության ստորաբաժանումներից: Ստացված դիտողությունները և առաջարկությունները հաշվի են առնվել գնահատման հաշվետվության լրամշակումներում: Ամփոփելով հաշվետվության բնապահպանական և սոցիալական ազդեցությունների վերլուծությունները՝ կարելի է եզրահանգել, որ նախատեսվող գործունեության իրականացման արդյունքում շրջակա միջավայրի վրա հնարավոր բացասական ազդեցությունները, որոնք առնչվում են շինարարական աշխատանքների հետ, կկրեն ժամանակավոր և տեղայնացված բնույթ և կլինեն թույլատրելի նորմայի սահմաններում: Դրանք կարող են բացառվել կամ մեղմվել գործունեության ընթացքում բնապահպանական միջոցառումների արդյունավետ իրականացմամբ: Լիճքի ջրամբարի կառուցմամբ հնարավոր կլինի լուծել տարածաշրջանում մի շարք ջրատնտեսական խնդիրներ, որոնցից են.

- լիարժեք ապահովել Մեղրիի ինքնահոսի տակ ընկած հողերի ոռոգումն, ինչպես նաև հեռանկարում ավելացնել մինչև 160 հա հողատարածք,
- հեռանկարում՝ Լիճքի ջրամբարից մինչև Մեղրիի ինքնահոս համակարգի գլխամասը՝ մոտ 13 կմ երկարությաբ հատվածն իրականացնել փակ խողովակաշարով, որի արդյունքում կխնայենք մինչև 1մլն մ-ով ջրաքանակ, հեռանկարում ջրային ռեսուրսների սակավման պատճառով առաջացած դեֆիցիտը փակելու համար:
- լիճքի ջրամբարից մինչև Մեղրիի ինքնահոս համակարգի գլխամաս փակ խողովակաշարի անցնելու դեպքում հնարավորություն է լինում օգտագործել մինչև 600 մ ջրի ճնշումը էլ. էներգիա ստանալու համար:

Փորձաքննական պահանջներ

1. Շինարարության ընթացքում ապահովել բնապահպանական կառավարման և մոնիթորինգի պլաններում նախատեսված միջոցառումների իրականացումը սահմանված ժամանակահատվածում:
2. Շինարարական աշխատանքների իրականացման ընթացքում առաջացող մնացորդային գրունտի, շինաղբի և տարբեր տեսակի թափոնների հեռացումն ու տեղափոխումն

անհրաժեշտ է իրականացնել ՀՀ օրենսդրությամբ սահմանված կարգով՝ տեղական ինքնակառավարման մարմինների կողմից հատկացված վայր:
3.Կանաչապատումն անհրաժեշտ է իրականացնել տարածաշրջանին և տեղի կլիմայական պայմաններին բնորոշ ծառաթփային բուսականությամբ՝ Կառավարության 2018 թվականի փետրվարի 8-ի N108-Ն որոշման պահանջներին համապատասխան:
4.Կառուցապատման աշխատանքների ընթացքում պահպանել «Մթնոլորտային օդի պահպանության մասին» օրենքի 11-րդ հոդվածով սահմանված պահանջները:
5.Առաջնորդվել ՀՀ կառավարության 2005 թվականի հունվարի 20-ի «Ջրաէկո-համակարգերի սանիտարական պահպանման, հոսքի ձևավորման, ստորերկրյա ջրերի պահպանման, ջրապահպան, էկոտոնի և անօտարելի գոտիների տարածքների սահմանման չափորոշիչների մասին» N 64-Ն որոշման պահանջներով:
6. Շինարարական աշխատանքների իրականացման ընթացքում հողաբուսական շերտի (հողի բերրի շերտ) հեռացումը և պահպանումը կատարել ՀՀ կառավարության 08.09.2011թ-ի թիվ 1396-ն և 02.11.2017թ-ի թիվ 1404-ն որոշումների պահանջներին համապատասխան:
7. Շինարարական աշխատանքների իրականացման ընթացքում անհրաժեշտ է առաջնորդվել ՀՀ կառավարության 2009 թվականի հոկտեմբերի 15-ի «Արևիք» ազգային պարկ ստեղծելու, «Արևիք» ազգային պարկի և «Արևիք» ազգային պարկ» պետական ոչ առևտրային կազմակերպության կանոնադրությունները հաստատելու մասին» N1209-Ն և 2010 թվականի N 71-Ն, N 72-Ն որոշումներով:
8.Աշխատանքների իրականացման ընթացքում անհրաժեշտ է առաջնորդվել ՀՀ կառավարության 2002 թվականի ապրիլի 20-ի N 438 որոշման 43-րդ կետի պահանջով՝ աշխատանքների կատարման ժամանակ պատմական, գիտական, գեղարվեստական և այլ մշակութային արժեք ունեցող հնագիտական և մյուս օբյեկտների հայտնաբերման պահից դադարեցնել աշխատանքները և դրա մասին անհապաղ հայտնել լիազորված մարմնին:

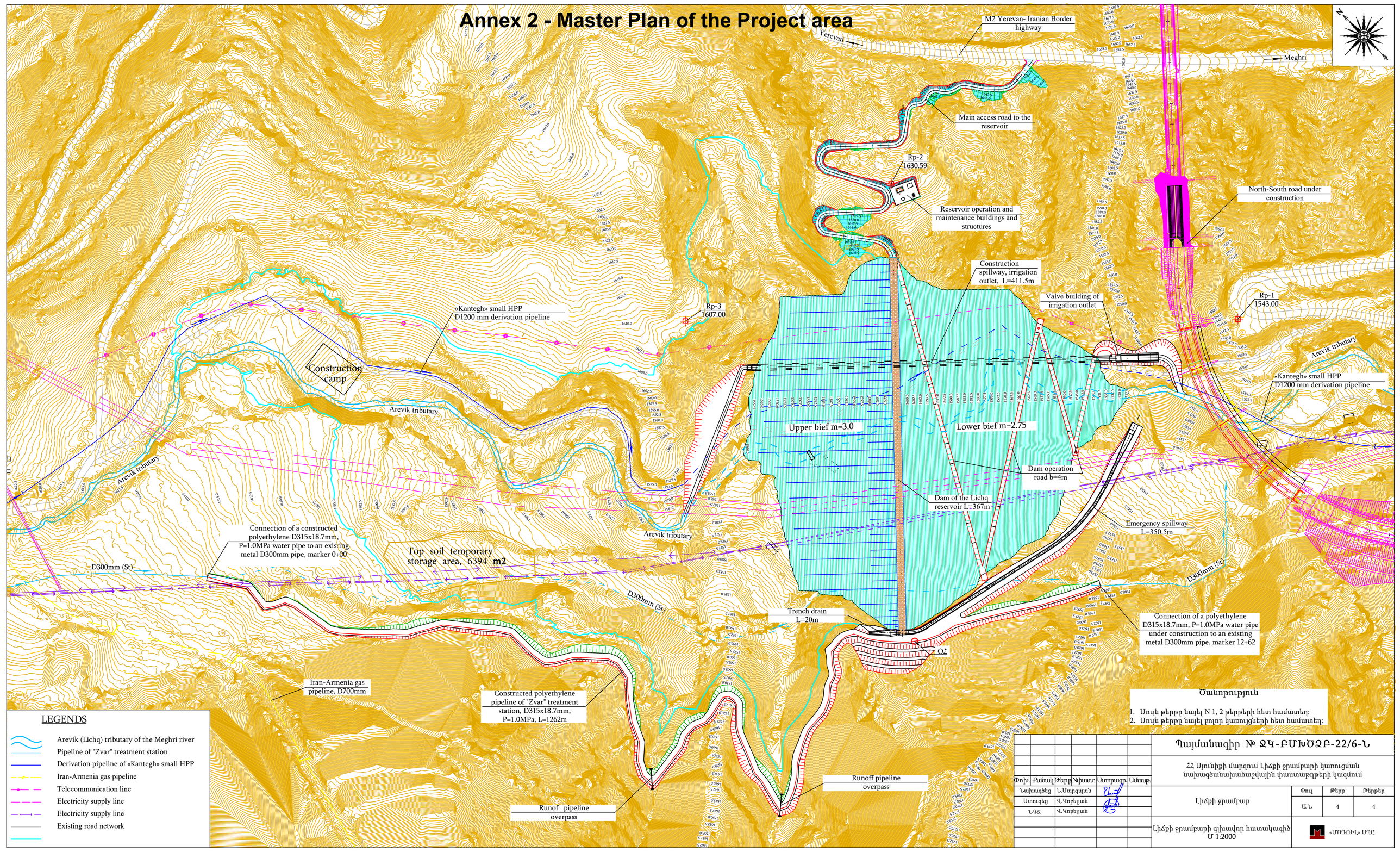
ԵԶՐԱՓԱԿԻՉ ՄԱՍ

Սյունիքի մարզի Մեղրի համայնքում Լիճքի ջրամբարի կառուցման շրջակա միջավայրի վրա ազդեցության գնահատման հաշվետվությանը տրվում է դրական 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 գլխավոր մասնագետ՝ Հովակիմ Ֆրունզիկյան

Annex 2 - Master Plan of the Project area



LEGENDS

- Arevik (Lichq) tributary of the Meghri river
- Pipeline of "Zvar" treatment station
- Derivation pipeline of «Kantegh» small HPP
- Iran-Armenia gas pipeline
- Telecommunication line
- Electricity supply line
- Electricity supply line
- Existing road network

Ծանոթություն

1. Սույն թերթը նայել N 1, 2 թերթերի հետ համատեղ:
2. Սույն թերթը նայել բոլոր կառույցների հետ համատեղ:

Փոխ.	Քանակ	Թերթ	Նվիրատու	Ստորագր.	Անվանք.
Նախագծեց	Ն.Սարգսյան				
Ստուգեց	Վ.Կոբելյան				
ՆԳՀ	Վ.Կոբելյան				

Պայմանագիր № ՋԿ-ԲՄԽԾՋԲ-22/6-Ն

ՀՀ Սյունիքի մարզում Լիճքի ջրամբարի կառուցման նախագծանախահաշվային փաստաթղթերի կազմում

Լիճքի ջրամբար

Փուլ	Թերթ	Թերթեր
Ա Ն	4	4

Լիճքի ջրամբարի գլխավոր հատակագիծ
Մ 1:2000

«ՄՈՂՈՒԼ» ՍՊԸ