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OJSC “Rogun HPP”

State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT – UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Volume 1, Chapter 01: Introduction



Volume 1 of this ESIA includes the following chapters:

1. Introduction
2. Legislation and Standards
3. Project Description
4. Analysis of Alternatives
5. Impact Assessment Methodology
6. Stakeholder Engagement
7. Environmental and Social Baseline Conditions
8. Air Quality
9. Greenhouse Gases
10. Climate Change
11. Noise and Vibration
12. Soils and Geology
13. Impacts on Water
14. Landscape and Visual
15. Biodiversity
16. Ecosystem Services
17. Socioeconomics
18. Community Health, Safety and Security
19. Labor and Working Conditions
20. Cultural Heritage
21. Major Accidents and Disasters
22. Traffic and Transport
23. Transboundary Cumulative Impact Assessment

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LIST OF ACRONYMS AND ABBREVIATIONS

Term	Definition
ADB	Asian Development Bank
AIIB	Asian Infrastructure Investment Bank
ALARP	As Low As Reasonably Practicable
AMSL	Above Mean Sea Level
AoI	Area of Influence
AQIA	Air Quality Impact Assessment
AQMP	Air Quality Management Plan
AQS	Air Quality Standard
ATPZ	Atypical Zone
BCT	Biodiversity Constraints Tracker
BF	Base Flow
BMP	Biodiversity Management Plan
BOD	Biological Oxygen Demand
BWO	Basin Water Organisation
CASA	Central Asia-South Asia project
CBD	UN Convention on Biological Diversity
CBRN	Chemical, Biological, Radiological and Nuclear (CBRN)
CCGT	Combined Cycle Gas Turbine
CEMP	Construction Environmental Management Plan
CEP	Committee for Environment Protection
CFP	Chance Find Procedure
CFRD	Concrete Face Rockfill dam
CHA	Critical Habitats Assessment
CHSSP	Community Health, Safety and Security Plan

Term	Definition
CIA	Cumulative Impact Assessment
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CoC	Code of Conduct
CME	Coronal Mass Ejections
CNG	WHO guidelines for community noise
COD	Chemical Oxygen Demand
CRC	Convention on the Right of the Child
CRVA	Climate Risk and Vulnerability Assessment
dB	Decibel
DFZ	Directorate of Flooding Zone of Rogun HPP
DLEO	District Livelihood & Engagement Officer
DNSH	Do No Significant Harm
DRS	Districts of Republican Subordination
DSPoE	Dam Safety Panel of Experts
E&SPoE	Environmental and Social Panel of Experts
EAAA	Ecologically Appropriate Area of Analysis
EBRD	European Bank for Reconstruction and Development
ECoW.	Ecological Clerk of Works
ECS	Environmental, Climate and Social
EDB	Eurasian Development Bank
eDNA	Environmental DNA
EFLOW	Environmental Flows
EFR	Environmental Flow Requirements
EFTA	EU and European Free Trade Area
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment

Term	Definition
EIB	European Investment Bank
EMZ	Electromagnetic Zone
EOO	Extent of Occurrence
EPAP	Emergency Preparedness Action Plan
EPRP	Emergency Preparedness and Response Plan
EPP	Emergency Preparedness Plan
EPC	Engineering, Procurement and Construction
ERP	Emergency Response Plan
ESCP	Environmental and Social Commitment Plan
ESF	Environmental and Social Framework
ESG	Environmental, Social and Governance
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESP	Environmental and Social Policy
ESPOE	Environmental and Social Panel of Experts
ESHS	Environmental, Social, Health and Safety
ESS	Environmental and Social Standards
ESSF	Environmental and Social Sustainability Framework
EU	European Union
FAO	Food and Agriculture Organization
FFI	Fauna & Flora International
FIDIC	Fédération Internationale des Ingénieurs-Conseils
FSL	Full Supply Level
G-res	Greenhouse Gas Reservoir Emissions Tool
GAP	Gender Action Plan
GBAO	Gorno Badakhshan Autonomous Oblast

Term	Definition
GBD	Global Burden of Disease
GBIF	Global Biodiversity Information Facility
GBVH	Gender-Based Violence and Harassment
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIIP	Good International Industry Practice
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GLOF	Glacier Lake Outburst Flood
GRM	Grievance Redress Mechanism
GW	Gigawatts
GWh	Gigawatt-Hour
GWP	Global Warming Potential
GWSP	Global Water Security and Sanitation Partnership
HESG	Hydropower Sustainability ESG Gap Analysis Tool
HH	Household
HLO	High Level Outlet
HPP	Hydropower Project
HSA	Hydropower Sustainability Alliance
HSAP	The Hydropower Sustainability Assessment Protocol
HSE	Health, Safety and Environment
HWSD	Harmonised World Soil Database
IAQM	Institute of Air Quality Management
IBAT	Integrated Biodiversity Assessment Tool
ICWC	Inter-State Commission for Water Coordination of Central Asia
IEA	International Energy Agency

Term	Definition
IED	Industrial Emissions Directive
IFAS	International Fund for the Aral Sea
IFC	International Finance Corporation
IFI	International Financial Institution
IGCC	Integrated Gasification Combined Cycle
IHA	International Hydropower Association
ILO	International Labor Organization
IPCC	Intergovernmental Panel on Climate Change
IPPC	International Plant Protection Convention
IsDB	Islamic Development Bank
ISMP	Invasive Species Management Plan
IUCN	International Union for the Conservation of Nature
JSC	Joint Stock Company
KFAED	Kuwait Fund for Arab Economic Development
KfW	Kreditanstalt für Wiederaufbau
LAeq,T	A-weighted, equivalent continuous sound level over a time period T
LFPR	Labor Force Participation Rate
LNAPL	Light Non-Aqueous Phase Liquids
LRP	Livelihood Restoration Plan
MAC	Maximum Allowable Concentration
mamsl	Metres Above Mean Sea Level
masl	Meters Above Sea Level
MCE	Maximum Credible Earthquake
MEF	Minimum Environmental Flow
MoEWR	Ministry of Energy and Water Resources
ML	Maintenance Flow

Term	Definition
MoLMEP / MLMEP	Ministry of Labor, Migration and Employment of the Population
MOL	Minimum Operating Level
MtCO2e	Million tonnes of Carbon Dioxide Equivalent
MW	Megawatt
MWh	Megawatt-hours
NEET	Not in Education, Employment, or Training
NGO	Non-Governmental Organization
NNL	No Net Loss
NNLF	No Net Loss Framework
NTS	Non-Technical Summary
O&M	Operation and Maintenance
OEL	Occupational Exposure Limits
OHL	Overhead Lines
ORP	Oxidation-Reduction Potential
PAHs	Project-Affected Households
PAPs	Project Affected Persons
PCB	Polychlorinated Biphenyls
PDCA	Plan-Do-Check-Act
PIC	Rotterdam Convention on Prior Informed Consent
PIU	Project Implementation Unit
PM	Particulate Matter
PM10	Particulate Matter ≤10 microns
PM2.5	Particulate Matter ≤2.5 microns
PMC	Project Management Consultant
PMF	Probable Maximum Flood
PMG	Project Management Group

Term	Definition
PO	Project Owner
POP	Persistent Organic Pollutant
PPE	Personal Protective Equipment
PR	Performance Requirements
PS	Performance Standard
RAP	Resettlement Action Plan
RBT	Red Book of Tajikistan
RCC	Gravity Roller Compacted Concrete Dam
RCIA	Rapid Cumulative Impact Assessment
RDO	Rugged Dissolved Oxygen
REF	Reference Flow
RLRF	Resettlement and Livelihood Restoration Framework
RMMRS	Republican Military Mine Rescue Service
RoR	Run of River
RPF	Resettlement Policy Framework
RTS	Remote Tunnel Spillways
RTS	Reservoir triggered seismicity (RTS)
SDG	Sustainable Development Goals
SDS	Safety Data Sheet
SEA/SH	Sexual Exploitation and Abuse/Sexual harassment
SECO	Swiss State Secretariat for Economic Affairs
SEE	State Ecological Expertise
SEP	Stakeholder Engagement Plan
SFD	Saudi Fund Development
SGM	DFZ Senior Grievance Manager
SH	Sexual Harassment

Term	Definition
SIC ICWC	Scientific Information Center of the Interstate Commission for Water Coordination
SN	Sanitary Norm
SOP	Standard Operating Procedure
SPS	Safeguard Policy Statement
TA	Technical Assistance
TBIA	Transboundary Impact Assessment
TDS	Total Dissolved Solids
TEAS	Techno-Economic Assessment Studies
TGEM	TajikHydroElectroMontazh
TL	Transmission Line
TMP	Traffic Management Plan
ToR	Terms of Reference
TSC	Total System Costs
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
TWh	Terawatt-hour
UN	United Nations
UN CCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNICEF	United Nations International Children's Emergency Fund
US	United States
USAID	United States Agency for International Development
UXO	Unexploded Ordnance
VC	Valued Components
WB	World Bank

Term	Definition
WBG	World Bank Group
WB SPDs	World Bank Standard Procurement Documents
WFD	Water Framework Directive
WHO	World Health Organization
WWTP	Wastewater Treatment Plant

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1. INTRODUCTION

This document details the process, findings and recommendations of the Environmental and Social Impact Assessment undertaken for the Rogun Hydropower Plant in Tajikistan. The ESIA is divided into three volumes:

- Volume 1: Environmental and Social Impact Assessment
- Volume 2: Environmental and Social Impact Assessment Annexes
- Volume 3: Environmental and Social Management Plans

1.1. PROJECT PROPONENT

1.1.1. This Environmental and Social Impact Assessment (ESIA) has been prepared for the Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan by WSP UK Limited (hereafter referred to as 'WSP') for the Rogun Hydropower Project (HPP) (hereafter referred to as 'the Project').

1.1.2. The Government of the Republic of Tajikistan established:

- Rogun Open Joint Stock Company (OJSC) (hereafter referred to as 'JSC Rogun') to manage construction and operation of the HPP.
- Directorate of Flooding Zone of Rogun HPP (DFZ) for the preparation of the impoundment area, and organize the resettlement of project affected persons (PAPs) in coordination with other government ministries and agencies; and
- Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan (PMG) to liaise with potential financial lenders for the Project.

1.2. INTRODUCTION TO THE PROJECT

1.2.1. The Project was first conceived in the Soviet Union in the 1950s and 1960s, as part of the regional development of the republics that are now independent states in Central Asia. The original purpose of the Project was to provide water regulation for irrigation schemes in Tajikistan, Uzbekistan and Turkmenistan, as well as a power supply for the Soviet Central Asian republics. Site investigation for the Project started in 1967. **Figure 1-1** presents a chronology of events in the development of the Project.

1.2.2. Due to economic and political changes in Tajikistan, the current purpose of the Project is to generate electricity to overcome critical shortages of electricity throughout the winter months and to meet future energy demand in the Republic of Tajikistan, while respecting the water needs of downstream riparian countries.

1.2.3. The Project will also have collateral benefits including:

- Downstream flow regulation potential – the addition of storage capacity provided by the Project reservoir will alleviate shortages in downstream areas during dry years;
- Electricity production for export – electricity generated by the Project will be exported to neighboring countries;

- Flood routing – the Vakhsh cascade, including the Nurek dam, is not designed to withstand the Probable Maximum Flood (PMF) for the Vakhsh River. The Project is designed to withstand the PMF and will therefore provide flood retention capacity and protection to Nurek and downstream dams; and
- Retention of sediments – retention of the high sediment load which would otherwise fill the Nurek reservoir. The Project will effectively extend the life of the Nurek HPP and Vakhsh cascade by over 100 years.

1.2.4. The Project is located approximately 100 kilometers (km) east of Dushanbe on the Vakhsh River. The river is intensively developed and hosts five operational HPP developments, of which the Project is the uppermost. The Vakhsh hydropower cascade currently includes the Nurek HPP, located 70 km downstream from the Project location and downstream of the Nurek, Baipaza, Sangtuda 1, Sangtuda 2 and Golovnaya dams.

1.2.5. Once complete, the height of the dam wall will be 335 meters (m) and a total of six 630 megawatt (MW) turbines will have a generation capacity of 3,780 MW and an average annual output of over 17,000 gigawatt (GW) hours. The Project has an expected life of 110 years, dependent on the sediment inflow. The reservoir will take approximately 16 years to fill to a maximum storage capacity of 13.3 km^3 and will flood an area of 170 km^2 at the full supply level (FSL).

1.2.6. The installation and commissioning of the turbines is being completed incrementally. As of 2023, two 400 MW turbines have been installed and are currently operational. This phase of the Project is referred to as Stage 1 throughout the ESIA. Stage 1 power generation is currently limited to 200 MW per turbine, due to the current reservoir levels, providing a combined capacity of 400 MW of power to the grid.

1.2.7. Stage 1 turbines have been installed with temporary impellers. The impellers will ultimately be replaced by Voith (Austria) as part of the Lot 1 Engineering, Procurement and Construction (EPC) contract, increasing the capacity of each turbine from 400 MW to 630 MW.

1.2.8. The Project has a number of associated facilities, these are described in **Volume 1, Chapter 3: Project Description** of this ESIA.

1.2.9. Construction of the Project (hereafter referred to as Stage 2) is ongoing. According to the most recent construction schedule, the main dam expected to be completed in 2032 with full inundation of the reservoir area expected by 2038 (correct as of March 2024).

1.2.10. A large numbcloser of Project Affected Persons (PAPs) have already been or will need to be relocated because of the Project. Resettlement is managed by the State Enterprise of the Directorate of Flooding Zone (DFZ) and is undertaken in phases aligned with the inundation levels of the reservoir.

1.2.11. The resettlement program includes a total of 69 villages from the Rogun, Nurobod, and Rasht districts affecting over 50,000 PAPs, with almost half from the Rasht district.

1.2.12. In 2014, 2,697 PAPs (under Resettlement Action Plan (RAP) 1) were resettled from eight villages in Rogun City and Nurobod District. A total of 16,919 PAPs are in the second phase of resettlement (RAP 2 2017-2026).

1.2.13. Further RAPs (RAPS 3, 4, and 5) will be developed by DFZ. All resettlement activities are due for completion by 2032. The total number of resettled PAPs throughout the Project life cycle may be

somewhat higher than current estimates, due to natural population growth among affected communities.

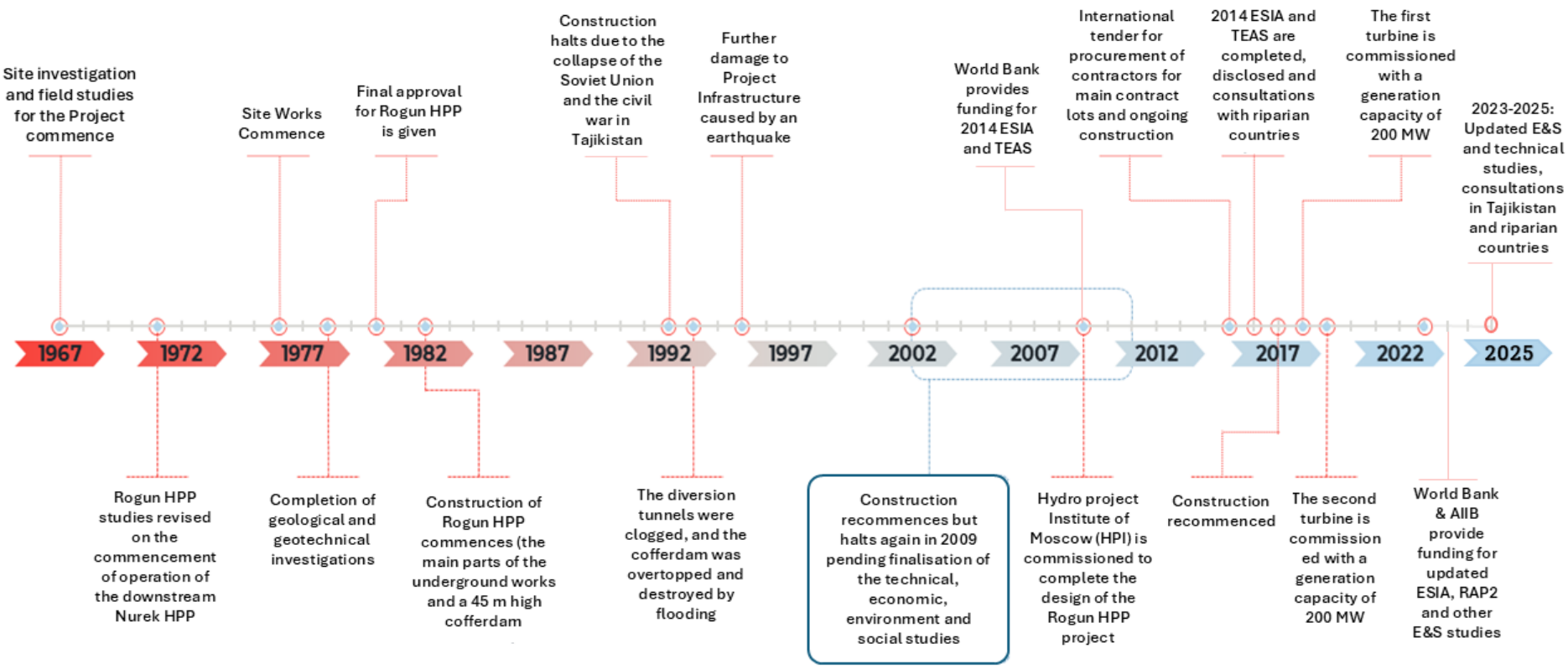


Figure 1-1 – Project Chronology

CURRENT WORKS

1.2.14. At the time of writing this ESIA (2025), large-scale construction activity is currently underway at the site. **Table 1-1** presents the current status of works at the Project site.

Table 1-1 - Current Status of Construction Works

Construction Stage	Description	Completion Date	Status
Pre-cofferdam	River diversion to allow construction to proceed, improving the access road and internal roads, and finalising diversion tunnel No. 3.	2016	Complete
Cofferdam	Construction of cofferdam to crest at 1,050 m asl.	Pre-cofferdam completed in 2016. Cofferdam completed in 2017	Complete
Stage 1 Dam	Construction of dam wall to crest at 1,110 m asl. This is an intermediate stage to allow early electricity generation.	Estimated to be completed in 72-84 months, inclusive of previous stages	Ongoing
Stage 2 Dam	Construction of dam wall to crest at 1,300 m asl with the reservoir level at 1,290 m asl after a 16-year inflow duration (approx. 2038).	Scheduled completion by 2032 or 2033.	Ongoing

1.2.15. Works are being undertaken and completed in four lots, including the main supplier (Lot 1) and three engineer-procure-construct (EPC) contracts (Lots 2, 3 and 4), as described in **Table 1-2.**

Table 1-2 - Description of Primary Contracts for Ongoing Works

Contract	Type	Size	Contract Award & Contractor	Scope
Lot 1 Contract	Electro-Mechanical Equipment	€370 million	Jan 2021; Voith Hydro (Austria)	Installation of four new turbine units, delivery of impellers for two early turbine units. Installation of the balance of plant and control equipment
Lot 2 Contract	Main Dam	US$2.4 billion	Jul 2016; WeBuild (Italy)	Design, procurement and construction of the following works: ▪ Modernization/reconstruction / completion (if necessary) of the diversion tunnels (DT). ▪ Construction of the cofferdam and river diversion.

Contract	Type	Size	Contract Award & Contractor	Scope
				▪ Treatment of the entire dam wall base (salt layer, grout curtain, drainage curtain). ▪ Installation of dam monitoring devices and reservoir monitoring. ▪ Main Dam (elev. 1,300 m asl).
Lot 3 Contract	Right Bank Structures	US$1.7 billion	Jul 2021; TGEM (Tajikistan)	Series of tunnels and spillways that provide adequate flood discharge capacity as the height of the main dam increases and the lower tunnels can no longer provide sufficient flood discharge capacity. Ongoing activity includes underground works, including tunnelling (hydraulic diversion tunnels, transportation tunnels), concrete wall linings and other minor works.
Lot 4 Contract	Left Bank Structures	US$789 million	Not awarded yet "Early works" underway at present	Construction of a multi-level water intake, six inlet pressure tunnels and shafts to hydraulic units and the corresponding outlet tunnels. "Early works" are taking place under Lot 4, including tunnelling for the water intake of the powerhouse, ventilation shafts, etc. These are not being undertaken as part of the EPC contract but by other contractors.

1.2.16. Ongoing construction also involves a number of other contracts pending appointment and full mobilization of EPC Contractors for all four lots.

1.2.17. More detailed descriptions of the current and future Project, the resettlement program, component specifications and Project activities undertaken to date are included in **Volume 1, Chapter 3: Project Description**.

1.3. APPLICABLE LENDER STANDARDS

1.3.1. Several financial institutions (hereafter referred to as 'Lenders') are likely to be involved in the Project. These include the World Bank (WB), Asian Infrastructure Investment Bank (AIIB), Asian Development Bank (ADB), European Investment Bank (EIB), Islamic Development Bank (IsDB), and the OPEC fund. A full list of Lenders is provided in **Volume 1, Chapter 2: Legislation and Standards**.

1.3.2. The Lenders' policies, standards and frameworks detail the E&S performance requirements that are conditional on a Lender providing funding to a project. The World Bank and AIIB provided Technical

Assistance funding in 2022 to allow Tajikistan to undertake project preparation activities including preparation of this ESIA, as well as other technical procurement and E&S studies and activities.

1.3.3. The World Bank and AIIB approved financing in 2024, contingent upon satisfactory completion of the ESIA and other E&S instruments as well as other requirements.

1.3.4. . The overarching E&S framework used in this ESIA is the WB Environmental and Social Framework (ESF) including:

- **Vision for Sustainable Development** which sets out the aspirations of the World Bank for a more environmentally and socially sustainable future.
- **WB E&S Policy for Investment Project Financing** which details the mandatory requirements that apply to the Bank.
- **Environmental and Social Standards (ESS)**: a set of 10 standards which together with their annexes set out the mandatory requirements on Borrowers for managing E&S risks on their projects.

1.3.5. The principles of the Lenders' E&S policies are, with a few exceptions, materially consistent with the WB ESF and compliance with the WB ESF substantially meets the requirements of other Lenders' policies and standards. In a few cases where other Lenders have specific requirements beyond those of the World Bank, these have been addressed as appropriate.

1.3.6. The ESF is supported by several relevant guidance and best practice notes prepared by the World Bank Group that inform the ESIA process. Collectively, these and other accepted guidelines comprise Good International Industry Practice (GIIP) for E&S performance, which the ESF requires to be taken into account in impact assessments. Additional information on the ESF is provided in **Volume 1, Chapter 2: Legislation and Standards**.

1.3.7. In addition to the above, the laws of Tajikistan, including international agreements to which Tajikistan is a party, will apply to the Project.

1.4. PREVIOUS ENVIRONMENTAL AND SOCIAL STUDIES KEY FINDINGS

1.4.1. From 2011 to 2014, the WB provided financing to assess the technical, environmental and social aspects of the Project. In 2014, an ESIA, an Environmental and Social Management Plan (ESMP), a Resettlement Policy Framework (RPF), a Resettlement Action Plan (RAP) for phase 1 of the resettlement program, a Livelihood Restoration Plan (LRP) and a Techno-Economic Assessment Study (TEAS) were prepared, disclosed for public review and comment, and adopted.

1.4.2. The 2014 ESIA was carried out for regulatory purposes to adhere to national legislation on environmental protection and ESIA procedure (No. 464), in addition to the World Bank Operational Policies (OPs), given the participation of the World Bank in the project assessment studies between 2011-2014. The scope of the 2014 ESIA and TEAS assessed the design, construction and full operation up to FSL 1290m.

1.4.3. Throughout preparation of the 2014 ESIA, the WB E&S Panel of Experts (hereafter referred to as '2014E&S PoE'), provided advice to the Government of the Republic of Tajikistan . In their final report, the 2014 E&S PoE concluded that the final draft ESIA *'is of acceptable international standard, and subject to some comments on key issues raised in the present report the Panel agrees with the overall conclusion and recommendations made in the ESIA'*.

1.4.4. In 2021, the WB reviewed the ongoing construction activities to:

- evaluate the adequacy and performance of the mitigation and management measures in the 2014 ESMP;
- assess whether the E&S impacts were being managed to acceptable levels; and
- evaluate the extent to which Rogun JSC and its contractors were implementing the requirements of the 2014 ESMP.

1.4.5. In 2023, the WB and AIIB approved Technical Assistance grants to support PMG in updating the 2014 ESIA and other E&S instruments and undertaking additional studies that are required to ensure the Project's technical and E&S planning and execution complies with the 2018 ESF and Good International Industry Practice (GIIP). The WB and AIIB approved the financing for the Project in December 2024.

1.4.6. In 2023, a newly constituted E&S PoE, whose role is to provide independent advice regarding the measures to enhance the overall environmental and social outcomes of the Project, produced two reports appraising the Project against each of the applicable WB ESF ESS. The E&S PoE reports highlighted several key issues, recommendations on organizational arrangements and E&S capacity building measures that would require consideration within the scope of the ESIA, RPF, Stakeholder Engagement Plan (SEP) as well as additional E&S studies. The E&S PoE findings have been considered within the scope of the ESIA.

1.5. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT SCOPE

1.5.1. This ESIA is an update to the 2014 ESIA for the Project and includes new information and new analysis required to address the issues and concerns raised in recent studies and subsequent to the completion of the 2014 ESIA. The aim of the ESIA update is to ensure the Project E&S planning and execution comply with the Applicable Standards, including GIIP, as described in **Volume 1, Chapter 2: Legislation and Standards**.

1.5.2. The updated ESIA incorporates an impact assessment methodology, characterization of baseline conditions to reflect current conditions, an updated E&S impact assessment, a Cumulative Impact Assessment (CIA) and, amongst other studies, a Carbon Footprint Analysis (CFA), Climate Change Risk Assessment (CCRA) and Minimum Flows Study, which are further described in Section 1.6.

1.5.3. Other key E&S instruments, including management measures, are described in detail in Section 1.6.

1.6. REPORTING APPROACH AND STRUCTURE

1.6.1. This ESIA builds on the findings and information presented in previous studies, input from the current ESPOE, and additional reports, studies and data etc prepared and collected since the issue of the 2014 Rogun ESIA. . This will enhance and address the key E&S issues resulting from ongoing construction and development of the Project, as well as updates to the Applicable Standards.

1.6.2. The ESIA update is informed by several key documents which include (but not limited to):

- ESIA for Rogun Hydro Power Plant (2014) consisting of three Volumes (ESIA, Technical Annexes and an ESMP);
- LRP for Stage 1 (2015).
- Phase 1 RAP (2014)

- RAP2/LRP2 for 2017-2026 (2018, 2025);
- RPF for Stage 1 (2014); Resettlement and Livelihood Restoration Framework (2024)
- Techno-Economic Assessment Study (TEAS) (2014).

1.6.3. This ESIA presents the findings of the assessment for the following E&S topics, across three volumes, including the potential for significant effects and identifies suitable mitigation measures. An overview of the structure of this ESIA includes:

- Volume 1: ESIA (**Table 1-3**) Volume 2: ESIA Annexes (**Table 1-4**)
- Volume 3: Management Plans are presented in (**Table 1-5**)

Table 1-3 – Volume 1: ESIA Report Structure

Chapter(s)	Title	Description
1	Introduction	Sets out the project background and the scope and structure of this ESIA.
2	Legislation and Standards	Describes the international agreements and national regulatory regime that provides the legal framework for the Project. International lender standards and guidelines applicable to the Project are also described.
3	Project Description	Describes the current and future development of the Project, including the specifications, components and activities undertaken to date. The Project description provides the information needed to inform the ESIA and includes qualitative and quantitative information on core Project components and Associated Facilities (AFs).
4	Alternatives to the Project	Presents the analysis of alternatives considered during the feasibility stage and site selection process and the reasons for the decision to take the Project forward at the selected site. This chapter is based on the assessment presented in the 2014 ESIA.
5	Impact Assessment Methodology	Outlines the proposed approach and method for the assessment of the significance of impacts.
6	Stakeholder Engagement	Presents an overview of stakeholder analysis, communications and consultation activities planned for the Project. Additionally, a summary of the issues identified by stakeholders to date and how these have been addressed is provided.
7	Environmental and Social Baseline	Lists the sources of secondary information used for the environmental and social baseline relevant to the Project Area of Influence (AoI) is provided. This chapter is supported by Annex 7.1 – Environmental and Social Baseline Conditions Report.
8 - 22	Impact Assessments	Describes the identification and assessment of potential environmental and social impacts, both adverse and beneficial, associated with the Project and the measures adopted to mitigate and manage impacts, alongside enhancement measures for opportunities for improved environmental and social performance. The impact assessment is detailed in the following chapters: ▪ 8) Air Quality ▪ 9) Greenhouse Gases ▪ 10) Climate Change ▪ 11) Noise and Vibration ▪ 12) Soils and Geology ▪ 13) Water Environment ▪ 14) Landscape and Visual ▪ 15) Biodiversity ▪ 16) Ecosystem Services

Chapter(s)	Title	Description
		▪ 17) Socioeconomics ▪ 18) Community Health, Safety and Security ▪ 19) Labor and Working Conditions ▪ 20) Cultural Heritage
21	Major Accidents & Disasters (MA&D)	Details the consideration and high-level assessment of likely significant adverse effects deriving from the vulnerability of the Project to relevant major accidents and/or disasters related to natural or human-made hazards (including operational failure).

Table 1-4 - Volume 2: ESIA Annexes

Annex	Title
7-1	Environmental and Social Baseline Conditions Report
12-1	Contaminated Land
13-1	Minimum Environmental Flows
13-2	Reservoir Slope Stability
13-3	Water Resources Modelling
15-1	Critical Habitat Assessment
17-1	Gender Assessment
17-2	Severance Impact Assessment
20-1	Gazetteer of Archaeological, Historic, Paleontological, Cultural and Sacred Sites
20-2	Gazetteer of villages
20-3	Village Ethnography Data
20-4	M-Vector Household Data
20-5	Cultural Heritage Drawings
20-6	Cultural Heritage Field Reports
24-1	Transboundary Cumulative Impact Assessment

Table 1-5 – Volume 3: Management Plans

Plan	Name
A1	Environmental and Social Management Plan (ESMP)
A2	Resettlement Action Plan 2 (RAP 2)
A3	Livelihood Restoration Plan 2 (LRP 2)
A4	Biodiversity Management Plan (BMP)
A5	No Net Loss Framework (NNLF)
A6	Cultural Heritage Management Plan (CHMP)
A7	Security Management Plan (SMP)
A8	Community Health and Safety Plan
A9	Traffic Management Plan (TMP) (Onsite/Offsite)
A10	Reservoir Landslide Management and Monitoring Plan
A11	Ancillary Works Plan
A12	Labor Management Procedures
A13	Stakeholder Engagement Plan
B1	Outline Excavation Spoil and Fill Storage Management Plan
B2	Outline Noise and Vibration Management Plan
B3	Outline Non-hazardous and Hazardous Waste Management Plan
B4	Outline Water and Wastewater Management Plan
B5	Outline Hazardous Materials Management Plan
B6	Outline Air Quality Management Plan
B7	Outline Site Rehabilitation Plan
B8	Outline Erosion Control Plan
B9	Outline Blasting and Explosives Management Plan
B10	Outline Worker Accommodations Management Plan
B11	Outline Retrenchment Plan
B12	Outline Emergency Preparedness and Response Plan
B13	Outline Occupational Health and Safety Plan

Plan	Name
B14	Outline Demolition Plan (Asbestos);

PUBLIC

JSC “Rogun HPP”

State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT – UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Volume 1, Chapter 2: Legislation and Standards



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2. LEGISLATION AND STANDARDS

2.1.1. This chapter summarizes the international agreements, Lender standards and Tajik national laws and regulations that are applicable to the Project.

2.2. INTRODUCTION

2.2.1. The ESIA is required to align the Project E&S performance to comply with several standards, including the international agreements that Tajikistan is party to, the international Lender E&S policies and guidelines that apply to the Project (hereafter referred to as 'the Applicable Standards') and Tajik national legislation and regulations. The relevant standards include but are not limited to:

- Tajikistan law, including international agreements to which Tajikistan is a party;
- The World Bank (WB) ESF (2018), the WB Group (WBG) General Environmental, Health, and Safety (EHS) Guidelines (2007); the Industry Sector EHS Guidelines which provide guidance on EHS issues in specific industry sectors; and relevant Operational Policies, including 7.50;
- The European Investment Bank (EIB) Environmental and Social Framework (ESSF), consisting of the E&S policy (2022) and revised E&S standards (2022); and the EIB Environmental, Climate, and Social (ECS) Guidelines on Hydropower Development (2019);
- Asian Development Bank (ADBlabor code): Safeguard Policy Statement (SPS) (2009) and associated safeguard documents;
- Asian Infrastructure Investment Bank (AIIB): Environmental and Social Framework (2019, 2021, 2022, and 2024); and
- Other environmental and social standards, objectives and goals prescribed by the Islamic Development Bank, the Eurasian Development Bank (EDB); the Saudi Fund for Development (SFD) and the Kuwait Fund for Arab Economic Development (KFAED).

2.2.2. The overarching E&S framework used in this ESIA is the WB ESF. The principles of the Lenders' E&S policies are, with a few exceptions, materially consistent with the WB ESF and compliance with the WB ESF substantially meets the requirements of other Lenders' policies and standards. In a few cases where other Lenders have specific requirements beyond those of the World Bank, these have been addressed as appropriate

2.3. TAJIK REGULATORY REGIME

2.3.1. **Table 2-1** provides a list of the Tajik government organizations that have environmental and social responsibilities for the Project.

Table 2-1 – Government Organizations with Environmental and Social Responsibilities

Government Organization	Responsibility
National Government Organizations	
Committee for Environment Protection (CEP) under the Government of the Republic of Tajikistan	The government executive body responsible for environmental protection, sustainable use of resources, forestry and hydrometeorology is responsible for decision-making related to environmental issues such as sustainable land use, deterioration of soil fertility, excessive use of water for irrigation, flooding problems, and obsolete/banned pesticides. CEP is responsible for: • Defining the main strategies for the protection, study, conservation and sustainable use of natural resources and mitigation of climate change effects; • Drafting laws and other regulatory documents, including environmental standards, instructions, and methodologies for the use of resources; • Issuing individual permits for the use of specific resources and withdrawing these if the user violates their terms; • Carrying out ecological assessments of planned activities; • Defining the system of specially protected territories and maintaining State cadastres of such territories, and of forests, factories, water bodies, and hazardous waste; • Regulating the use and protection of waters and the issuance of permits (licences) for special water usage; • Implementing the Water code in conjunction with the Ministry of Energy and Water Resources; and • Implementing the requirements of the law of State Environmental Expertise (SEE).
Ministry of Energy and Water Resources - Department of Water Resources and Cadaster	Responsible for the development of guidelines and collection of data on surface and groundwater resources, quality, allocations and publication of data.
Ministry of Justice	Executive body implementing the state policy and normative legal regulation in the sphere of legal aid to the citizens, promotion of legal and criminal justice, and judicial and criminal prosecutions. The Ministry of Justice also manages the registration of civil status acts, non-governmental organizations, and public associations, as well as the provision of legal aid to citizens.
Ministry of Health and Social Protection	Responsible for the development and implementation of policy, regulations and norms related to public health.

Government Organization	Responsibility
Ministry of Labor, Migration and Employment	Responsible for developing and implementing policies relating to employment, labor issues, workplace safety and migration practices.
State Statistical Committee	Collects, processes, and disseminates statistical data on the economy, population, social development, and the environment. This includes monitoring air quality, water resources, and waste management. The committee's reports are essential for informing policy decisions and guiding efforts to protect the environment and promote sustainable development in Tajikistan.
Committee for Emergency Situations and Civil Defense under the Government of the Republic of Tajikistan	Responsible for emergency response within Tajikistan, including seismic and human-made disasters. Supports the implementation of the Water Code with the CEP.
Committee of Women and Family Affairs	Responsible for gender issues and implementation of family policy.
Committee for Architecture and Construction under the Government of the Republic of Tajikistan	Responsible for regulating and overseeing the architectural and construction sectors in the country. It sets standards and guidelines for construction projects, issues permit, and ensures compliance with building codes and regulations. The committee also plays a role in urban planning, infrastructure development, and the preservation of architectural heritage. Its work is essential for ensuring the safety, quality, and sustainability of construction projects in Tajikistan.
Agency of Standardization, Metrology, Certification and Trade Inspection under the Government of the Republic of Tajikistan	Responsible for setting all standards in Tajikistan, e.g. drinking water quality and other standards.
Service for State Supervision of Works Safety in Industry and Mining under the Government of the Republic of Tajikistan	The Service on the state supervision of safe operation in the industry and mining is specially authorized central executive body performing activities for regulation of regulatory legal acts of industrial safety, control and supervision of compliance with law in the field of rational use and protection of subsoil, to the mining sphere, control of geological studying of subsoil, turnover of explosive materials of civil appointment, safe operation in chemical and metallurgical industry, safety of load-lifting constructions, the vessels working under pressure and the attraction equipment.
State Sanitary and	Responsible for carrying out sanitary and epidemiological supervision to ensure the sanitary and epidemiological safety of the

Government Organization	Responsibility
Epidemiological Service of the Republic of Tajikistan	population of the Republic of Tajikistan. It operates under the Ministry of Health and Social Protection of the Republic of Tajikistan and is authorized by the Government of the Republic of Tajikistan to conduct state sanitary and epidemiological supervision. Its organizational and managerial documents include acts such as sanitary-epidemiological survey reports, sanitary-epidemiological prescriptions, protocols on sanitary-epidemiological violations, resolutions on imposing fines, resolutions on suspending the operation of facilities, sanitary-epidemiological conclusions, and agendas for explaining sanitary-epidemiological violations, approved by the Chief State Sanitary Doctor of the Republic of Tajikistan and registered in accordance with the legislation.
Main Department of the State Fire Service of the Ministry of Internal Affairs of the Republic of Tajikistan	Responsible for overseeing and managing fire safety and prevention activities throughout the country. It is tasked with ensuring compliance with fire safety regulations, conducting fire inspections, and responding to fire emergencies. The department educates the public and firefighters on fire safety, maintains firefighting equipment, and investigates the causes of fires. It also collaborates with other agencies and organizations to enhance fire safety measures.
State Forestry Agency under the Government of the Republic of Tajikistan	Responsible for formulating and implementing unified state policies, regulatory and legal frameworks, and state management in forestry, forest resources, hunting, and game management.
State Committee on Investment and State Property Management	Responsible for various investment-related functions, including asset valuation and established to streamline public administration reforms and manage state property, investment attraction, and entrepreneurship support
Ministry of Agriculture	Responsible for overseeing agricultural policies, development, and management within the Republic of Tajikistan. The department creates and implements policies to enhance agricultural productivity and sustainability. As well as coordinating with international organizations to fulfil obligations under global conventions and agreements.
Ministry of Transport	Responsible for overseeing the country's transportation infrastructure, policies, and development. The department plays a crucial role in ensuring the efficient movement of goods and people, both domestically and internationally. It is responsible for the development and maintenance of road networks, formulating policies to enhance transportation systems and services, and implementing safety standards and regulations for all modes of transport
Ministry of Finance	Responsible for managing the Republic of Tajikistan's public finances, including budgeting, fiscal policy, and financial regulation. In addition, to engaging with international financial organizations and donors to secure funding and support for development projects.
State Committee on Land	Responsible for overseeing land management, geodesy, and cartography within the Republic of Tajikistan. Established by the

Government Organization	Responsibility
Management and Geodesy	government to enhance the structure of central executive bodies, it plays a crucial role in managing land resources, conducting geodetic surveys, and maintaining accurate maps and spatial data.
Local Government Responsibilities	
Local Hukumat at municipal and district levels	The Hukumat is the local executive body responsible for the implementation of national policy and administration of State services and regulations.
Jamoat	A Jamoat is a smaller administrative body within a Hukumat and may include one or more settlements or villages. The Jamoat is responsible for organizing community-based delivery of public services. A Jamoat has no budgeting authority and consequently is limited in its role; principally in implementing the Land Code through allocating land and terminating rights to land and assigning new land.

2.4. NATIONAL ENVIRONMENTAL AND SOCIAL REGULATORY FRAMEWORK

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

2.4.1. Three laws establish the requirements for impact assessment in Tajikistan:

- The Law on Environmental Protection (2011);
- The Law on Ecological Expertise (2012); and
- The Law on Environmental Impact Assessment (2017).

2.4.2. The Laws on Environment Protection, Environmental Impact Assessment and Ecological Expertise requires the Government to approve a list of activities for which a complete EIA is mandatory.

2.4.3. The Law on State Ecological Expertise (SEE) defines the principles and procedures for environmental impact assessment to prevent proposed activity causing harm to the environment. The Law also regulates social, economic and other consequences of the implementation of the proposed project.

2.4.4. The SEE examines the compliance of proposed project activities with environmental legislation and standards to ensure that probable social, economic and ecological consequences are scientifically considered, findings are justified, comprehensive and objective and the development is in accordance with the law. The SEE must conclude that economic and other activities can be implemented in accordance with existing environmental standards with sufficient environmental protection and mitigation measures. Financing of programs and projects is allowed only after a positive SEE finding.

2.4.5. An Environmental Impact Assessment (EIA) study is a component of the SEE, as set out in the 2011 amendments to the Environmental Protection Law and in the Law on the State Ecological Expertise (2012).

2.4.6. The EIA is the responsibility of the Project and must analyze the short- and long-term environmental, genetic, economic, and demographic impacts and consequences. SEE for all investment projects is the responsibility of the Committee for Environmental Protection (CEP) and its regional offices, under the Government of Tajikistan. All civil works must be assessed with impacts and proposed mitigation which is reviewed and monitored by CEP.

2.4.7. Conducting the EIA study is the responsibility of the project proponent. The Procedure for carrying out the EIA (Government Resolution No. 532 of November 1, 2018) establishes general requirements for the contents of the EIA documentation.

2.4.8. The current guidelines for EIA do not require a preliminary assessment (screening) of a proposed project to decide whether an EIA is required as the list of objects and activities for which an EIA is required is detailed. In addition, the guidelines do not define the scope of the EIA.

2.4.9. **Table 2-2** provides a list of the relevant laws on the protection of the environment, with a summary of the objectives and the relevance to the Project.

Table 2-2 - National Laws on Environmental and Social Protection

Legislation	Objective	Relevance to Project
The Constitution of the Republic of Tajikistan	The Constitution of the Republic of Tajikistan (1994, as amended in 2003) guarantees citizen's rights and recognizes the importance of Environmental Protection, including the following key articles: Freedom of Thought (Article 30), Right to Health (Article 39), Environmental Protection (Article 43), Anti-discrimination (Article 14), Safeguarding Nature (Article 22), Freedom to Associate (Article 32), and Right to Petition (Article 37).	Safeguards rights of citizen's working on or affected by the Project.
The Law on Environment Protection (21 July 2011, № 208)	The Law stipulates that Tajikistan's environmental policy should give priority to environmental actions based on scientifically proven principles, to combine economic and other activities that have an impact on the environment with nature preservation and the sustainable use of resources. The Law defines the applicable legal principles, the protected objects, the competencies and roles of the Government, the CEP, local authorities, public organizations, and individuals. The Law also stipulates measures to secure public and individual rights to a safe and healthy environment and requires a combined system of ecological expertise and environmental impact assessment of any decision on an activity that could have a negative impact on the environment.	Governs the protection of natural resources that are impacted by a project. The Project must comply with these requirements alongside those of the Lenders.
The Law on Ecological Expertise (16 April 2012, № 818)	This Law determines the principles and procedure for conducting environmental assessment and is directed at the prevention of harmful effects of implementation of the planned activity on the environment and related social and economic conditions. The Law regulates	Sets out the need for independent environmental expertise in undertaking assessments under Tajik law.
Law of the Republic of Tajikistan on Environmental Impact Assessment (18 July 2017, № 1448)	This Law establishes the general provisions for EIA, including the principles of evaluation of the impact on the environment; the competencies and powers of state authorities; the procedure for conducting the EIA, including the mandatory requirements and phases of the process. It also defines the roles, rights, and duties of public associations in the EIA and the rights of citizens for access to information on the EIA.	Safeguards the rights of Project-Affected People and organizations to receive information on the Project throughout the EIA and construction processes.
Law of the Republic of Tajikistan on Environmental Monitoring	This Law determines the organizational, legal, economic and social basis for ensuring environmental monitoring.	Governs the requirements around monitoring of potential Project environmental and social effects.

Legislation	Objective	Relevance to Project
(March 25, 2011)		
Law of the Republic of Tajikistan on Environmental Audit (December 26, 2011)	This Law determines the principles and procedures for carrying out environmental audits.	Governs the requirements around Project reporting and audits during the construction and operation phases.
Law of the Republic of Tajikistan on Specially Protected Natural Areas and Objects (26 December 2011, № 788)	This Law determines legal, organizational, and economic basis of protected natural territories, and sets their objectives, the mode of activities and zoning.	Potentially relevant under the Biodiversity Management Plan
Law of the Republic of Tajikistan on Fauna (January 5, 2008) (as amended of the Law of the Republic of Tajikistan on 24.12.2022, No. 1937)	This Law establishes the general principles for the protection, recovery, and reasonable use of fauna. It establishes the legal, economic, and social basis of industry with a primary focus on the protection and recovery of fauna resources.	Relevant to the management of the effects on biodiversity and the development of the various management plans for the Project.
Law of the Republic of Tajikistan on Protection and Using of Flora (2004, amended in 2008)	This Law defines principles of the state policy in the field of protection and rational use of flora, determines the legal, economic, and social basis in this area, and is directed at preserving and reproducing of flora resources.	Relevant to the management of the effects on biodiversity and the development of the various management plans for the Project.
Forest Code of the Republic of Tajikistan (2011)	The Code regulates forestry and is directed at creating use of forests, their safekeeping and protection, conservation and improvement of the natural environment, and protection of timber and agricultural products.	Relevant to the management of the effects on biodiversity and the development of the various management plans for the Project.

Legislation	Objective	Relevance to Project
Law of the Republic of Tajikistan on Air Protection (2012)	The Law on Air Protection defines the economic mechanism for air protection, including its objectives, sources of financing for air protection measures and payments for air pollution (within and beyond established limits).	Protection of the workforce on site from adverse air quality during construction and operation, as well as nearby communities.
Law of the Republic of Tajikistan on Soil Protection (October 16, 2009)	Determines the basic principles of state policy, the legal basis of activities of public authorities, natural persons and legal entities for the purpose of rational and careful use of soils, preserving quality, fertility and protection of soils against negative phenomena, and governs the complex of relations connected with the protection of soils.	Governs the requirements around preservation of soils where practicable during stripping and stockpiling and reuse.
Law of the Republic of Tajikistan On Production and Consumption Waste (2005, last amended in 2011)	This Law establishes the principles for the collection, storage, use, transportation, neutralization, and disposal of waste materials. It defines the public administration, supervision and control in the field of waste and is designed to prevent adverse effects on the health of the workforce involved in the waste industry. In addition, the law states that payments for waste disposal depend on the volume of waste and its toxicity.	Governs the requirements around the life cycle of all material use, reuse and disposal during the Project construction and operation phases.
The Water Code (2000, last amended 2012)	The Law establishes policies on water management, permitting, dispute resolution, usage planning and cadaster. It promotes rational use and protection of water resources exercised by all beneficiaries and defines the type of water use rights, authority and roles of regional and local governments for water allocations among various users, collection of fees, water use planning, water use rights and dispute resolution.	Governs the use of water and sustainable use of water resources during the Project construction and operation phases, including resettlement.
Law of the Republic of Tajikistan on Hydrometeorological Activity (2002)	This Law sets the legal basis of activities in the field of hydrometeorology. The objective is to direct the needs of the state, physical persons and legal entities in providing hydrometeorological as well as environmental information.	Provision of environmental information for the Project.
Law of the Republic of Tajikistan on the drinking water and drinking water supply (December 29, 2010)	Establishes legal, organizational, economic and social basis of potable water provision. The state guarantees the provisions of drinking water, water disposal, and drinking water quality and safety.	Safeguards workers as well as resettled households regarding the provision of safe drinking water and sanitary waste removal.

Legislation	Objective	Relevance to Project
Code of Health Care of the Republic of Tajikistan of May 30, 2017. No. 1413 (as amended by the Law of the Republic of Tajikistan of 29.01.2021 No. 1762)	This Code governs the public relations regarding healthcare and is aimed at the implementation of constitutional rights of citizens and health protection.	Safeguards the rights of workers during construction and operation to healthcare, as well as supporting resettlement in terms of levels of healthcare provision.
Law of the Republic of Tajikistan on the protection of population and territories from emergency situations of natural and human-made character (July 15, 2004)	This Law governs public relations regarding the prevention of emergency situations, decreasing the extent of damage and losses from emergency situations, resolution of emergency situations and the timely notification of the population of dangerous areas resulting from emergency situations of a natural and technogenic nature.	Safeguards the rights of citizens and workers under emergency scenarios during Project construction and operation phases, including during earthquakes and a dam wall breach.
Law of the Republic of Tajikistan on the Fire Safety (December 29, 2010)	Determines general legal, economic, social, and organizational basis of ensuring fire safety in the Republic of Tajikistan.	Outlines the requirements for fire prevention and management in buildings for Rogun HPP and emergency response.
Law on the Safety of Hydraulic Structures (2010 as amended in 2018)	Governs requirements for ensuring safety during design, construction, commissioning, operation, maintenance, reconstruction, and decommissioning of hydraulic engineering structures. Establishes the obligations of public authorities, owners and operators of these structures.	Relevant for the construction and operation of the dam.
The Land Code 1992, as amended 2016.	The Land Code regulates land relations and provides for "use and protection of land and soil fertility ...". Land is subject to rational use and the Code allows local authorities to make decisions regarding "rational" land use.	Relevant to the resettlement of Project Affected People (PAPs).
Law of the Republic of Tajikistan on the Land Reform (March 5, 1992)	The Law provides a set of legal, economic, organizational and technical measures to facilitate new land development.	Governs the transition of land for development including the resettlement areas.

Legislation	Objective	Relevance to Project
Law of the Republic of Tajikistan on Land Valuation (May 12, 2001)	Establishes the legal basis of land assessment in the Republic of Tajikistan and determines the criteria used in evaluating the land.	Established the valuation requirements for land in relation to resettlement.
Law of the Republic of Tajikistan on Land Management (January 5, 2008, amended 2016)	The Law requires authorities to perform mapping and monitoring of land quality, including soil pollution, erosion and waterlogging.	Establishes the requirements around managing the land on the Project especially in relation to pollution.
Law on the Licensing of Certain Types of Activities (2004, amended in 2015)	The Law includes several types of activities, in particular handling hazardous waste, environmental audits and collection and processing of scrap metals.	Outlines the requirements around waste management for the Project.
The Civil Code	The Code regulates the legal status of participants in civil transactions and property and non-property relations.	Relevant to the resettlement of PAPs.
Housing Code of the Republic of Tajikistan 2022.	Establishes the right to housing and sets out the conditions upon which people can be evicted or deprived of the right to use a dwelling.	Relevant to the resettlement of PAPs.
Economic Procedural Code of the Republic of Tajikistan 2008.	Protection in case of legal proceedings on matters related to involuntary resettlement.	Relevant to the resettlement of PAPs.
Civil Procedural Code of the Republic of Tajikistan 2008.	Establishes the procedure, rules and conditions for judicial protection in the event of legal proceedings on issues related to involuntary resettlement.	Relevant to the resettlement of PAPs.
State Registration of and Rights to Real Estate Act 2008 (No. 3)	Establishes the legal basis for registration of real estate rights and restrictions on these rights.	Relevant to the resettlement of PAPs.

Legislation	Objective	Relevance to Project
Land Administration Act 2016.	Obliges the authorities to map and monitor the quality of land, including soil contamination, erosion and logging.	Outlines requirements for monitoring impacts on natural resources such as woodland.
Code of Administrative Violations (2010)	The Code establishes administrative liability for organizations, their officers, and individuals for a range of violations, including careless treatment of land, violation of rules for water use or water protection or failure to comply with SEE. The 1998 Criminal Code also covers crimes against ecological safety and the environment, such as violations of ecological safety at work, poaching and spoiling land, as well as violation of rules for the protection and use of underground resources. The maximum fine is up to 2,000 minimal monthly salaries and the maximum sentence is up to eight years in prison.	Establishes the Polluter Pays Principle for a wide range of environmental violations that may arise from activities undertaken during the Project construction and operation phases.
Law on Environmental Information (2011)	The Law defines the legal, organizational, economic and social rationale for providing environmental information and establishes the right of individuals and legal entities to receive complete, reliable, and timely environmental information. Article 4 provides the right of access to environmental information and Article 8 defines the conditions for restricting access to environmental information.	Safeguards the rights of Citizens to the provision of information on the Project and the level to which information can be provided, especially where sensitive information is requested.
The Land Code (1996, last amended 2016)	The Constitution of the Republic of Tajikistan establishes exclusive state ownership of land. The Law establishes the rules that control the assignment and termination of the rights to use (or lease) land. Rights to use land can be primary or secondary. Primary use rights include perpetual use, limited or fixed-term use up to 20 years and life-long inheritable tenure	Outlines the rights of citizens and others to land and its use, especially regarding resettlement
The Law on Subsoil (1994)	This Law establishes the legal basis for the study, protection and use of subsoil. Extraction of common minerals such as sand, clay and gravel in their natural form with little processing and cleaning to meet local economic needs may be undertaken without permission. Article 15 allows the owners of land rights to extract common minerals to a depth of five meters, without the use of explosives.	Outlines the requirements around extraction of materials, especially in relation to Project borrow areas and quarries.
The Law on Pastures (2013)	This Law defines the basic principles of pasture use, including protection of pastures and the environment, and attraction of investments for more effective use and protection of pastures. The Law specifies the powers of local administrations to control environmental safety and	Sets out the requirements around activities on pastureland, with

Legislation	Objective	Relevance to Project
	pasture use in accordance with state regulations and standards. The law prohibits the implementation of a few activities in pastures, such as cutting down trees or bushes, building roads, misuse of grazing land, pollution of the environment with waste and grazing of livestock beyond the established limit. The Law requires users to ensure the effective use of pastures, including the protection of pastures against degradation and pollution.	relevance to inundation and resettlement.
The Law on Dehkan Farms (2016)	This Law provides the legislative basis for the establishment and operation of privately owned commercial farms known as Dehkan farms. According to the Law of 2009, Dehkan farms carried out activities without any legal status, but the new Law allows Dehkan farms to obtain the status of legal entities. It also clarifies and fixes the rights of members of Dehkan farms as land users. The law improves the management of Dehkan farms and defines the rights and duties of their members. It allows farmers to legally erect field camps on land as temporary buildings, which makes it possible to significantly improve productivity during the agricultural season. The law requires Dehkan farms to take measures to improve soil fertility and improve the ecological status of lands, make timely payments for water and electricity and provide statistical information to government agencies.	Safeguards the rights of certain farms and farmers and is especially relevant to resettlement.
The Law about Culture (No. 2033 as of January 3, 2024)	Protection of cultural heritage is grounded in paragraph 44 of the Constitution, which requires all citizens to respect and protect historical and cultural monuments. This law establishes rights concerning cultural activities, including intangible cultural heritage and requires protection, management and monitoring of historical and cultural monuments. Heritage resources are found in archaeological sites, sites of ancient settlement, tumuli, remnants of ancient settlements, castles, industries, channels, roads, ancient burial places, stone sculptures, graven images, antiquity items and places of ancient settlements. The Ministry of Culture and its local representative offices are primarily responsible for protecting cultural heritage.	Outlines the requirements around protection of historic and cultural monuments. Especially relevant in the Project inundation zone.
Law on Protection and Use of Historical and Cultural Heritage (2012)	The objective of the Law is, among others, to regulate the protection and effective use of cultural heritage objects for the benefit of society., including works of art, sculpture, applied decorative arts and other objects that have historic, cultural, architectural, urban planning, art and aesthetic value. The Law establishes state control over preservation and use of historical and cultural heritage objects to fulfill international obligations, the creation of favorable conditions for storage and	Outlines requirements for the investigations required to determine the presence of cultural heritage resources within the Project area with appropriate conservation measures.

Legislation	Objective	Relevance to Project
	restoration of objects of historic and cultural significance, the determination of responsibility for damaged to heritage resources caused by action or inaction and establishing a database of cultural objects.	
The Labor Code (2016)	The Labor Code prohibits discrimination in employment and sets the minimum age of employment, as well as the conditions under which minors can work and establishes rules for the employer-employee relationship and for protection of workers. The Code prohibits forced labor and underage labor. The Code establishes rules for minimum wages, leave, overtime and has provisions for pregnant women and caregivers for children. It also sets the rules for settling disputes between workers and employers. The Labor Code stipulates requirements for occupational health and safety. It establishes the right of workers to workplaces that are protected from exposure to dangerous and harmful factors. Employers are required to tell workers of the risks and hazards of their jobs and requires employers to provide appropriate personal protective equipment. Employers are required to provide workers with compulsory social insurance against accidents, disease or injuries that may result from undertaking the work. Workers the right to refuse to undertake work that violates labor protection requirements. In addition, workers engaged in hazardous working conditions are entitled to free medical and preventative care, additional paid leave and other benefits and compensation. In case of disability or death, employers must provide compensation in multiples of average annual earnings. Employers must train workers in performing their work safety and must provide collective and personal protection of workers.	Safeguards the rights of workers, women and children. Incorporated into the Project labor management practices.
Law on Labor Protection (2009, No, 517)	This law establishes the legal framework for labor protection, aiming to create safe working conditions that preserve the life and health or workers.	Safeguards the rights of workers, incorporated into the Project labor management practices.
Law on Minimum Wage (2024, No. 1009)	This law sets the minimum wage standards and ensures workers receive fair labor compensation	Safeguards the rights of workers, incorporated into the Project labor management practices.

Legislation	Objective	Relevance to Project
The Law on Equality and Elimination of all forms of discrimination (2022)	All citizens of Tajikistan have the right to equality and effective protection against discrimination in all its forms. National legislation prohibits “sexual harassment and non-physical harassment in the workplace.”	Safeguards the rights of workers and PAPs to equal opportunity and treatment.
The Law on Public Associations (2007, last amended 2019)	Under the Law on Public Associations (2007), a public association may be constituted in one of the following organizational and legal types: public organization, public movement, or a body of public initiative. This legislation requires NGOs to notify the Ministry of Justice about funds received from international sources prior to utilizing the funds and to post financial information on their websites.	Safeguards the rights of citizens with interest in the Project to form a public organization (NGOs).
The Law on Public Meetings, Demonstrations and Rallies (2014)	Article 10 of the Law bans persons with a record of administrative offences (i.e., non-criminal infractions) under Articles 106, 460, 479 and 480 of the Code for Administrative Offences from organizing gatherings. Article 12 of the law establishes that organizers must obtain permission fifteen days prior to organizing a mass gathering.	Outlines the requirements for public demonstrations by citizens. Relevant for demonstrations that may be organized.
Law on the Self-Government of Settlements and Villages (August 5, 2009, No. 549)	This Law empowers a Jamoat with broad authority and a mandate to support community efforts to address local socio-economic needs.	Outlines the requirements for local government, especially in relation to resettlement.
Law of the Republic of Tajikistan “On Fish Farming, Fishing and Protection of Fish Resources” (July 19, 2022 No.1892)	The Law establishes the legal and organizational framework for the development of commercial fisheries, aquaculture activities, catching and processing of fish and stipulates measures for the protection of aquatic bioresources and their habitat. The Law also regulates public relations regarding aquaculture, fishing and the protection of fish resources.	The Project must assess and mitigate potential impacts on aquatic ecosystems and fish populations, ensuring compliance with national environmental standards.
Law on the Prevention of Violence in the Family (LPDV) (enacted 2013).	This law focuses on the prevention of domestic violence and provides administrative measures rather than criminal penalties. These measures include protective orders and recognize victims' rights to receive legal, medical, and psychosocial support. The Law governs the prevention of domestic violence (DV) and determines tasks of the agencies responsible for prevention of	Relevant to the resettlement of PAPs.

Legislation	Objective	Relevance to Project
	violence in the family including measures for identification, prevention and elimination of conditions that promote violence.	
Law on Freedom of Information (2008)	This law is part of a legal framework (underpinned by Article 25 of the Constitution) governing media and public access to information. This law ensures that citizens have the right to access information held by public authorities, promoting transparency and accountability	Safeguards the rights of citizens with public access to information about the Project.
Law on the Appeals of Individuals and Legal Entities (2016)	This law contains legal provisions on established information channels for citizens to file their complaints, requests and grievances. Article 14 of the Law sets the timeframes for handling grievances, which is 15 days from the date of receipt that do not require additional study and research, and 30 days for the appeals that need additional study.	Safeguards the GRM process for the Project.
Regulation "about compensation of losses to the land users and losses of agricultural products" Decree of Government of Republic of Tajikistan, 2000. № 515.	Sets out the framework for reimbursement for land users' losses in the case of expropriation.	Relevant to the resettlement of PAPs.
Regulation № 641 "On the order of compensation for losses of land users and damage of the agricultural production process" (30 December 2011).	Sets out an order of compensation of losses of land users.	Relevant to the resettlement of PAPs.
Resolution of the Government of Tajikistan of January 20, 2009, No. 47, "On the Resettlement from the Flood Zone of Rogun HPP of the Population of	Regulates the resettlement of people living within the flooding zone of Rogun HPP (in Rogun city and Nurobod).	Relevant to the resettlement of PAPs.

Legislation	Objective	Relevance to Project
Rogun City and Nurobod District".		
Resolution No. 162 of March 28, 2015, "On modifications and additions to Resolution of the Government of Tajikistan No. 47 of January 20, 2009".	Regulates the compensation process for resettlement from the Rogun HPP flood zone.	Relevant to the resettlement of PAPs.
Finalization of the Construction - Project Station Measures to Create a Reservoir (TOM VII 1900- 08-VII-y)	Provides measures, volume and cost indicators of work for all activities related to the preparation of the Project zone. To include resettlement of the population, restoration of agricultural production, reconstruction of highways, reconstruction of power supply facilities and communication lines, sanitary preparation of the reservoir, protection of cultural and archaeological monuments, transport development of the reservoir, measures with regard to fish resources and other works to include archaeological research, inventory of buildings, planting and installation of control and measuring equipment.	Outlines measures relevant to the resettlement of population and preparation of the Project reservoir zone.

2.5. OTHER TAJIK LEGISLATION

2.5.1. Other Tajik legislation that may apply to Project-related activities include:

- The Law on Radiation Safety;
- The Law on Environmental Education of the Population;
- The Law on Biological Safety;
- The Law on Industrial Safety of Dangerous Production Facilities;
- The Law on Equality and Elimination of Discrimination (2022);
- The Law on Appeals of Physical and Legal Entities (2016);
- The Law on Emergency Response Services, Emergency Rescue Teams and Rescue Worker Status;
- The Law on Control of Civil Purpose Explosives;
- The Law on State Social Insurance;
- The Law about Labor Unions; and
- The Law on Conformity Assessment.

2.6. CENTRAL ASIAN WATER MANAGEMENT AGREEMENTS

2.6.1. Prior to the independence of Tajikistan in 1991, the Soviet Union had concerns about the water crisis in the Aral Sea and allocated water distribution limits among the former Soviet Republics of the Aral Sea Basin, establishing a series of protocols and resolutions.

2.6.2. Water distribution limits for the Amu Darya Basin were established by the Scientific and Technical Council of the Ministry of Water Resources of the Soviet Union on March 12, 1987. On September 10, 1987, Protocol 566 was formally endorsed in Moscow by the riparian states of the Amu Darya Basin, now known as Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. Protocol 566 is still used today as a reference document for discussions on water allocation and water-sharing principles between the nations of the Amu Darya Basin.

2.6.3. **Table 2-3** outlines the water distribution limits in the Amu Darya Basin.

Table 2-3 - Water distribution limits in the Amu Darya Basin

Country	Maximum allocation (millions m3 / year)	Share Percentage (%)
Kyrgyzstan	400	0.7
Tajikistan	9,500	15.4
Uzbekistan	29,600	48.1
Turkmenistan	22,000	35.8
Total for basin	61,500	100

2.6.4. After the independence of the former Soviet Republics, a joint declaration was issued on October 12, 1991 regarding compliance and continuity in the allocation of water to the riparian states. The Almaty Agreement was signed on February 18, 1992 as an “agreement on cooperation in joint management, use and protection of interstate sources of water resources” to maintain and adhere to the sharing of the transboundary water resources set out in Protocol 566 for the Amu Darya, in addition to establishing an Interstate Commission for Water Coordination (ICWC) and designating it as the body responsible for the definition of seasonal allocations in line with the annual agreements.

2.6.5. The Department of Energy and Water Resources is responsible for representing the Republic of Tajikistan at the ICWC and BVO Amu Darya, in addition to reaching agreements with water allocations. Formal agreements between the Republics of Tajikistan and Uzbekistan are in place to manage expectations and obligations of both countries in the consideration of issues of mutual concern.

2.6.6. A Memorandum (dated 2022) between the government of the Republic of Tajikistan and the government of the Republic of Uzbekistan sets out the intentions of cooperation with regard to the generation of energy from Rogun HPP; including the long-term export of energy from Tajikistan to Uzbekistan during the summer months, under mutually beneficial terms.

2.6.7. To date, Afghanistan has not been formally involved in discussions regarding the allocation of the waters of the Amu Darya.

2.6.8. Transboundary impacts that extend to countries beyond Tajikistan are discussed in **Volume 1, Chapter 24** of this ESIA.

2.7. INTERNATIONAL STANDARDS AND GUIDELINES

INTERNATIONAL OBLIGATIONS

2.7.1. In addition to national legislation and regulations on environmental issues, Tajikistan is also signatory to several international treaties focused on environmental issues:

- Vienna Convention for the Protection of the Ozone Layer, 1996, as updated by Montreal Protocol on Substances that Deplete the Ozone Layer;
- UN Convention to Combat Desertification (CCD), 1997;
- UN Convention on Biological Diversity (CBD), 1997, as updated by Cartagena and Nagoya Protocols;
- Ramsar Convention (joined 2000);
- Bonn Convention on the Conservation of Migratory Species of Wild Animals (joined 2001), as updated by Bukhara Deer Memorandum, 2002;
- UN Framework Convention on Climate Change, 1998, with related update Kyoto Protocol, accessed on December 29, 2008, and entered into force on March 29, 2009;
- Stockholm Convention on Persistent Organic Pollutants (ratified 2007);
- Aarhus Convention (UNECE Convention on Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters) (joined 2001), as updated by Kiev Protocol on Pollutant Release and Transfer Registers to the Convention on Access to Information, on May 21, 2003;
- Convention on International Trade in Endangered Species of Wild Fauna and Flora, 2016.
- UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage (joined 1992);
- Rotterdam Convention on Prior Informed Consent (PIC) procedure on September 28, 1998, ratification pending;
- The United Nations Convention to Combat Desertification (1997); and

- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (2016).

2.7.2. In addition, Tajikistan has ratified several core labor-related conventions and standards of the International Labor Organization (ILO), including:

- Tripartite Consultation (International Labor Standards) Convention (2014);
- Labor Inspection Convention (2009);
- Convention for the Safeguarding of the Intangible Cultural Heritage (2006);
- Convention on the Rights of the Child (CRC) (1993);
- Employment Policy Convention (1993);
- Occupational Safety and Health Convention (1981);
- Convention on the Elimination of All Forms of Discrimination Against Women (1979);
- International Covenant on Economic, Social and Cultural Rights (1976);
- Forced Labor (C029) and Abolition of Forced Labor (C105);
- Minimum Age (C138) and Worst Forms of Child Labor (C182);
- Discrimination (C111);
- Freedom of Association and the Right to Organize (C087);
- Right to Organize and Collective Bargaining (C098); and
- Equal Remuneration (C100).

WORLD BANK ENVIRONMENTAL AND SOCIAL FRAMEWORK

2.7.3. The policies and standards of the various Lenders to the Project are summarized in this section. The E&S framework used as the overarching framework in this ESIA is the WB Environmental and Social Framework (ESF) including:

- Vision for Sustainable Development which sets out the aspirations of the World Bank for a more Environmentally and Socially sustainable future;
- WB E&S Policy for Investment Project Financing which details the requirements that apply to the Bank; and
- Environmental and Social Standards (ESS): a set of 10 standards which together with their annexes set out the mandatory requirements on Borrowers for managing E&S risks on their projects.

2.7.4. The underpinning principles of the Lenders' E&S policies are materially consistent with the WB ESF. The assumption is that, in most cases, compliance with the WB ESF will result in effective compliance with other lenders policies and standards. The implementation of this "*common approach"* is consistent with ESS1.

2.7.5. In general, the environmental and social assessment will consider the requirements of OP 7.50 for projects on international waterways.

2.7.6. **Table 2-4** outlines the WB ESSs and their relevance to the Project. **Table 2-5** outlines the key gaps between National Tajik legislation and WB ESS requirements.

Table 2-4 - World Bank Environment and Social Standards

ESS No.	Title	Relevance	Comments
ESS1	Assessment and Management of Environmental and Social Risks and Impacts	Relevant to the Project for both construction and operation	Identification, assessment, evaluation and management of environmental and social risks and impacts, including identification of applicable requirements and monitoring outcomes, including Associated Facilities.
ESS2	Labor and Working Conditions	Relevant to the Project for construction and operation	Labor management procedures, occupational health and safety, workforce protection, worker grievance redress mechanism (GRM), with specific requirements for contractor and subcontractor employees within the primary supply chain.
ESS3	Resource Efficiency and Pollution Prevention & Management	Especially relevant for the construction phase around use of all materials for extraction, use, and disposal. Also relevant for climate change risk. Sets out the need for the Assessment of Alternatives.	Sustainable use of resources and minimization of adverse impacts on human health and the environment through management of wastes, chemicals and hazardous materials.
ESS4	Community Health and Safety	Especially relevant for protecting communities close to the Project area during construction and operation as well as along the logistics routes	Avoidance and control of risks and impacts on communities from Project activities and workers, emergencies, security, and other factors.
ESS5	Land Acquisition, Restrictions on Land Use, and Involuntary Resettlement	Relevant to all resettlement and livelihood restoration undertaken as part of the Project.	Identification, avoidance and mitigation of impacts from Project-related land acquisition that may cause physical displacement (relocation, loss of shelter) and economic displacement (loss of assets or access to assets, leading to loss of income sources or other means of livelihood) or both. Resettlement activities are planned and implemented with appropriate disclosure of information, meaningful consultation and informed participation.
ESS6	Biodiversity Conservation and Sustainable Management of Living Natural Resources	Especially relevant in the inundation zone and downstream of the Rogun Dam between Rogun and Nurek.	Protection and conservation of biodiversity and habitats, support to the livelihoods of local communities.

ESS No.	Title	Relevance	Comments
ESS7	Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities	Not relevant to the Project	No Indigenous Peoples are present in the Project area.
ESS8	Cultural Heritage	Especially relevant in the inundation zone for loss of any tangible heritage and for resettlement regarding loss of intangible heritage.	Protection of tangible and intangible cultural heritage from potential adverse impacts of Project activities and support its preservation.
ESS9	Financial Intermediaries	Not relevant to the Project	Financial Intermediaries do not apply since Bank funding is not being provided to financial institutions for further on-lending.
ESS10	Stakeholder Engagement and Information Disclosure	Relevant to all stages of the Project including construction and operation phases and especially during resettlement events.	Identification and engagement of local and other stakeholders throughout the Project life cycle, disclosure of Project information, and GRM for stakeholders.

Table 2-5 – Comparison of World Bank ESS against Tajik Law

(where ESS guidelines have been scoped out in Table 2.4 these have been omitted in the comparison of standards)

ESS	Specific topic/area	ESS Requirement	Tajik Legal requirements/gaps
ESS1 – Assessment and Management of Environmental and Social Risks and Impacts.	Scope	ESSs apply to Associated Facilities	Associated Facilities are not specifically included by Tajikistan law, except to the extent that all activities in Tajikistan are subject to laws.
	E&S Framework	The Project may use the Borrower's framework to meet ESS objectives. The Rogun HPP requires application of World Bank and other lender requirements.	No provision for alternative requirements except that international standards take precedence if agreements are in place.
	ESIA	▪ Conduct E&S assessment, including stakeholder engagement ▪ Retain international expert(s) for high-risk projects ▪ Apply national framework, ESSs, Environmental, Health and Safety Guidelines (EHSGs)/ Good international industry practice (GIIP) ▪ Apply mitigation hierarchy ▪ Offset significant residual impacts ▪ Differential measures for vulnerable or disadvantaged people ▪ Consider primary suppliers ▪ Assess cumulative impacts	▪ EIA law (2012) has much less emphasis on social conditions and impacts, but other laws partly fill gaps, but with less specificity concerning community impacts ▪ No distinction between international and Tajikistan experts ▪ No reference to EHSGs or GIIP ▪ No equivalent provision for offsets ▪ No equivalent provisions for vulnerable and disadvantaged people ▪ No coverage of primary suppliers ▪ No requirement for assessment of cumulative impacts
	Environmental and Social Commitment Plan (ESCP)	ESCP includes specific requirements that must be met within a specified time, and also can and should be updated during implementation as conditions and risks change.	No provision in permits/approvals for delayed compliance or for updating requirements.
	Monitoring	▪ Monitoring proportionate to nature of project, risks and impacts, and compliance requirements	Monitoring required but less emphasized, with limited feedback mechanisms.

ESS	Specific topic/area	ESS Requirement	Tajik Legal requirements/gaps
		▪ Reports to World Bank	
	Stakeholder Engagement	Engage stakeholders throughout project life cycle.	Generally consistent but no requirement for a project-specific SEP.
ESS2 – Labour and Working Conditions	Scope	ESS2 applies to all workers employed by PMG, Rogun JSC, and Rogun HPP who work on the Project, as well as all contracted workers, primary supply workers, and community workers.	Labor Code applies to all workers in Tajikistan, including foreign workers.
	Working Conditions & Labor Relations	Requirements include: ▪ Written labor management procedures including terms and conditions of employment ▪ Non-discrimination and equal opportunities ▪ Right to set up Worker's organizations	Generally consistent
	Protecting the Workforce	Specific requirements around child and forced labor.	Minimum employment age is 14, with other limits consistent with ILO, but no work that could "cause health or moral damage" if the worker is under 18. Forced labor is prohibited. There are no workers under the age of 18 on Rogun HPP.
	Grievance Redress Mechanism (GRM)	GRM has to be provided for all direct and contracted workers	No specific requirement for GRM for workers.
	Occupational Health and Safety (OHS)	▪ Measures relating to occupational health and safety must be applied to the project: ▪ Apply World Bank Group General and sector specific EHS Guidelines	Generally consistent but less detailed.

ESS	Specific topic/area	ESS Requirement	Tajik Legal requirements/gaps
		▪ Requirements to protect workers, train workers, document incidents, emergency preparation, addressing issues must be implemented ▪ Provide safe working environment ▪ Workers allowed to report safety issues and refuse to work under certain circumstances in a blame-free environment ▪ Provide appropriate facilities (canteens, toilets, etc.) and ensure accommodations meet needs of workers ▪ All employers to collaborate on applying OHS requirements ▪ Monitor OHS performance	
	Contracted Workers	▪ Reasonable efforts to verify contractors have labor management procedures to meet requirements of ESS2 (except those that apply to community and primary supply workers) ▪ Procedures for managing and monitoring performance ▪ Access to GRM	Safety requirements apply to all employers, including contractors, but no obligation for developers to verify compliance.
	Community Workers	Requirements for working conditions and OHS applied to community labor.	Labor Code applies to employers and employees, not volunteers.
	Primary Supply Chain	Depending on level of control/influence, assess risk of child labor, forced labor, and safety issues and require suppliers to address significant risks.	Tajikistan law applies if work is done in Tajikistan. There is no obligation on employers in other countries or requirements for the prime contractor.
ESS3 – Resource Efficiency &	Scope	Borrowers must apply feasible resource efficiency and pollution prevention measures in accordance with mitigation hierarchy.	Some limited requirements but not comprehensive.

ESS	Specific topic/area	ESS Requirement	Tajik Legal requirements/gaps
pollution Preventions	Energy Use	Adopt measures in EHS guidelines if project has significant energy use.	No specific limits. No significant energy usage.
	Water	Assess water use and impacts and communities and adopt mitigation measures as needed.	Permits required for water usage.
	Materials	Use GIIP to reduce significant resource usage.	Resource usage requires permits.
	Pollution Prevention & Management	General requirements to minimize risk, no specific requirements for services, ecosystem services, emergencies, etc.	▪ Specific standards for different pollutant type including emission limits ▪ Detailed requirements for hazardous and other wastes ▪ Regulations on hazardous materials ▪ Signatory to international conventions ▪ No requirements to verify haulers/contractors
ESS4 – Community Health Safety and Security	Community health and safety (H&S)	▪ Evaluate risks to community H&S and apply mitigation hierarchy and GIIP to reduce risks ▪ Consider third-party safety risks in designing infrastructure and equipment, with regard to high-risk locations ▪ Ensure safety of services provided to communities ▪ Identify traffic/road risks, assess risks if needed, consider safety in fleet decisions, take measures to protect public. ▪ Assess and avoid impacts on provisioning and regulating ecosystem services as appropriate ▪ Avoid or minimize potential for disease transmission and communication (including HIV/AIDs and sexually transmitted diseases), including due to labor influx ▪ Consider and provide necessary protections for vulnerable groups	▪ Potable water provision and drinking water quality standards ▪ Air quality standards ▪ Soil protection measures ▪ Waste management requirements ▪ Community health care provision ▪ Emergency event preparedness and response

ESS	Specific topic/area	ESS Requirement	Tajik Legal requirements/gaps
		▪ Address risks to community of hazardous materials management ▪ Prepare for and respond to emergencies, consider this in EIAs, prepare response plans	
	Security Personnel	▪ Assess and address risks of security arrangements ▪ Apply principles of proportionality, GIIP, and law ▪ Verify contracted workers are not implicated in past abuses and are trained ▪ Investigate incidents and report unlawful acts to authorities	No specific requirements
	Annex 1. Safety of Dams	▪ Design and construction of new dams to be supervised by experienced professionals ▪ Dam safety measures to be adopted and implemented during design, tendering, construction, operation, and maintenance ▪ Dam does not fall into categories of paragraph 2, thus most of annex does not apply ▪ Safety measures designed by qualified engineers to be adopted in accordance with GIIP (paragraph 5) ▪ Confirmation of no or negligible risks to communities due to failure of dam	No equivalent requirements
ESS5 – Land Acquisition, restriction on land use and Involuntary Resettlement	Applicability	▪ Assess need during ESIA process ▪ Applies to permanent and temporary displacement, listing types of infringements ▪ Limitations on applicability ▪ Applies to land users and owners	▪ All land in state ownership ▪ Rights to use land granted with legal certificates ▪ May be used only as authorized ▪ Legal users may lease land for authorized uses
	General	▪ Affected people: landowners, users with legal claims, and users with no legal claims ▪ Design project to avoid/minimize displacement	▪ Only those with legal rights eligible for replacement land or compensation ▪ Replacement land preferred option

ESS	Specific topic/area	ESS Requirement	Tajik Legal requirements/gaps
		▪ Provide replacement cost and assistance, disclose standards, offer land-for-land where possible, pay compensation before displacing people where possible ▪ Engage with affected communities, including women. ▪ Grievance redress mechanism (GRM) ▪ Census, cut-off dates, notices; detailed plan and monitoring required; requires audit if there is significant displacement	▪ Detailed requirements for committee memberships and actions ▪ Compensation based on established rates for trees or other items lost
	Displacement	▪ Detailed requirements for physical displacement ▪ Compensation at full replacement cost, excluding depreciation ▪ Detailed requirements for economic displacement, including livelihood restoration	▪ Replacement with equivalent land and houses preferred over compensation ▪ Compensation at market value, including depreciation ▪ Compensation for lost profits required, but not livelihood restoration
	Collaboration	Collaborate with other involved agencies, provide support as needed; include arrangements in resettlement plans	Committee membership and responsibilities defined in Land Code
	Technical and Financial Assistance	World Bank may provide support to resettlement planning	No requirements
	Annex 1: Involuntary resettlement instruments	Detailed requirements for resettlement plans, resettlement frameworks, and process frameworks	No detailed requirements
ESS6 – Biodiversity Conservation and Sustainable Management of	General	▪ Consider direct, indirect, & cumulative impacts in ESS1 EIA ▪ Characterize baseline conditions	▪ Requires protection of biodiversity but less detailed in specific requirements. ▪ No specific requirements for assessment of ecosystem services

ESS	Specific topic/area	ESS Requirement	Tajik Legal requirements/gaps
Living Natural Resources.		▪ Manage risks with mitigation hierarchy and GIIP, including adaptive management ▪ Differentiated habitats; ESS applies to all and provides for offsets ▪ ESS applies to modified habitat with significant biodiversity value ▪ Avoid natural habitats unless there is no feasible alternative; if affected, achieve no net loss of biodiversity or Critical habitat ▪ Requirements if a project will affect legally protected and international recognized areas of high biodiversity value ▪ Strict conditions on affecting critical habitats, requires biodiversity management plan (BMP) ▪ No introduction or spreading of invasive species ▪ Requirements for projects involving primary production and harvesting	▪ No specific requirements around Primary Supply chain.
ESS8 – Cultural Heritage	Scope	Covers tangible and intangible (limited) cultural heritage, whether legally protected or not and whether previously identified or not	Law covers non-material (language, customs, ceremonies and celebrations, knowledge and skills, traditional crafts, dancing, music, art, etc.) and material cultural heritage. Some legal limits on weddings, funerals, and other activities
	General	▪ Assess and avoid impacts on cultural heritage ▪ Follow chance find procedure (CFP) if a find is encountered ▪ Involve relevant experts if needed	▪ General requirements to protect cultural heritage and not to disturb sites of interest ▪ No specific requirement for CFP
	Consultation	▪ Identify and consult with affected and interested stakeholders ▪ Maintain confidentiality if needed ▪ Allow continued access to affected sites	▪ No requirement for consultations except with Ministry of Culture representatives ▪ Must provide access to information

ESS	Specific topic/area	ESS Requirement	Tajik Legal requirements/gaps
	Legally Protected Assets	Comply with regulations and plans, consult with sponsors	Generally consistent
	Specific Types of Heritage	▪ Desk-based and expert consultation to identify archaeological sites and specify protections ▪ Mitigate impacts on built heritage, preserve physical and visual context of structures ▪ Identify and protect treasured natural features ▪ Identify and protect movable cultural heritage	Less detailed requirements but generally consistent
	Commercial Use	Not relevant for this project	n/a
ESS10 – Stakeholder Engagement and Information Disclosure	General	▪ Engage stakeholders throughout project life cycle, determine how they wish to be engaged ▪ Provide stakeholders with information ▪ Maintain documented record of engagements	Generally consistent but less detailed
	Engagement During Project Phases	▪ Identify and analyze stakeholders, including disadvantaged or vulnerable ▪ SEP required, with detailed requirements for disclosure, timing of consultations, measures for disadvantaged or vulnerable groups, etc. ▪ Disclosure of information early to allow for consultation on design ▪ Consultation to allow ongoing two-way communication throughout project life cycle ▪ Engagement and disclosure of information to continue throughout implementation, following SEP	▪ No requirement to analyze stakeholders. ▪ No formal plan required. ▪ Early disclosure required. ▪ No specific requirement for continuing engagement
	Grievance Process	▪ Establish and implement prompt, effective, culturally appropriate, and discreet GRM	Tajikistan law provides channels for filing complaints, requests, and appeals.

ESS	Specific topic/area	ESS Requirement	Tajik Legal requirements/gaps
		▪ No limit on legal remedies	
	Organizational Capacity	Define roles and responsibilities, assign personnel to implement stakeholder engagement activities.	No specific requirement for assigning roles and responsibilities.
	Annex 1: Grievance mechanism	Options for managing GRM regarding methods of submission, log, advertised procedures, appeals process, mediation.	Appeals of Individuals and Legal Entities (2016) (

2.7.7. The WB ESF states that Borrowers and projects are also required to apply the relevant requirements of the WB Group EHSGs. These are technical reference documents with general and industry specific examples of GIIP. The standards referenced in this section are included for the purposes of the consideration of best practice, it does not imply financing of the Project by all banks.

EUROPEAN INVESTMENT BANK (EIB)

2.7.8. The EIB ESSF is an overarching policy framework that focuses on sustainable and inclusive development, committing to a just and fair transition and supporting the transition to economies and communities that are climate and disaster-resilient, low-carbon, environmentally sound and more resource efficient.

2.7.9. The EIB ESSs set out standards and obligations in ten areas and identifies key pieces of EU legislation that should be applied. As the Project is located outside the jurisdiction of the EU and European Free Trade Area (EFTA), the EIB ESSs specify that the Project should comply with the core principles and essential procedural elements laid down by the relevant EU legislation. There are 10 ESSs, including:

- Standard 1: Environmental and Social Impacts & Risks;
- Standard 2: Stakeholder Engagement;
- Standard 3: Resource Efficiency & Pollution Prevention;
- Standard 4: Biodiversity and Ecosystems;
- Standard 5: Climate Change;
- Standard 6: Involuntary Resettlement;
- Standard 7: Vulnerable Groups, Indigenous Peoples & Gender;
- Standard 8: Labor Rights;
- Standard 9: Health, Safety & Security; and
- Standard 10: Cultural Heritage.

ASIAN DEVELOPMENT BANK (ADB)

2.7.10. The ADB SPS (2009) and associated safeguarding documents aim to avoid, limit and compensate for negative project impacts.

2.7.11. The ADB SPS builds on three previous safeguard policies:

- The environment;
- Involuntary resettlement; and
- Indigenous peoples.

2.7.12. The SPS brings the three safeguard policies into a single policy that enhances consistency and coherence and more comprehensively addresses environmental and social impacts and risks.

2.7.13. The SPS aims to promote the sustainability of project outcomes by:

- Avoiding adverse impacts of projects on the environment and affected people, where possible;
- Minimizing, mitigating, and/or compensating for adverse project impacts on the environment and affected people when avoidance is not possible; and
- Helping borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

ASIAN INFRASTRUCTURE INVESTMENT BANK (AIIB)

2.7.14. The AIIB Environmental and Social Framework (ESF) (2019, 2021, 2022 and updated in July 2024) aims to create environmentally and socially sustainable developments for the Bank and its clients through the integration of good environmental and social planning, alongside management of risks and impacts, to feed into preparation, decision-making and implementation phases on supported projects.

2.7.15. The framework includes three key documents:

- Environmental and Social Policy;
- Environmental and Social Standards; and
- Environmental and Social Exclusion List.

ISLAMIC DEVELOPMENT BANK (ISDB)

2.7.16. The IsDB aims at bettering lives, delivering impact, boosting recovery, tackling poverty, building resilience and driving green economic growth.

2.7.17. The IsDB has made the 17 UN SDGs a key factor in their investment decision-making, as the high-level SDGs and the 169 specific targets, encompassing the social, economic and environmental dimensions of development and these aspirations for human dignity, is in line with the principles and objectives of development from an Islamic perspective.

SAUDI FUND OF DEVELOPMENT (SFD)

2.7.18. The SFD was established as a governmental institution to provide support in the form of soft loans to finance development projects in developing countries. SFD has defined its goal as unifying efforts with leading global organizations and contributing to sustainable development.

2.7.19. Through the unlimited support of the Government of the Kingdom of Saudi Arabia (KSA), and as defined in its law, the SFD's stated objective is to 'contribute to financing development projects in the developing countries by granting them the necessary loans, the technical aids necessary for financing studies and institutional support.'

2.7.20. The SFD has played a significant role in enhancing renewable energy in Asia and has signed six loan agreements for renewable energy in Pakistan and Nepal, all of which relate to four hydropower plant developments. Since its establishment, the SFD has made important contributions through its loans towards mitigating climate change, such as by supporting various solar and hydropower projects. By the end of 2021, it funded 15 development loans for the renewable energy sector in nine developing countries, worth a total of $650.6 million.

2.7.21. According to the SFD and UN Development Programme (UNDP) joint workshop on climate change (June 27, 2023), SFD officials highlighted the Fund's commitment to assisting sustainable development through clean energy, afforestation, and greening initiatives in developing countries.

2.7.22. The SFD provide loans for developing countries, which they define as countries with limited economic and financial resources and are characterized by being:

- Less developed;
- Structurally impoverished;
- In need of fundamental development assistance;
- Landlocked and non-coastal; and
- Facing economic and social challenges, such as lack of natural resources and high population growth rates.

2.7.23. SFD loans are directed towards the following economic and social sectors within developing countries:

- Developing basic infrastructure by expanding transport and communication networks;
- Strengthening protection against diseases and epidemics by supporting the healthcare sector;
- Developing human resources;
- Providing energy for all;
- Ensuring food and water security;
- Preserving the environment and public health;
- Providing adequate housing for low-income groups; and
- Developing industry and mining.

KUWAIT FUND FOR ARAB ECONOMIC DEVELOPMENT (KFAED)

2.7.24. The KFAED was established to assist Arab and other developing countries to prosper economically. No geographic, ethnic, religious, caste or cultural barriers restrict access to the Fund's loans and assistance; and the Fund provides technical assistance to finance the cost of feasibility studies.

2.7.25. The KFAED supports projects that have a strong public sector element and are of a developmental nature, and assistance may be provided to the following sectors: infrastructure, agriculture, irrigation, transport, communications, energy, water supply, sewage treatment, education and health.

2.7.26. In a news article dated June 26, 2023, the KFAED stated the importance of encouraging joint efforts with the Group members contributing to investments in the energy sector to combat the impacts of climate change and its challenges.

2.8. GOOD INTERNATIONAL INDUSTRY PRACTICE (GIIP)

WORLD BANK GROUP (WBG) ENVIRONMENTAL, HEALTH AND SAFETY (EHS) GUIDELINES

2.8.1. The WBG has developed EHS Guidelines as technical reference documents containing industry-specific examples of GIIP that are referred to in the WB ESF. The WBG requires Borrowers to apply the relevant measures of the EHS Guidelines.

2.8.2. The General EHS Guideline (2007) includes guidelines for environmental controls during facility construction and operation (air and water emissions, hazardous materials management, noise, contaminated land, etc.) and occupational and community health and safety during construction and operation.

2.8.3. The WBG has also outlined Industry Sector Guidelines providing industry-specific examples GIIP. The Industry Sector Guidelines are designed to be used together with the General EHS Guidelines.

2.8.4. The principle EHS Industry Sector Guidelines relevant to the Project, include but are not limited to:

- EHS Guidelines for Construction Materials Extraction (2007).
- EHS Guidelines for Electric Power Transmission and Distribution (2007).
- EHS Guidelines for Toll Roads (2007).
- EHS Guidelines for Waste Management Facilities (2007).
- EHS Guidelines for Water and Sanitation (2007).
- EHS Guidelines for Crude Oil and Petroleum Product Terminals (2007).

WORLD BANK - GOOD PRACTICE HANDBOOK - ENVIRONMENTAL FLOWS FOR HYDROPOWER PROJECTS (2018)

2.8.5. The WB has produced a good practice handbook, written in collaboration with the IFC, to provide guidance to practitioners for a consistent approach to assess and manage hydropower project impacts on downstream river ecosystems and people through the assessment and provision of e-flows.

WORLD BANK GUIDANCE ON HYDROPOWER OPERATION AND MAINTENANCE (2020)

2.8.6. The WB has produced a handbook to provide guidance to raise awareness among utility managers, decision makers, and other stakeholders of the benefits of developing robust operation and maintenance (O&M) strategies for all existing hydropower plants and those under development.'

2.8.7. The handbook was written in collaboration with the International Hydropower Association (IHA) with financial support from the Global Water Security & Sanitation Partnership (GWSP) and the Swiss State Secretariat for Economic Affairs (SECO).

2.8.8. The handbook outlines practical steps and recommendations to prepare *ad hoc* O&M strategies that will help to extend the life expectancy of assets, while securing hydropower production in a cost-effective way and preventing high-cost expenditures for rehabilitating facilities that have not been maintained properly.

WORLD BANK GOOD PRACTICE NOTE ON DAM SAFETY (2020)

2.8.9. The good practice note provides additional guidance on the application of relevant requirements of the ESF, in particular in utilising a risk management approach to the application of dam safety requirements. The document provides guidance on guidance on compliance requirements, a risk management approach to dam safety, risk analysis tools, quality of information and capacity as well as application to World Bank operations and associated procedural aspects.

WORLD BANK – ESSENTIAL ELEMENTS FOR ENSURING THE SAFETY OF DAMS AND DOWNSTREAM COMMUNITIES POLICY NOTE (2023)

This policy note provides guidance to policy makers and practitioners on the essential elements for establishing regulatory regimes for assuring the safety of dams and downstream communities.

The policy note summarizes country case studies; provides a comparative analysis of the legal, institutional, and regulatory requirements; and recommends legal, institutional, technical, and financial elements relevant for different countries.

EIB – ENVIRONMENTAL, CLIMATE AND SOCIAL GUIDELINES ON HYDROPOWER DEVELOPMENT (2019)

2.8.10. The EIB has also published Guidelines on Hydropower Development which set out the EIB's objectives for investments in hydropower projects, establishing sector-specific standards and criteria which promoters should meet. They also summarize best practice recommendations for integrating social, biodiversity, natural resource management and climate considerations into hydropower projects.

IFC – GOOD PRACTICE NOTE - ENVIRONMENTAL, HEALTH, AND SAFETY APPROACHES FOR HYDROPOWER PROJECTS (2018)

2.8.11. The IFC authored a guidance document on best practices for managing environmental, health, and safety (EHS) risks for hydropower projects to minimize their environmental impact, ensure the safety of workers and communities, and promote sustainable development. The document was written by the IFC with support from Golder Associates and the World Bank.

2.8.12. It sets out guidelines on:

- Environmental Management:
  - Watershed Management;
  - Habitat Conservation; and
  - Instream Flow.
- Occupational Health and Safety (OHS):
  - Construction Safety; and
  - Operational Safety.
- Community Health and Safety:
  - Dam Safety; and
  - Public Health.
- Performance Indicators and Monitoring:
  - Environmental Monitoring; and
  - OHS Monitoring.

INTERNATIONAL COMMISSION ON LARGE DAMS (ICOLD) – WORLD DECLARATION ON DAM SAFETY (2019)

2.8.13. The document sets ICOLDs declaration that dam safety is of ICOLDs highest priority. The changing conditions of dam safety are highlighted to include aspects such as lack of experience in dam safety management and operations and climate change.

2.8.14. Overarching pillars of dam safety are recognized and include, amongst others, the structural integrity of dams being the keystone to dam safety, the importance of routine surveillance, maintenance, monitoring, emergency planning and training as well as a comprehensive dam safety approach.

INTERNATIONAL HYDROPOWER ASSOCIATION (IHA)

2.8.15. The IHA is a non-profit membership association, operates in over 120 countries, and includes leading hydropower owners and operators, developers, designers, suppliers, and consultants. The IHA has played a leading role in improving understanding of good and best practices in hydropower development and operations.

2.8.16. The IHA published the Hydropower Sustainability Standard, a global certification scheme outlining sustainability expectations for hydropower projects around the world, and managed by the Hydropower Sustainability Alliance (HSA).

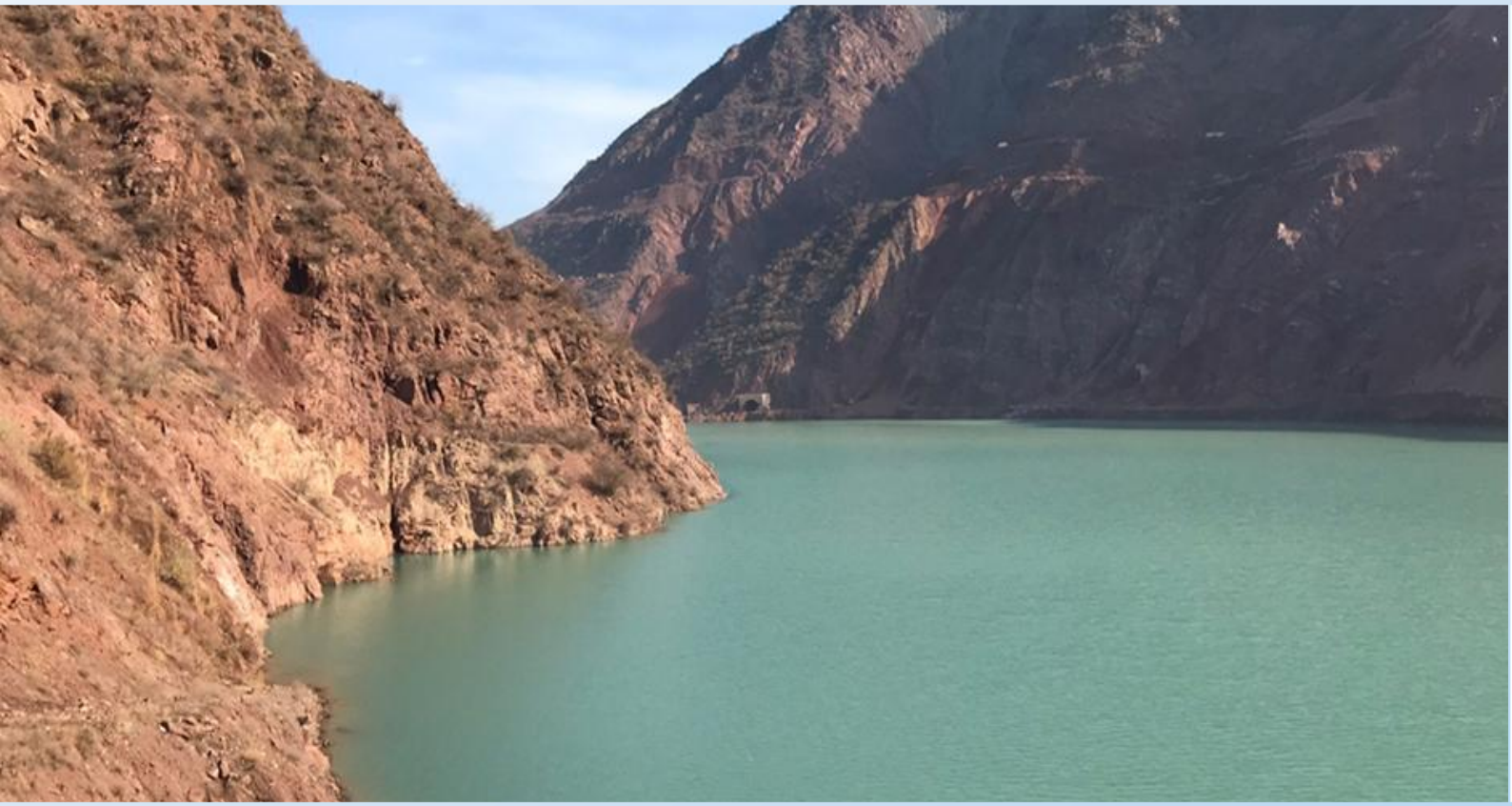
2.8.17. The IHA has several assessment tools and guidelines used to design, develop, and assess hydropower projects including:

- The Hydropower Sustainability Guidelines on GIIP
- Hydropower Sustainability Standard - a framework designed to ensure that hydropower projects are developed and operated in a sustainable manner. It encompasses twelve ESG topics and a robust assessment and certification process. It aims to balance the benefits of hydropower with the need to protect communities and the environment, promoting responsible growth in the sector;
- The Hydropower Sector Climate Resilience Guide - practical and systematic guidance for hydropower engineers, operators and project owners to develop climate resilient projects; and
- The Carbon Calculator for Reservoirs (g-res tool) – a tool used to predict greenhouse gas emissions from a reservoir.

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT – UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Volume 1, Chapter 3: Project Description



JUNE 2025

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3. PROJECT DESCRIPTION

3.1.1. This chapter provides a description of the Project location, components, associated facilities, activities and organization for the construction and operational phases.

3.2. PROJECT OVERVIEW

3.2.1. The Rogun HPP Project has been under construction for many years, most recently since 2018 with work currently ongoing. As of May 2025, the status of the Project is:

- A dam crest at 1,110 meters above sea level (masl) (Stage 1: Dam Construction);
- A reservoir at elevation 1,075 masl with a surface area of 12 square kilometers (km^2) (Stage 1: Reservoir Creation);
- An underground powerhouse with two operating turbines (Units 5 and 6) with a combined generation capacity of 400 MW. In 2025, these will be upgraded to a capacity of 630 MW each.
- Three high pressure water outlets, referred to as High Level Outlet (HLO) one and two and remote tunnel spillways (RTS), headrace tunnels and four diversion tunnels;
- A gas insulated substation and five transmission lines that connect the Project to the national grid, Dushanbe and other countries;
- Approximately 70 km of underground roads;
- Approximately 26 km of aboveground roads, mostly unpaved;
- Approximately 15 km of water tunnels;
- Permanent offices and site buildings;
- Temporary construction areas including borrow pits, spoil storage, concrete batching, logistics and laydown areas, offices and other construction facilities;
- One main construction camp for over 20 construction contractors involving approximately 20000 workers (95% of which are from Tajikistan) on the lower terrace between the reservoir and Rogun City. This camp will be flooded by 2026/2027 and contractors will be relocated to new locations; and
- A program to resettle villages and households that are located within the footprint of the reservoir inundation zone. To date, about 10,000 Project Affected Persons (PAPs) have been resettled with a choice of moving to host communities or new settlements.

It is clear, therefore, that the project is unique in the sense that the project location is a highly disturbed, brownfield, construction site. This feature is, therefore, taken into account in the description of the baseline conditions and impact assessment which are presented in subsequent chapters.

3.2.2. Once construction of the Rogun HPP is completed, the Project will comprise:

- A dam with a crest at 1,300 masl by 2032, and an overall height of 335 m (Stage 2: Dam Construction);

- A reservoir with the water level progressively raised until 2038 when the full supply level (FSL) is reached at 1,290 masl. The reservoir will have total surface area of 170 km², a length of approximately 70 km and capacity of approximately 13.3 km^3 (Stage 2: Reservoir Creation);
- A surface spillway, two mid-level and three high-level tunnels to protect the dam and allow safe passage of floodwaters up to the Probable Maximum Flood (PMF);
- An underground powerhouse and transformer room in excavated caverns on the left bank. The powerhouse will contain six turbines, having a maximum generation capacity of 3,780 MW;
- Approximately 5-6 km of above ground surface roads;
- Six transmission lines connecting the Project to the national grid and other countries;
- Reinstatement of the 55 km bare earth road on the left bank to connect with the new bridge that will span the Surhkhob River to alleviate severance of the left bank villages due to the reservoir; and
- Continuation of the resettlement program until about 2032, by which time about 50,000 people in 69 villages will have been resettled into either new or existing settlements.

3.2.3. Once complete, the Project will be the largest installation in Central Asia, with a generation capacity of 3,780 MW and an average annual generation of over 17,000,000 MW-hour (17,000 gigawatt-hour (GWh) or 17 billion Kilowatt-hour (KWh). The Project has an expected life of 110 years, dependent on the sediment inflow. Furthermore, by intercepting sediment upstream of Nurek, it will extend the lifespan of the Nurek hydropower plant by 100 years or more.

3.2.4. Further information regarding the Project components is provided in **Table 3-7**.

PROJECT ORGANIZATION

3.2.5. The contractors involved in the construction of Rogun HPP and their specific work packages are described in **Table 3-1**.

Table 3-1 - Construction Lots

Contract	Type	Size	Contract Award & Contractor	Scope
Lot 1 Contract	Electro-Mechanical Equipment	€370 million	Jan 2021; Voith Hydro (Austria)	Installation of four new generating units; and delivery of two runners in 2024 for the two existing early generating units. Installation of the balance of plant and control equipment. As of 2025, they have not mobilized. Turbines will be manufactured and assembled elsewhere. Once preparation and installation begin, the works will be supervised by a Project Management Consultant (PMC) and completed by 2027.
Lot 2 Contract	Main Dam	US$2.4 billion	Jul 2016; WeBuild (Italy)	Design, procurement, and construction of the following works:

Contract	Type	Size	Contract Award & Contractor	Scope
				▪ Modernization/reconstruction / completion (if necessary) of the Diversion Tunnels (DT). ▪ Construction of the cofferdam and river diversion. ▪ Construction of transition sections DT-1 and DT-2. ▪ Treatment of the entire base (salt layer, grout curtain, drainage curtain). ▪ Installation of dam monitoring devices and reservoir monitoring. ▪ Main Dam Stage 1 to elev. 1,110 masl; and ▪ Main Dam Stage 2 to elev. 1,300 masl.
Lot 3 Contract	Right Bank Structures	US$1.7 billion	Jul 2021; TGEM (Tajikistan)	A series of tunnels and spillways that provide adequate flood discharge capacity as the height of the main dam increases and lower tunnels can no longer be safely used. Works not yet completed under Lot 3 will be re-tendered as Lot 3a once finance has been received.
Lot 3a	Right Bank Structures		Contracted awarded in Feb 2025	
Lot 4 Early Works	Left Bank		EMZ and Tunnel Sadd Ariana (Ariana)	To implement preparatory tunnelling and other works in advance of appointment of the Lot 4 EPC contractor. These are works located on the Left Bank and include: the powerhouse, transformer cavern, intake tunnels and tailrace. Both contractors will vacate the site upon appointment of the EPC contractor for Lot 4. Performance is supervised by Rogun JSC.
Lot 4 Contract	Left Bank Structures	US$789 million	Contracted awarded in Feb 2025.	Construction works for the completion of the Left Bank structures including the multi-level water intake, six inlet pressure tunnels and shafts to hydraulic units and the corresponding outlet tunnels. AFRY is the prime designer. Pre-construction (preparatory) activities are taking place by two major ‘early works’ contractors, involving underground works on tunnelling for water intake areas of the powerhouse, ventilation shafts, etc.

3.2.6. Approximately 20 small non-EPC contractors undertake various preparatory and maintenance works and are supervised by Rogun JSC.

3.2.7. As of May 2025, there are approximately 20,000 people employed for Project construction and resettlement planning and implementation. About 95% of the workforce is Tajik and the remainder expatriate.

3.2.8. The current Project organizational structure is presented in **Figure 3-1.**

3.2.9. When international financing becomes available, the organizational structure will remain except for:

- A Project Management Consultant (PMC) will be appointed to replace the Employers Representative to supervise all technical and Environmental and Social Health and Safety (ESHS) performance for all contractors on site across Lots 1-4. They will report to Rogun JSC.
- An EPC Contractor will be appointed to complete the Lot 4 works. Following the EPC appointment, the Ariana and EMZ contracts will be terminated;
- The Lot 1 EPC Contractor, Voith, will mobilize to the site to install and commission the new turbines.

3.2.10. Construction of the Project and resettlement program will be completed in 2032.

ESHS RESPONSIBILITIES

3.2.11. The responsibility for ESHS management is divided between three organizations on site:

- Project Management Group (PMG) for Energy Facilities Construction: under the President of Tajikistan has been appointed to coordinate all parties involved in Rogun HPP, including liaison with international lenders.
- Employer/Owner: OJSC Rogun HPP (aka Rogun JSC): responsible for ongoing operation of Rogun HPP and for construction of the Project. Rogun JSC provides supervision of Lot 3 EPC, Lot 4 early works contractors, other smaller contractors and of the Employer's Representative, Tractebel ELC. Rogun JSC is ultimately accountable for all parties' compliance with Tajikistan Law and, in future, International Standards.
- Employers Representative (Tractebel) provides overall supervision of E&S compliance monitoring for Lot 4 and recently expanded to cover all lots and the two major early works contractors.

3.2.12. ESHS staffing requirements for the construction process are summarized in **Table 3-2**.

Table 3-2 - ESHS Staffing for Rogun HPP Construction

Nominal Positions	PMG	Rogun HPP						Other Contractors	Total
		Rogun JSC	ER/PMC	EPC Lots					
				1	2	3	4		
HSE									
HSE Manager/ deputy	2	1	3	1	2	2	2	2	15
HSE Senior (4 shifts)	1	1	5	1	4	4	4	2	22

Nominal Positions	PMG	Rogun HPP						Other Contractors	Total
		Rogun JSC	ER/PMC	EPC Lots					
				1	2	3	4		
Social Specialist	1	0	0	0	0	0	0	0	1
Gender Specialist	1	0	1	0	0	0	0	0	2
Environmental Specialist (4 shifts)	1	1	4	1	4	4	4	4	23
HSE Supervisors (4 shifts)	0	0	10	0	4	4	4	4	26
OHS specialists (4 shifts)	1	1	50	4	32	24	24	12	148
Laboratory	0	0	0	0	12	0	0	0	12
Traffic officers (4 shifts)	0	4	4	1	1	1	1	1	13
Community Laison	1	2	0	0	0	0	0	0	3
ESHS administrative support	2	1	2	1	4	3	3	2	18
HR									
HR Manager	1	1	1	1	1	1	1	1	8
HR specialists/assistants	0	5	4	2	16	10	10	4	51
HR administrative support	1	1	2	1	3	2	2	1	13
Total	**12**	**18**	**86**	**13**	**83**	**55**	**55**	**33**	**355**

3.2.13. ESHS staffing requirements for the operational process are summarized in **Table 3-3**.

Table 3-3 – Proposed ESHS Staffing Rogun HPP Operational

Nominal position	PMG	OJSC Rogun (Operation)	DFZ
International advisor	on call	0	on call
HSE Manager	1	1	1
Environmental specialists	0	1	0
OHS shift managers	0	2	0

Nominal position	PMG	OJSC Rogun (Operation)	DFZ
Safety officers	0	4	0
Traffic officers (1/shift)	0	1	0
HSE administrative support	1	1	0
HR Manager	1	1	1
HR specialists/assistants	0	1	0
Community liaison	0	0	3
Grievance manager	1	0	1
Total (local)	**4**	**12**	**6**
Total (expat)	**1**	**0**	**1**

3.2.14. Off-site, the State Enterprise Directorate for Flood Zone (DFZ) is responsible for developing and implementing the resettlement and livelihood restoration program, in addition to managing and overseeing the left bank works. They employ two main contractors, one for construction at new resettlement sites and another for demolition of relocated villages. DFZ also employs the State Forestry Agency to undertake land clearance works in advance of flooding, and another contractor who transports property of resettled households to designated resettlement sites.

3.2.15. ESHS staffing requirements for DFZ during the active resettlement phase are summarized in **Table 3-4**.

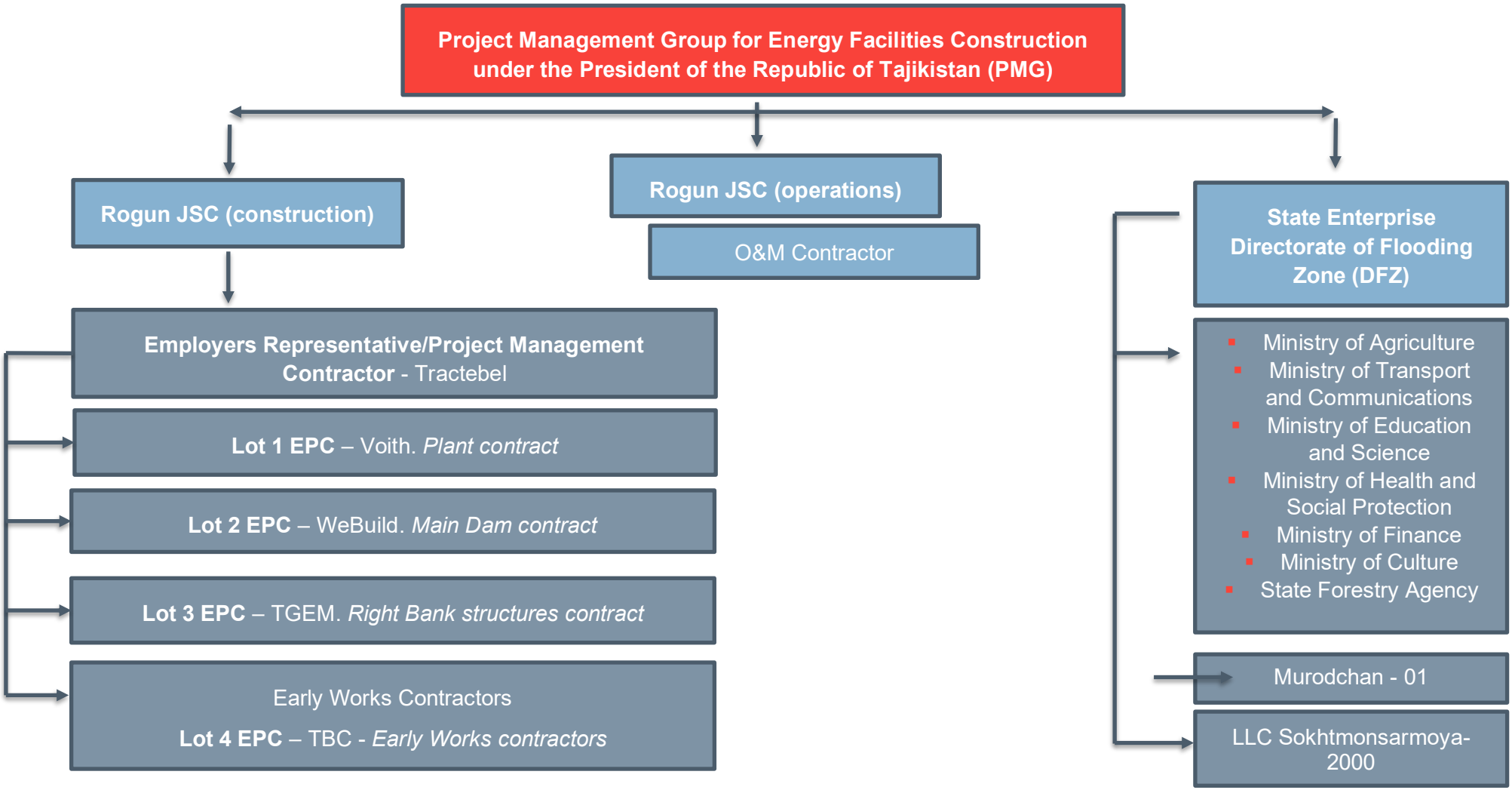
Table 3-4 - DFZ ESHS Staffing for Active Resettlement Phase

Position	Number	Contractors [(a)]	Total
Consultants (as needed)	1	0	1
Resettlement and Livelihoods Advisor	1	0	1
Resettlement Specialist 1	20	0	20
Assistant Resettlement Officer	4	0	4
ESHS Manager	1	3	4
Environmental and Social Specialists	2	0	2
HR Specialist	1	3	4
Community Engagement Manager	1	0	1
District Livelihood and Engagement Officer	14	0	14

Position	Number	Contractors [a]	Total
Monitoring and Evaluation Officer	1	0	1
IT/Data Management Specialist	1	0	1
Total	**47**	**6**	**53**

(a) - Resettlement is expected to be complete in 2032

Figure 3-1 – Current Project Organization Structure



3.3. PROJECT LOCATION AND CONTEXT

3.3.1. The Republic of Tajikistan is a landlocked nation in Central Asia, with an area of 142,326 km² (54,952 sq. mi). Dushanbe is the country's capital and largest city. On 9 September 1991, Tajikistan declared itself an independent sovereign nation from the Soviet Union.

3.3.2. Tajikistan is divided into four administrative regions or provinces. These regions are:

- Sughd province.
- Khatlon province.
- Gorno-Badakhshan Autonomous province.
- Region of Republican Subordination.

3.3.3. The Region of Republican Subordination is divided into seven districts (rayons), namely Fayzabad, Rogun, Nurobod, Rasht, Tavildara, Tajikabod and Jirgital. The Project will directly affect Rogun, Nurobod and Rasht districts. See **Figure 3-2**.

3.3.4. The Project is located approximately 100 km east of the Tajik capital of Dushanbe on the Vakhsh River within the Amu Darya basin. The Vakhsh River is one of the two main tributaries of the Amu Darya, which is the largest river in Central Asia with a total length of 2,540 km. The Amu Dayrya originates at the confluence of the Pyanj and Vakhsh rivers and drains a catchment area of 543,739 km². The Amu Darya basin is shared between Kyrgyzstan, Afghanistan, Tajikistan, Turkmenistan, and Uzbekistan.

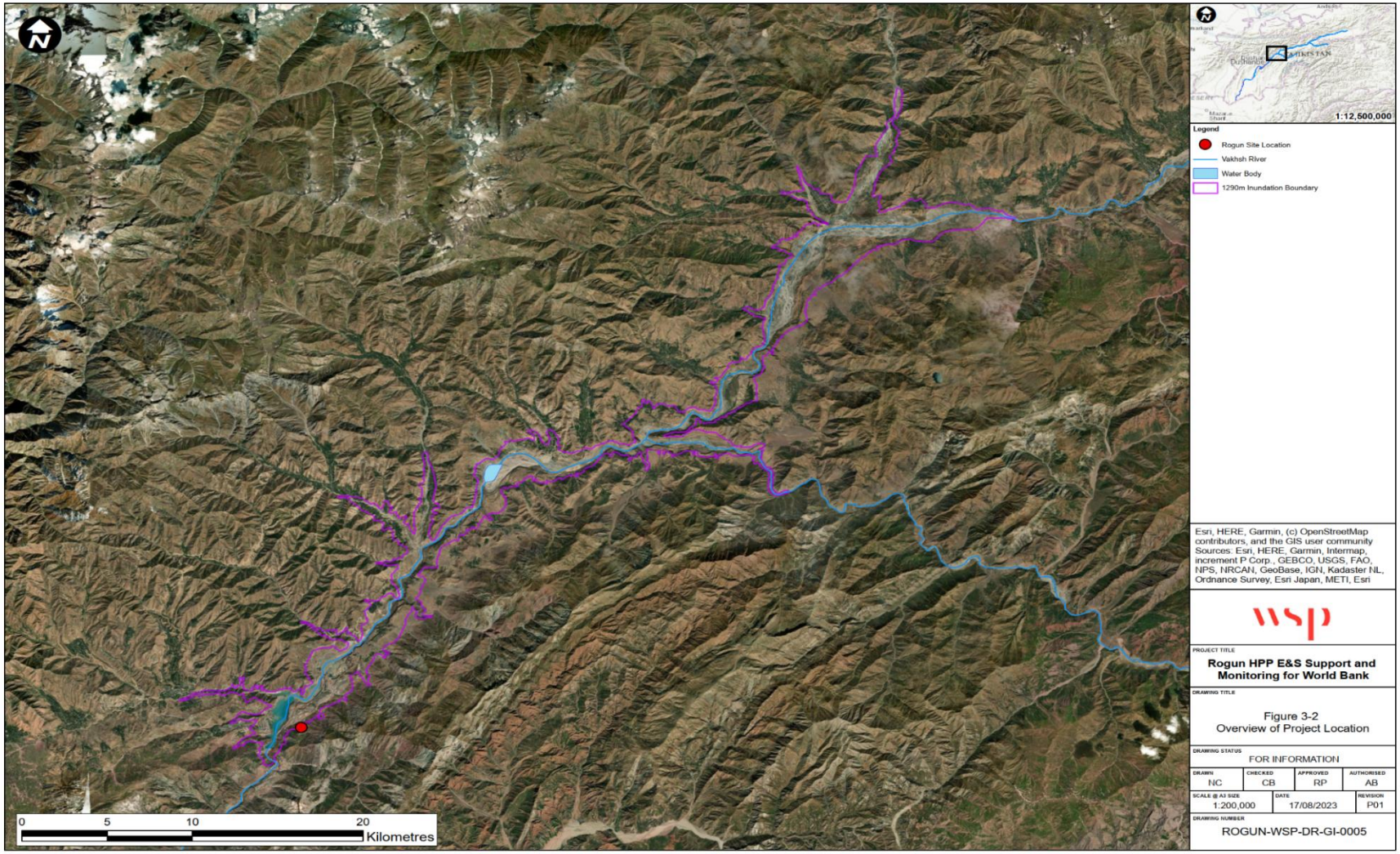
3.3.5. Four right bank tributaries (Kafirnigan, Surhan, Sherabad and Zeravshan) and one left bank tributary (Kunduz) flow into the Amu Darya within its middle reach. Currently, the Zeravshan does not reach the Amu Darya since its water is being used for irrigation within the territory of Uzbekistan. Further downstream towards the Aral Sea the river has no more tributaries. It is fed largely by water from melted snow, thus maximum discharges are observed in summer and minimum ones in January-February.

3.3.6. One of the tributaries of Vakhsh River, the Kizil-Su, originates in Kyrgyzstan, flows through the Pamir-Alai mountains of Tajikistan and joins the Muk-Su, forming the Surkhob River. The Vakhsh River is formed by the confluence of Surkhob with Obihingou and then joins the Pyanj River after 520 km to form the Amu Darya. The Pyanj and Amu Darya form the border between Tajikistan and Afghanistan.

3.3.7. The drainage area of the Vakhsh River in Tajikistan is 31,200 km^2. Most of the river runs through mountainous territory. At the Project site, about 340 km upstream of the confluence with the Pyanj, the river flows through a narrow, 400 to 500 m deep V-shaped gorge with gradients of the valley sides up to 50°.

3.3.8. In its upper reaches, the Vakhsh River flows through a narrow valley with a steep gradient but, on a few sections the valley is wider and almost flat, and here the river has formed extensive floodplains. The floodplain near Komsomolobod and another near Novobod is located within the flooding zone of the reservoir. The confluence of the Surkhob and Obihingou tributaries will also be submerged by the reservoir.

Figure 3-2 - Overview of Project Location



3.3.9. The Vakhsh River is intensively developed and accommodates **five** existing hydropower dams; of which the Project is the furthest upstream, in a cascade that includes the Nurek HPP, located 70 km downstream from the Project and, downstream of Nurek, the Baipaza, Sangtuda 1, Sangtuda 2 and Golovnaya Dams. The Rogun HPP is located at the upstream end of the cascade. Key features of the hydropower dams are presented in **Table 3-5**).

Table 3-5 - Vakhsh Cascade Hydropower Dams

	Rogun	Nurek	Baipaza	Sangtuda 1	Sangtuda 2	Goluvnaya
Stage	Under construction	In operation since 1979, now under rehabilitation	In operation since 1986	In operation since 2009	In operation since 2011	In operation since 1963, now under rehabilitation
Live Storage Hectometers (hm^3)	10,300	4,200	87	18	5	4
Installed Capacity (MW)	3,780	2,600 (2019) 3,300 (by 2028)	600	670	220	240
Regulation	Inter-annual	Inter-annual	Weekly	Daily	Daily	Daily

3.3.10. Planning for the Shurob HPP began in the Soviet era to locate the HPP on the Vakhsh River between Rogun HPP and the Nurek reservoir. However, the scheme is on hold until Rogun HPP is constructed.

3.3.11. Although the Vakhsh River lies within Tajikistan, the Amu Darya basin is shared between Kyrgyzstan, Afghanistan, Tajikistan, Turkmenistan, and Uzbekistan and is one of the two main tributaries of the Aral Sea. On February 18, 1992, the Almaty Agreement (previously Protocol 566) was ratified to manage the water allocation and water-sharing principles between the nations of the Amu Darya basin, except for Afghanistan, which is not party to the Agreement.

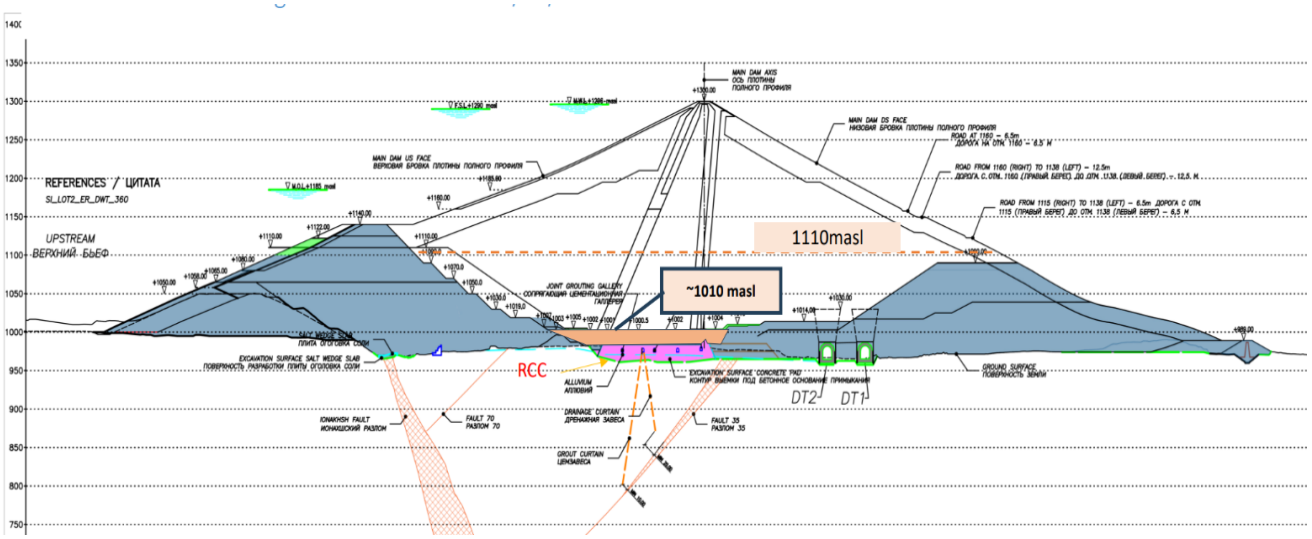
PROJECT HISTORY

3.3.12. The Project has a long history and was first proposed under the Union of Soviet Socialist Republics (USSR) in 1959. In 1978, a technical design of a 335 m dam and six power units of 630 MW each installed in an underground power plant was prepared. The final construction decision was granted in 1980, and the main construction work began in 1982. Construction of the main components of the underground works and a 45 m hydraulic cofferdam progressed until 1990 when work was suspended due to political changes and the independence of Tajikistan. In 1993, there was a flood during which the diversion tunnels were blocked, and the cofferdam was destroyed.

3.3.13. The Government of Tajikistan announced the construction of the Project to resume in May 2008. Limited construction and maintenance activities were resumed until 2011, when a Techno-Economic Assessment Study (TEAS) was written by Coyne et Bellier, which was reviewed by the 2014 Dam Safety Panel of Experts (DSPoE) and found to be of sound design. An overview of previous studies and key findings is presented in **Volume 1, Chapter 1** of this ESIA.

3.3.14. The Project is being constructed in two stages (**Figure 3-3**), with details of each stage discussed in Sections 3.4 and 3.7. Stage one construction commenced in 2014 and is almost complete.

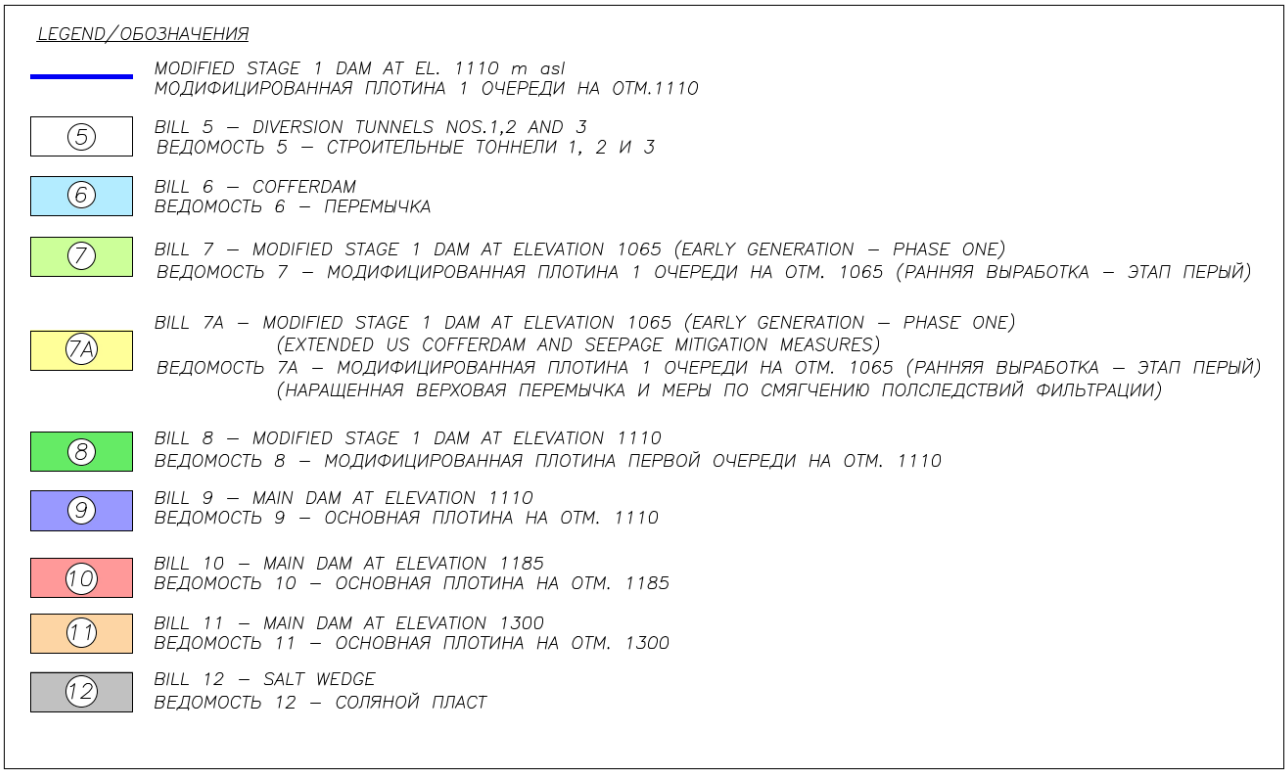
Figure 3-3 - Overview of Construction Stages



Source: Dam Safety Panel of Experts, 2024.

3.3.15. The phases have changed since **Figure 3-3** was produced and are described in **Figure 3-4**. Currently Phase 5, 6, 7, 7a and 8 are complete.

Figure 3-4 - Phases Description



3.3.16. The construction of the Project is proceeding in stages as described in **Table 3-6**.

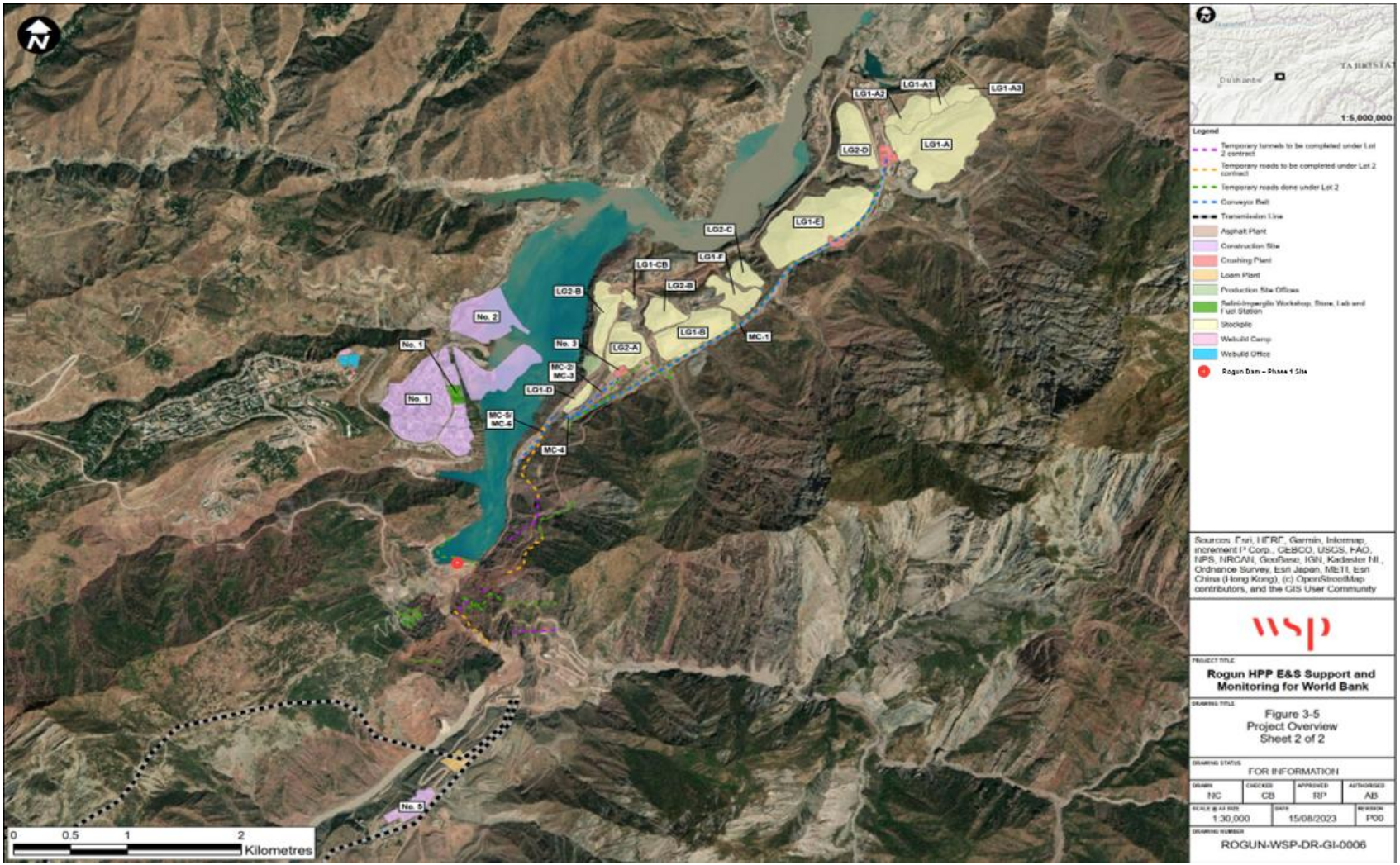
Table 3-6 - Construction Schedule

Construction Stage	Description	Completion Date	Status
Pre-cofferdam	Start of the river diversion to allow construction to proceed, improving the access road and internal roads, and finalizing DT3.	2016	Complete
Cofferdam	Construction of cofferdam to crest at 1,050 m asl.	Pre-cofferdam completed in 2016. Cofferdam completed in 2017	Complete
Stage 1 Dam	Construction of dam to crest at 1,110 m asl. This is an intermediate stage to allow early electricity generation.	Estimated to be completed in 2025.	Ongoing
Stage 2 Dam	Construction of dam to crest at 1,300 m asl and the reservoir level will be at 1,290 m asl filling over a 16-year period (approx. 2038).	Scheduled construction completion by 2032 or Left Bank structures contract.	Ongoing

3.3.17. After the Project receives financing in 2025, early works contracts will be terminated, and all works will be completed under EPC contracts based on FIDIC (Fédération Internationale des Ingénieurs-Conseils) and World Bank Standard Procurement Documents (SPDs).

3.3.18. Most of the existing ongoing accommodations and work camps for existing contractors are on construction site 1 (see **Figure 3-5**). This area will be flooded in 2026/2027, before which accommodation and work camps will be relocated to new areas within Construction Site 2 and Area 5.

Figure 3-5 - Existing Rogun HPP Project



3.4. PROJECT COMPONENTS

3.4.1. This section describes the built components of the Project and the areas immediately surrounding the dam and reservoir. The Project components considered in the ESIA are summarized in **Table 3-7**.

Table 3-7 - Rogun HPP Project Components

Component	Description
Lot 1	
Powerhouse and Turbines	▪ Total Installed Capacity: 3,780 MW. ▪ Number of Turbine Units: 6. ▪ Located in a sedimentary complex constituted of sandstone and siltstone. ▪ Powerhouse Cavern: 220 x 20 x 70 m. ▪ Transformer Cavern: 220 x 20 x 70 m. Powerhouse and transformer caverns will have 200 m vertical by 800 m horizontal by 12 m diameter tunnel/shaft for ventilation. At present, temporary equipment provides ventilation, which is poor. Under the Lot 4 contract, permanent forced-air equipment will be installed (forced-air in, natural exhaust), expected completion in approximately 2025.
Lot 2	
Dam (Stage 2) and Reservoir	The Stage 2 Dam consists of an earth-rock-filled dam. The cofferdams form part of the main embankment body. It has an inclined loam core, with upstream and downstream fine and coarse filter zones (or a transition zone below the upstream minimum operating level). The shells consist of granular alluvium with rockfill placed on the outside of the shell. Information regarding the dam is presented in Section 3.7. ▪ Total land area under the reservoir – 16,823.25 hectares: ▪ Agricultural – 8,036.23 hectares. ▪ Irrigated – 3,43.67 hectares.

Component	Description
	▪ Forests and bushes – 727.26 hectares. ▪ Others – 7,716.09 hectares.
Crushing Facilities	There are six crushing facilities currently under operation: ▪ One closed area crusher facility with 1 million m3 / year aggregate production capacity. ▪ Five open area crusher facilities with an aggregate production of between 12 to 15 m3/month each. RCC Crushing Plant – Left Bank Upstream ~1198 m asl The system is fed by alluvium type material (Labydors) taken from stockpile area at Quarry No.15. The Crushing Plant has been set with screens of predetermined dimensions suitable to produce aggregates [0-5 mm], [5-20 mm] and [20-40 mm] as designed for the RCC mixes to be used for the Main Dam RCC Pad. Main mechanical components of the Crushing Plant are: ▪ Feeder – METSO Nordberg VF661 – Initial Screening. ▪ Jaw Crusher - METSO Nordberg C140 – Primary Crushing. ▪ 2-story screening - METSO Nordberg CVB2661 – Primary Crushing. Cone-shaped Crusher - METSO Nordberg GP500S – Secondary Crushing.3-Story Screening - METSO Nordberg TS5.3 (x2) – Secondary Crushing.
Lot 3	
Headrace Tunnels	The primary purpose of headrace tunnels is to convey water from the reservoir or intake structure to the powerhouse, to drive turbines to produce electricity. Once all six turbine units are operational in the powerhouse, the maximum discharge capacity is 1,626 m^3/s. Construction of the tunnels involves drilling and blasting with the excavated tunnel lined with reinforcing steel bar grids and concrete.
Diversion Tunnels	Diversion tunnels for diverting the river during construction or repair of other hydraulic structures are part of the hydropower complex.

Component	Description
	There are currently four diversion tunnels operating on site known as DT-1, DT-2, DT-3 and DT-4. DT-1 and DT-2 will work under a maximum head of 120 m, and their maximum discharge should preferably not exceed 1,600 m^3/s/tunnel. A maximum head of 120 m is tolerated in tunnels during the construction period. This value can be overpassed by 30 m, i.e., 150 m, in extreme conditions such as high floods or seismic events. The design of the dam and reservoir accounts for the possibility for this to occur such that permanent structures are not compromised. Construction of the tunnels is as described for the headrace tunnels.
Lot 4	
Spillways	High Level Outlet 1 (HLO-1) HLO-1 spillway consists of an outlet, 600 m long and 12 m in diameter pressurized tunnel equipped with maintenance gate and radial service gate followed by a 200 m long free surface flow tunnel before entering a vertical vortex shaft which is followed by a 350 m long tunnel. High Level Outlet 2 (HLO-2) HLO-2 spillway consists of an outlet, some 310 m long 12 m in diameter pressurized tunnel equipped with maintenance gate and radial service gate which is followed by a 14 m diameter 3.2 km long free surface flow tunnel that is followed by a chute type structure. HLO-1 and HLO-2 remain in operation until they lose functionality due to siltation and are replaced by Remote Tunnels Spillways. Remote Tunnel Spillways (RTS) The RTS features an ogee-shaped outlet structure equipped with radial gate, followed by a roughly 4 km long horseshoe-shaped tunnel, 13 m in width and height, that is terminating in a stilling basin. The discharge capacity per RTS is higher than HLOs 2,400 m3/s, to cope with Probable Maximum Floods (PMF). All flood releasing facilities are being constructed to the right abutment with dimensions of about 2 km long and 1.5 km wide.
Other Project Components – responsibilities shared between EPC Contractors	
Transportation Routes	A single gate provides access to the Project site.

Component	Description
	There are approximately 70 km of underground transport routes; most of which will be converted to water tunnels or plugged as the reservoir rises. Six km of underground roads will remain after construction. Currently there are 26 km of surface roads, most unpaved. Approximately 5-6 km of this will remain after construction. Concrete and other supplies arrive from Dushanbe on public roads.
Power Supply (Back up)	A back-up power supply is necessary beyond the construction phase for electricity usage for operational site facilities. A direct power source from the 6 x 630 MW turbines will be used as power supply in normal circumstances. Back-up power is currently supplied by the existing turbines 5 and 6, diesel generators and a direct power source from Nurek HPP.
Current accommodation	As of May 2025, approximately 20,000 people are engaged for construction activities with peak employment likely during the period between 2025-2028. Of the current workforce, approximately 2,800 are office workers, made up of administrative, manager and support workers (cleaners, canteens, shops) who work 8am to 5pm, approximately 14,000 work 12-hour shifts in construction, on a 15 day on/off schedule with some night shifts (depending on the work program and individual contractors). Each shift includes 1 hour for lunch. Except for some WeBuild employees and a few small camps, all accommodation is on Construction Site 1 (and will only be used as long as the non-EPC contractors are on site. Current accommodation sites will be demolished and rehabilitated before being flooded in 2026/2027. Buses transport workers to and from their workplaces to their accommodation on Construction Site 1. Most of the contractors have their own buses, which collect workers from designated locations around half an hour before the start of their shift and transfer them to their construction site area. The designated pickup locations vary depending on the contractor, but usually, contractors collect workers in either Rogun City or by the worker accommodation camps. Approximately 300-400 live outside of Rogun city within 30km and are transported to and from their villages. Some contractors, workers and office staff hire accommodation in Rogun City (approximately 2 km uphill from the main worker accommodation area). Rogun JSC provides accommodation for their staff in four tower block buildings in Rogun City. Each contractor is responsible for collecting sanitary waste, with liquids from sewage going into sumps which drain into the ground and solids periodically removed for disposal to the Rogun Municipal Wastewater Treatment Plant (WWTP). Rogun JSC is in the process of designing and installing water treatment facilities for all of Construction Camp 1. Photos of on-site accommodation camps are presented in **Figure 3-6, Figure 3-7** and **Figure 3-8**.

Component	Description
Future accommodation	Before Construction Camp 1 is flooded in 2026/2027, all four EPC contractors will design and construct accommodations and other facilities on land to be allocated by Rogun JSC. This will be in two new construction camps in Construction Camp 2 and Site 5 (refer to Figure 3-2). Contracts will require accommodation and facilities to meet Project Standards.
Medical Facilities	Most major contractors provide medical facilities on-site. For the contractors that do not have their own medical facility, there are central Rogun Medical Centers that can be utilized by all workers. For any serious injuries or operations, workers are transported off-site to the closest medical centers in Rogun City or to a hospital in Dushanbe. Currently, across all medical centers on-site, there are: ■ 27 Doctors ■ 13 Paramedics ■ 6 Nurses ■ 38 Healthcare Professionals ■ 1 Dentist ■ 45 Drivers ■ 4 Janitors ■ 11 Emergency Vehicles Details of Health Centers and First-Aid Points on-site, include: ■ Health Center of the Department of Affairs - JSC "Rogun HPP" on Construction Site No. 1. ■ Health Center of the Department of Affairs - JSC "Rogun HPP". ■ Medical Center of the JSF "Sokhtmoni Asosi". ■ Medical Center of JSC "Tojikhydromontazh". ■ JSC "TGEM" Medical Center - Construction Site No.1. ■ Medical Center of JSC "TGEM" - Quarry 15. ■ Medical Center of JSC "TGEM" - Koni 26.

Component	Description
	■ Medical Center of JSP "ZTM (EMZ) Norak. ■ LOT2 Contractor - WeBuild Medical Facilities. The medical center of LOT2 contractor WeBuild has the capacity to deal with more significant accidents amongst other site workers on a triage basis. Limited surgical procedures can be carried out and designed to meet International GIIP standards. Medical Centers under LOT2 Contractor WeBuild include: ■ WeBuild Medical Center. ■ WeBuild Medical Hospital. ■ First Aid Point - Construction Site No. 5. ■ WeBuild Medical Center - Koni 15 asphalt plant. ■ WeBuild Medical Emergency Brigade and Intensive Treatment Room Photos of selected on-site medical facilities are presented in **Figure 3-7**.
Borrow Pits / Quarries / Batching plants	Three quarries are currently operational on the Rogun site by Lot 2 contractor WeBuild, but under the subcontractor TGEM working within the quarries. There are currently up to 6 batching plants operating on site, these are managed by WeBuild, TGEM, Ariana, MEZ, and TGM. **Quarry 15** Extracted material for use in construction of the dam wall such as sand and gravel – alluvium sedimentation. As of November 2023, a total of 46 million m^3 of material was extracted. Of this, 20 million m3 has been used (mostly in construction of the dam). The remaining 26 million m^3 of extracted material is stored in three open stockpiles, comprising of sand and gravel (alluvium material). This is transported using a 7 km covered conveyor to the batching plants. Another 5 million m^3 was extracted from the Right Bank area until May 2024. Approximately, 5 million m^3 of extracted material will be moved to the Left Bank stockpiles, as the Quarry 15 and stockpiles will be inundated by the reservoir with no rehabilitation. During the Soviet era, approximately 10 million m3 of stone, sand and gravel material was extracted from Quarry 15a, this area is now inundated by the reservoir and crushed for use in the batching plant. Five million m^3 of material remains and is stored in two stockpiles on the Left and Right Bank and is planned for use in the batching plants.

Component	Description
	Quarry 17 Quarry 17 is extracting Loam (clay and sand) material and is located downstream of the Dam, with use of a small stockpile area. A total of 20 million m^3 of material will be extracted, of which; 7 million m3 of fine material for dam core backfilling, and the remaining 13 million m^3 used for a later stage of dam construction. As of November 2023, a total of 1 million m^3 of fine material has been extracted at Quarry 17. This is expected to be operational until 2029/2030. Quarry 17 is not within the inundation zone for the reservoir, and there are no current plans to rehabilitate or use the land beyond operation. **Quarry 26** Quarry 26 is located on the Kishrog River right bank in the downstream area of the dam, 2.5 km from the site. Extracting rock mass material for use in the dam construction is undertaken via blasting, and is divided into 3 sections: ▪ Quarry 26 is no longer operational. ▪ Quarry 26A is currently operational. ▪ Quarry 26B designated for any additional material if required. A total of 15 million m3 of material to be extracted from Quarry 26A, with approximately 3 million m3 material already extracted. Quarry 26 is outside the inundation zone, and there are no current plans for future uses or rehabilitation of the area. The working Quarry 26A has a height of up to 210 m. The quarry is planned to be developed by 10 m high benches and a slope of 70º between the 6 m wide berms. Material is quarried from borrow pits using blasting techniques.
Stockpiles and material transfer	There are several stockpiles on site used to store extracted and processed materials. Locations of stockpiles are shown in **Figure 3-5.** Materials from upstream quarries and stockpiles are transported to the dam and to stockpiles downstream of the dam by a 7 km covered conveyor. A new 8-9 km covered conveyor (called the 'flying belt') transports materials from the downstream quarry and stockpiles to the dam site. The existing conveyor has reduced traffic by about 100 trucks per hour and the new conveyor will also reduce traffic further. Spoil from the ongoing tunnelling which is not suitable for use in the dam is transported by truck to piles in locations within the future reservoir footprint that will be flooded. A spoil heap has been established in Area 5 to take aggregate that is out of geotechnical specification.

<table>
<tr><th>Component</th><th>Description</th></tr>
<tr><td>Fuel Storage Areas</td><td>Rogun JSC has an old storage area in Construction Site 1 for its own and minor contractor use and includes:
Seven underground diesel storage reservoirs/tanks.
Three above-ground diesel and petrol storage reservoirs/tanks.
The major contractors each have their own fuel storage areas.
Selected photos of the Fuel Storage Areas are presented in Figure 3-7.
These areas will be rehabilitated prior to being flooded.</td></tr>
<tr><td>Concrete Batching Facilities</td><td>1,000 tonnes of cement arrive per day from Dushanbe which equates to about 30 trucks per day.
There are eight concrete batching plants on-site with an effective capacity of 40 m^3/h.
There are approximately 25 concrete mixers with an average capacity of 6 m^3/h.
A disused but not decommissioned batching plant is located in Construction Site 2.</td></tr>
<tr><td>Power Supply (non-grid)</td><td>Power supply is necessary throughout the construction phase for electricity usage on site. Prior to 2018, a direct power source from diesel generators and a direct power source to Nurek HPP was used. Following the completion of the Stage 1 Dam in 2018, the operation of the existing Unit 5 and 6 turbines allow direct power from Rogun HPP, although for some construction activities, diesel generators are required as detailed below:
<table>
<tr><th>L4 Class Name</th><th>Equipment description</th><th>Location</th><th>Brand</th><th>Model</th><th>Year</th></tr>
<tr><td>Generator Set 250 To 799 KVA</td><td>ELECTRIC GENERATOR 275 KVA</td><td>Rogun Site Office</td><td>SDMO</td><td>D275</td><td>2014</td></tr>
<tr><td>Generator Set 0 To 249 KVA</td><td>ELECTRIC GENERATOR TRIFASE</td><td>Asphalt Plant</td><td>GREEN POWER</td><td>GP 44KVA</td><td>2017</td></tr>
<tr><td>Generator Set 0 To 249 KVA</td><td>ELECTRIC GENERATOR TRIFASE</td><td>Drilling & Grouting Area</td><td>GREEN POWER</td><td>GP 44KVA</td><td>2017</td></tr>
<tr><td>Generator Set 250 To 799 KVA</td><td>3 PHASE VOLTAGE GENERATING SET >100KW</td><td>Quarry 15</td><td>CME</td><td>730KVA</td><td>2007</td></tr>
</table></td></tr>
</table>

Component	Description					
	Generator Set 250 To 799 KVA	3 PHASE VOLTAGE GENERATING SET >100KW	Outside of T3	CME	730KVA	2006
	Generator Set 250 To 799 KVA	3 PHASE VOLTAGE GENERATING SET >100KW	Drilling & Grouting Area	COELMO	FDTC87*25 250/275 KVA	2011
	Generator Set 800 To 1250 KVA	ELECTRIC GENERATOR 800KVA PRP	Construction Camp 5	CUMMINS	TCM800C	2011
	Generator Set 0 To 249 KVA	3 PHASE VOLTAGE GENERATING SET <100KW	KT-9	GREEN POWER	GP44 S/I-A	2018
	Generator Set 0 To 249 KVA	3 PHASE VOLTAGE GENERATING SET <100KW	Crushing Plant	GREEN POWER	GP44 S/I-A	2018
	Generator Set 0 To 249 KVA	3 PHASE VOLTAGE GENERATING SET <100KW	Quarry 15	GREEN POWER	GP44 S/I-A	2018
	Generator Set 0 To 249 KVA	3 PHASE VOLTAGE GENERATING SET <100KW	Drilling & Grouting Area	GREEN POWER	GP44 S/I-A	2018
	Generator Set 250 To 799 KVA	ELECTRIC GENERATOR	Batching Plant	COELMO	PDT256G2	2014
	Generator Set 800 To 1250 KVA	CONTAINERIZED 20' DIESEL GENERATOR	Outside of Tunnel T-37	MILANTRACTOR	GDCU1290SXCTAPF	2012
	Generator Set 800 To 1250 KVA	CONTAINERIZED 20' DIESEL GENERATOR	Outside of Tunnel T-37	MILANTRACTOR	GDCU1290SXCTAPF	2012
	Generator Set 800 To 1250 KVA	CONTAINERIZED 20' DIESEL GENERATOR	Construction Camp 5	MILANTRACTOR	GDCU1290SXCTAPF	2012
	Generator Set 800 To 1250 KVA	CONTAINERIZED DIESEL GENERATOR 1250KVA	Construction Camp 5	MILANTRACTOR	GDCU1250SXCTAPF 1250KVA	2009
Waste Storage Areas	As construction works are undertaken in four main work packages, each contractor provides its own waste storage areas and disposal facilities.					

Component	Description
	LOT2 Construction – WeBuild Contractor Facilities for waste storage areas within LOT2 construction are managed by the contractor WeBuild, and include areas at the tank farm, maintenance yard and garage, warehouses, crushed-ore storage, and a washing facility. The domestic waste storage area is constructed of concrete brick, fitted with concrete flooring, however, there is no roofing, and hence no protection from rain, wind or snow. Hazardous waste is stored in the workshop service area prior to uplift by the waste contractor. The storage area is constructed from concrete and is covered with corrugated roofing. Waste is stored within open-top intermediate bulk containers (IBCs) or on top of wooden pallets within the concrete cubicles. Signs and labelling of waste are noted within the storage area. **LOT3 Construction – TGEM Contractor** The storage area shown in Figure 3-4 is for uncontaminated construction waste Hazardous waste is stored in metal barrels fitted with lids, which in turn are kept inside larger containers. **LOT4 Early Works Construction - Sadd Ariana Co. Contractor** Hazardous wastes are removed from site by a waste contractor for disposal at a certified waste disposal site; and Septic tanks are installed on site for the collection of sewage waste. **Non-hazardous waste / construction debris** All contractors reportedly had their non-hazardous wastes transported by licensed hauler to licensed landfills To the north of Construction Site 1 rock rejects interspersed with a number of small loads of construction debris are being stored. Rogun JSC is in the process of designing a repository for construction debris and other non-hazardous waste. Downstream of Construction Site 5 is a small expanse of rock piles interspersed with truckloads of construction debris. **Hazardous waste** A licensed hauler takes away hazardous waste for recycling (batteries and some other wastes), for treatment or disposal at facilities in Dushanbe. **Medical waste**

Component	Description
	In the past, medical waste from the HPP's central clinic went to Obigarm, where there was no proper management, so it was burned with local medical waste. Since early 2023 the Rogun hospital has had a new UNICEF-financed facility for medical wastes including an ampule crusher and dry sump for crushed-glass storage and an incinerator with 1m3 capacity and burn temperature of 700-1000 degrees centigrade. Medical waste accumulates and is burned every one or two days, and medical waste from the Rogun HPP site is brought three to four times per week. Rogun contributes only a small part of what they receive.
Sewage Disposal (non-municipal)	Each contractor's sewage waste is managed in ponds / sumps. Liquid is generally infiltrated into the ground and solids are reportedly removed by a hauler for treatment in the Rogun Wastewater Treatment Plant (WWTP). A treatment system plant to treat sanitary water from Construction Camp 1 is now operational. It will be removed before flooding in 2027 and relocated for use elsewhere. The HPP also has a small plant that will be sufficient through to full operation.
Left Bank Road	The filling of the reservoir will submerge the unpaved road connecting 15 villages in the Nurabad district and one village in the Rogun district on the left bank; affecting a population of approximately 8,000 people. In addition, seven pedestrian bridges, including vehicle bridges, will also be submerged by 2028. The loss of the bridges and road will result in loss of access to the facilities and amenities that are available in the larger villages located on the right bank, including access to hospitals. To alleviate the severance, reinstatement of the left bank road will be funded by the AIIB. The works will be managed by the DFZ and constructed by the Ministry of Transport and local contractors. The reinstatement will involve a 55-km bare earth road to join the new International Bridge currently under construction. **Figure 3-10**Error! Not a valid result for table. shows the route of off-site roads and bridges, including the right-and left bank roads. An assessment of the potential impacts of the left bank road inundation and reinstatement is considered in **Volume 2, Annex 17-3: Severance Impacts** of this ESIA and will be managed as described in **Volume 3, A11: Ancillary Works Plan**.

3.4.2. The Project will result in the resettlement of a large number of people and, resettlement is outlined in **Section 3.5** of this chapter and assessed in detail in **Volume I, Chapter 17: Socio-economics** of this ESIA.

Figure 3-6 - Temporary Facilities – LOT2 WeBuild



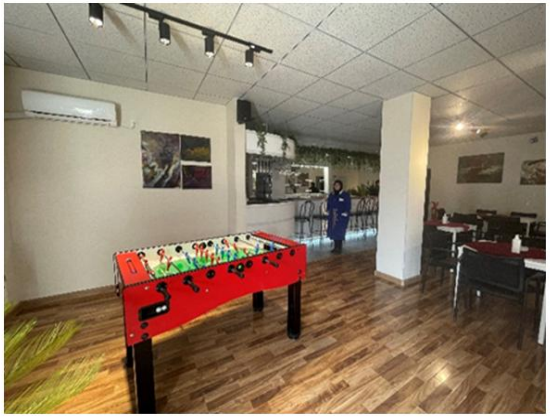
Camp Canteen - WeBuild



Self-Contained Flat - WeBuild



Landscaped Garden by Accommodation Blocks - WeBuild



Games Room - WeBuild

Figure 3-7-Temporary Facilities – Accommodations, Medical Facilities and Fuel Storage



Standard Dormitories - Inventor



Accommodation Toilets - Inventor



WeBuild Medical Facilities



Shared Kitchen in Self-Contained Male Dormitory - Nekzod



Shared Male Bedroom - Nekzod



Underground Fuel Storage Tanks



Oil Drums

Figure 3-8 - Temporary Facilities – Accommodation & LOT4 Tunnel Sadd Ariana



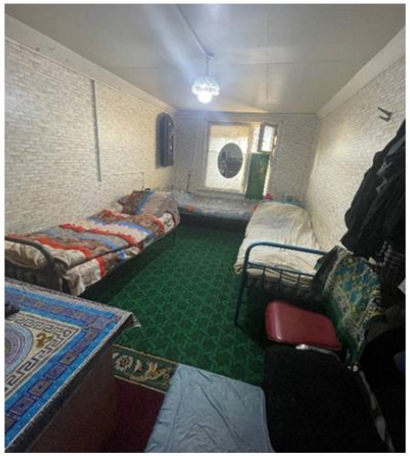
Camp *Male Toilets - Sohili Nur*



Standard Bedroom - Sohili Nur



External View of Worker Accommodation Camp - Tunnel Sadd Ariana



Standard Bedroom - Soktmoni Asnsi



Camp Toilet—Soktmoni Asnsi



Toilets - Tunnel Sadd Ariana



Standard Bedroom - Tunnel Sadd Ariana

Figure 3-9 - Temporary Facilities – Potable Drinking Water, Site Transport & Accommodations



On-site drinking water—Farrob



On-site drinking water - TGEM



Overcrowded rooms—causing workers to sleep on the floor—Khokrud



Toilets - Nekzod

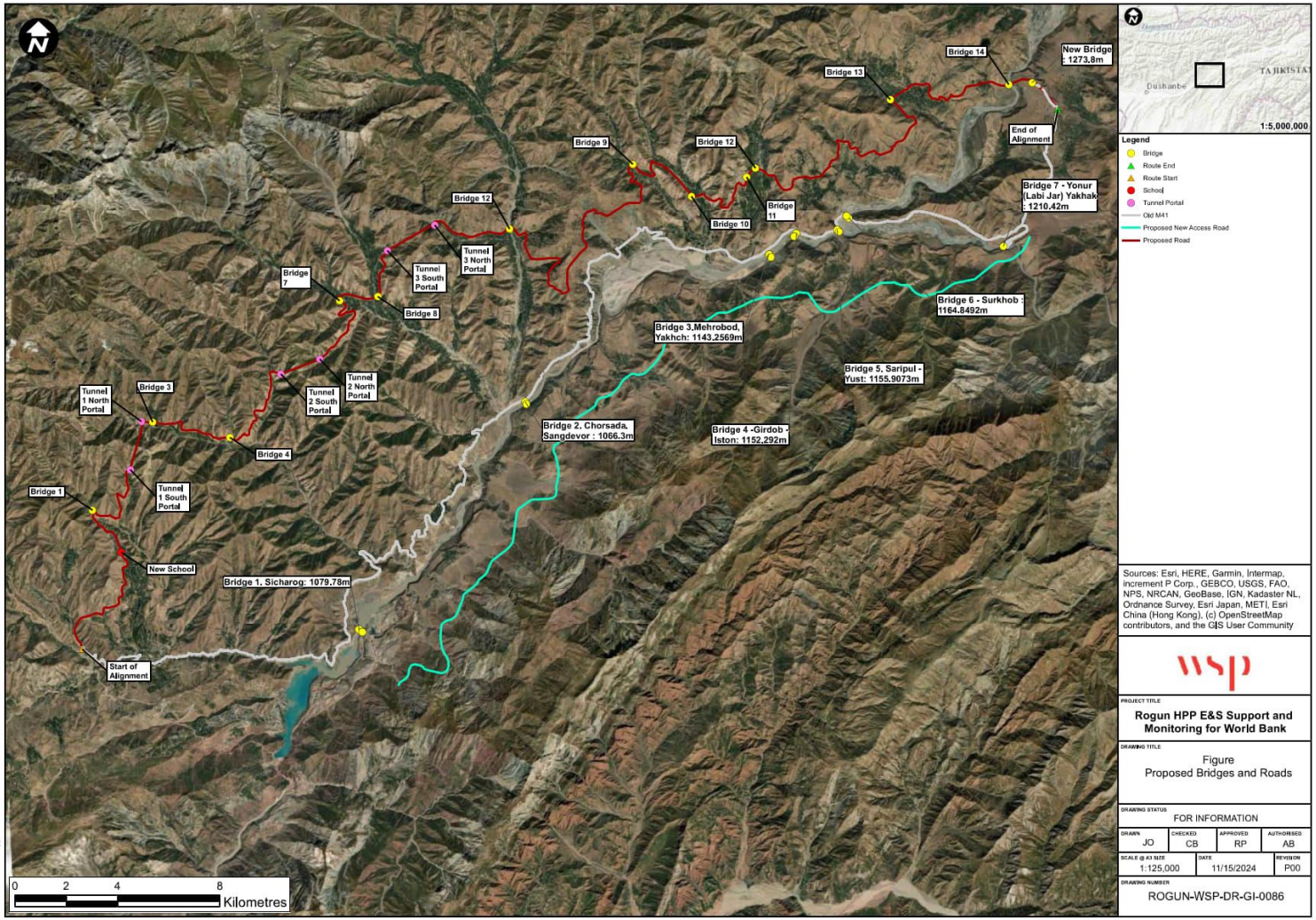


Exposed Drinking Water—Soktmoni Asnsi



Worker Site Transport - WeBuild

Figure 3-10 – Proposed Roads and Bridges (off-site)



3.5. RESETTLEMENT

3.5.1. Resettlement is managed by the Directorate of Flooding Zone (DFZ) and, to date, has been funded by the Government of the Republic of Tajikistan. In future, some resettlement activities may be financed by one or more International Lenders and, as such, the program is considered a core Project component.

3.5.2. The effects of resettlement are considered in **Volume 1, Chapter: 17: Socio-economics** of this ESIA. The Project funding to households to be resettled comprises a grant issued by DFZ to facilitate the establishment of new dwellings in resettlement areas and reestablish the PAP's primary source of income. A loan from either the Ministry of Labor or Ministry of Agriculture is also available if required by the PAP to enhance their level of income or access additional resources to improve their livelihood. Livelihood restoration for PAPs in the form of apprenticeships are also being funded by the Project.

3.5.3. The physical infrastructure required for the establishment of new cities or the expansion of existing towns is funded nationally, is constructed to National Requirements and assessed for compliance with Tajik law by the Committee for Environmental Protection. Infrastructure provision and replacement is managed by DFZ and has generally been adequate to maintain and improve living standards for most resettled households. Generally, PAPs construct their own homes on a designated plot of land.

3.5.4. Resettlement is planned in phases that are aligned with the inundation levels of the reservoir. According to data from DFZ as of October 2024, resettlement of households in the flooding zone is due for completion by 2032. This will include 69 villages from the Rogun, Nurobod, and Rasht districts affecting an estimated 50,267 PAPs.

3.5.5. **Table 3-8** presents resettlement figures by Resettlement Action Plan (RAP)[1] and impoundment levels and **Table 3-9** presents a summary of villages during past, ongoing, and future resettlement phases.

Table 3-8 - Resettlement Figures (from Disclosed RPF)

Impoundment levels based on lowest point of villages (m asl)	Proposed years to complete resettlement	RAP period	No. of villages covered in each RAP	No. of households covered in each RAP	No. of PAPs covered in each RAP	RAP Status
1092-1220	2014-2017	2014-2017 RAP 1	8	326	2,697	Completed

[1] A RAP outlines the procedures and actions to be taken to mitigate adverse effects, compensate for losses, and provide assistance to displaced persons to improve or at least restore their standards of living.

Impoundment levels based on lowest point of villages (m asl)	Proposed years to complete resettlement	RAP period	No. of villages covered in each RAP	No. of households covered in each RAP	No. of PAPs covered in each RAP	RAP Status
1110-1290	2017-2026	2017-2026 RAP 2	16	1,710	16,919	In progress (finalized in 2024)
1185-1270	2026-2028	2026-2028 RAP 3	16	1,328	9,206	RAP 3 ready by 20263
1271-1295	2028-2030	2028-2030 RAP 4	17	2,215	12,547	RAP 4 ready by 20274
1296-1414	2030-2032	2030-2032 RAP 5	12	1,209	8,898	RAP 5 ready by 20295
TOTAL AFFECTED POPULATION				6,788	50,267	

Table 3-9 - Villages Relocated by Resettlement Phases within the Flooding Zone

No.	Planned Year for Completion	Name of the Village	District & city - out-migration	New village/city to which the resettled communities have moved.	Lower point of Village (m)	Upper point of the Village (m)	Status
1	2017	Sicharogh	Rogun city	Rogun city, Yoli Garmoba Tursunzoda city, Toichi village	1,115	1,143	Completely relocated.
2	2017	Sari Pul	Nurobod district	Danghara district, Chorsada 2 village Nurobod district, Darband city Tursunzoda city, Toichi village	1,153	1,196	Completely relocated.
3	2017	Furudgoh (Airport)	Nurobod district	Danghara district, Chorsada 2 village Nurobod district Darband city	1,165	1,185	Completely relocated.
4	2018	Saidon	Rogun city	Rogun city, Saidoni Nav Tursunzoda city, Toichi	1,210	1,301	Completely relocated.
5	2018	Makhallai poyon	Nurobod district	Danghara district, Chorsada 2 Nurobod district, Darband city	1,182	1,250	Completely relocated.
6	2018	Chanor	Nurobod district	Tursunzoda city, Toichi and Namuna Faizobod district, Sebiston Nurobod district, Darband city	1,199	1,255	Completely relocated.
7	2024	Roghuni poyon	Nurobod district	Faizobod district, Sebiston	1,242	1,265	Resettlement in progress (more than 50%)-plots selected, compensation in-progress to households
8	2025	Obiboriki poyon	Nurobod District	Faizobod district, Sebiston	1,259	1,327	Resettlement in progress (50-99%).

No.	Planned Year for Completion	Name of the Village	District & city - out-migration	New village/city to which the resettled communities have moved.	Lower point of Village (m)	Upper point of the Village (m)	Status
9	2025	Obiboriki bolo	Nurobod district	Faizobod district, Sebiston	1,327	1,487	Resettlement in progress (50-99%).
10	2025	Mehrobod (formerly Komsomolobod)	Nurobod district	Nurobod district, Darband city Tursunzoda city Toichi, Namuna	1,250	1,280	Resettlement in progress (0-20 %).
11	2025	Lughuri poyon	Rogun city	Faizobod district	1,222	1,293	To be resettled.
12	2025	Bedikho	Nurobod district	Explanatory work ongoing	1,143	1,221	To be resettled.
13	2025	Aligalaboni bolo	Nurobod district	Faizobod district, Tursunzoda city	1,189	1,237	To be resettled.
14	2025	Khakimii poyon	Nurobod district	Faizobod district	1,190	1,246	To be resettled.
15	2025	Khakimii bolo	Nurobod district	Faizobod district	1,260	1,276	To be resettled.
16	2025	Khumrog (formerly Kumok)	Nurobod district	Explanatory work ongoing	1,285	1,340	To be resettled.

PHASE 1 RESETTLEMENT

3.5.6. Resettlement of eight villages, 326 households and 2,697 people was guided by RAP 1 that was developed in 2014, and a Livelihood Restoration Plan 1 (LRP 1) created in 2015. A World Bank audit of Phase 1 resettlement concluded that the program met the principles established in 2014 RPF, 2014 RAP 1, and LRP 1 and was in line with the World Bank requirements (WB OP 4.12).

PHASE 2 RESETTLEMENT

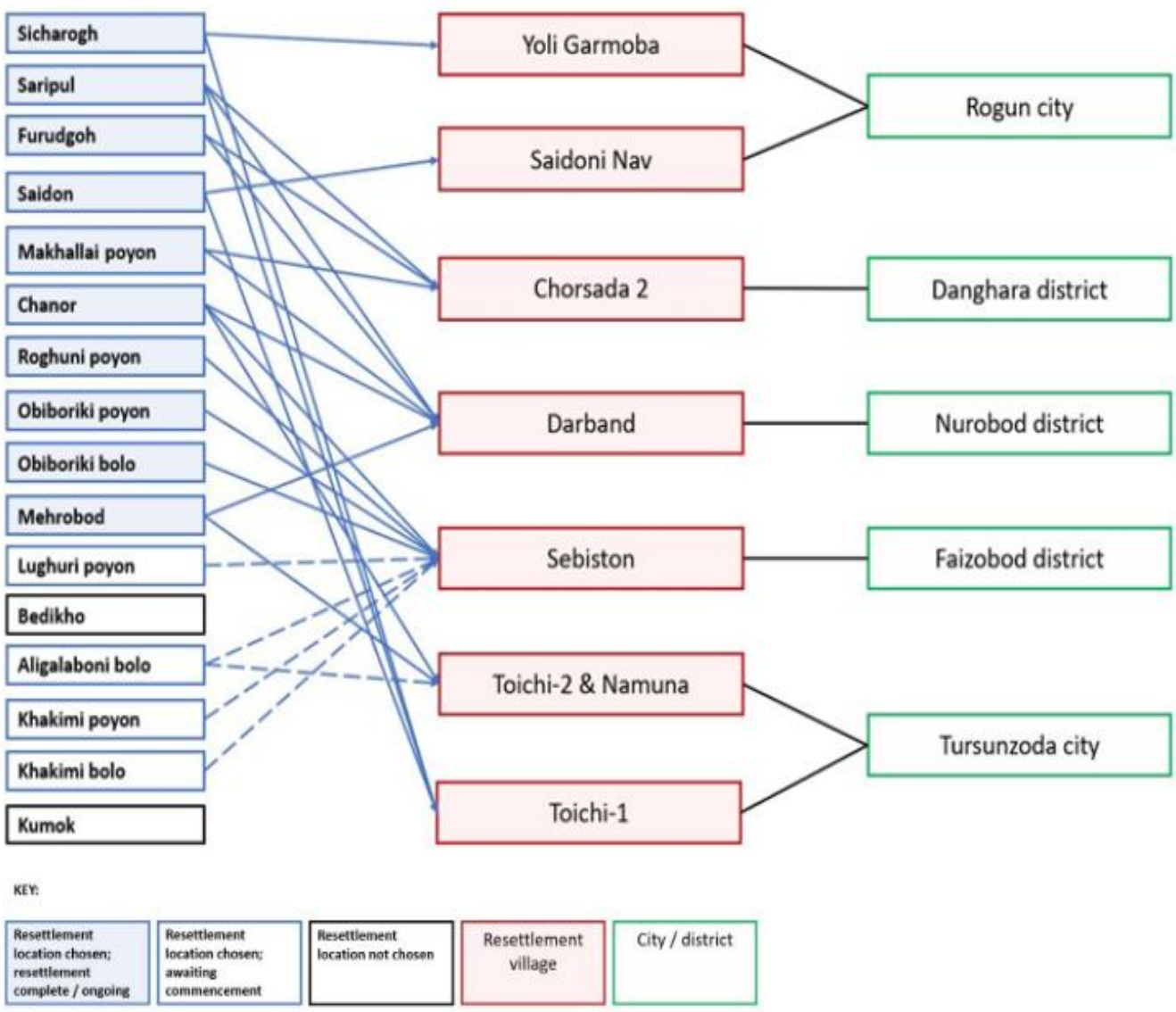
3.5.7. Initially, all resettlement after completion of RAP 1 was referred to as Phase 2. DFZ subsequently developed RAP 2 to cover the period 2018-2026 and is in the process of implementing that RAP. This RAP 2 for 2018-2026 is being updated as part of the ESIA process and will be compliant with the new ESS5 requirements.

3.5.8. To guide ongoing and future resettlement, a Resettlement Policy Framework (RPF), including a Livelihood Restoration Framework, were adopted in 2024. The RPF calls for at least three additional RAPs to guide the remainder of the resettlement program which will be completed by 2032.

3.5.9. RAP 2 is in the process of being implemented. It covers about 1,710 households (more than 16,919 people), of which approximately 500 households (over 4,600 people) have already been resettled, and the remainder are due for resettlement by end of 2025.

3.5.10. The updated RAP 2 will apply retroactively to households resettled since 2017 and to those that will be resettled through 2026. Relocation of villages under RAP 2 is illustrated by **Figure 3-11**.

Figure 3-11 – Resettlement of Villages Under RAP 2 (Source: DFZ data)



MULTIPLE DISPLACEMENT IMPACTS

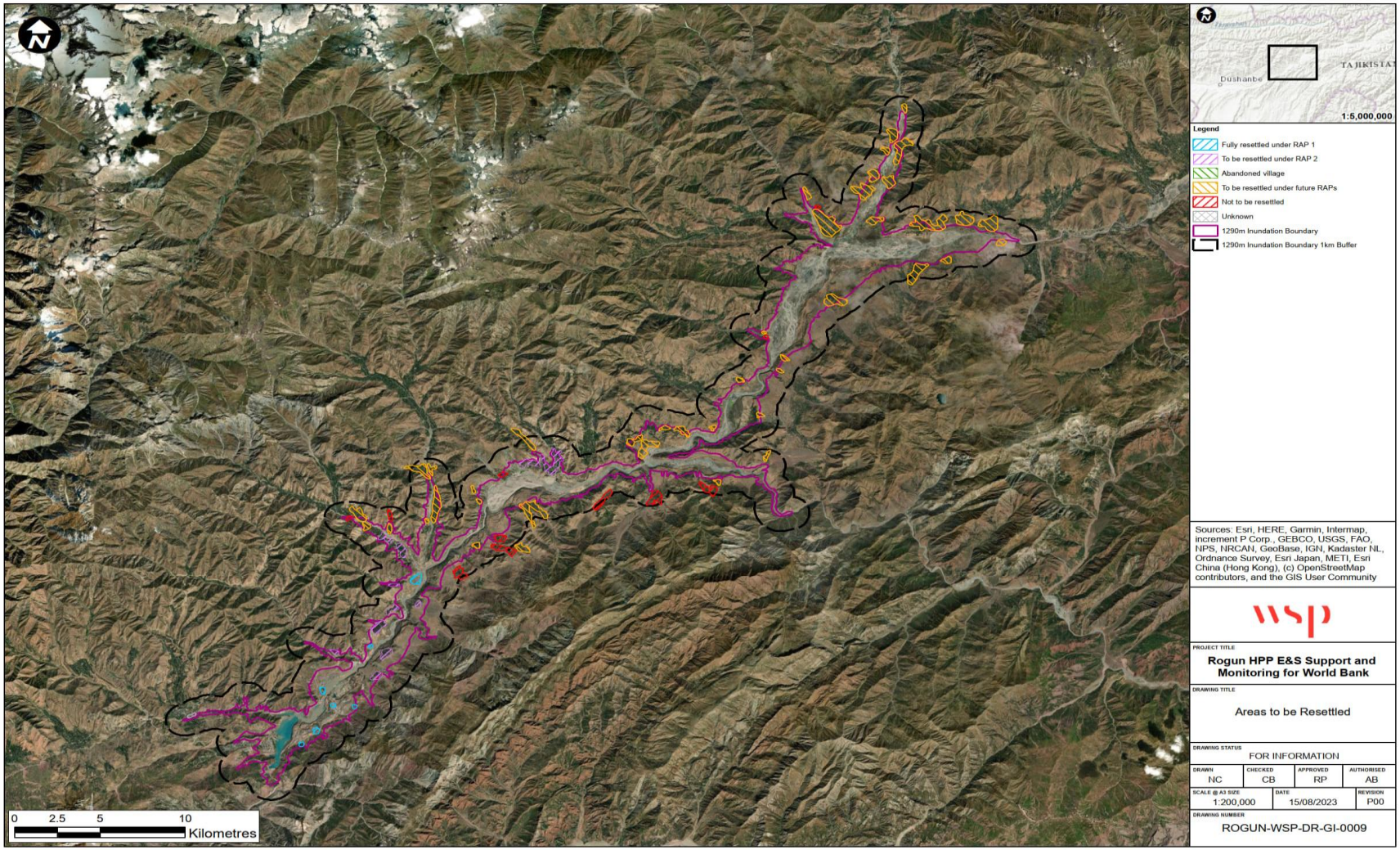
3.5.11. People in some villages that will be affected by resettlement for the Project, may also be impacted by other projects, including:

- Elements of the CASA-1000 rural electrification project, which required land to be acquired in Tursunzoda and Rudaki;

- M41 Obigarm-Nurobod road realignment project – (ADB & EBRD) required land acquisition in Rogun city and Nurobod district;
- Dushanbe-Tursunzoda-Uzbekistan border road project (ADB) required land acquisition, in particular, in Tursunzoda City; and
- Dushanbe-Bokhtar road project (ADB & JICA) required land acquisition in Rudaki district.

3.5.12. The effects of multiple displacement will be assessed within this ESIA where information is available. Where applicable projects may be developed in the future there will be a requirement to ensure these impacts are assessed in future ESIAs for these specific projects.

Figure 3-12 - Areas to be Resettled



IDENTIFICATION AND PREPARATION OF RESETTLEMENT SITES

3.5.13. The State Committee on Land Management and Geodesy are responsible for identifying suitable land for resettlement sites. Meaningful engagement is undertaken with PAPs to understand their needs and desires when identifying such locations. The land is requested via the local authorities and must be approved by the Jamoats and local community before resettlement can proceed.

3.5.14. Before the land acquisition for the development of resettlement sites can begin, the site must be approved by government ministries and agencies with appropriate competences (e.g., the Ministry of Environmental Protection confirms that the site is not vulnerable to, and will not cause, significant environmental risks). Once all necessary approvals have been granted, relocation to the site can begin.

3.5.15. Resettlement sites are selected in areas where the earthquake risk is low and where there is available agricultural and pastureland of sufficient quality to prevent pressure on local resources due to the additional population. All new and existing residents have the right to unrestricted use of common pasture lands. As an example, in Tursunzoda, additional common pastureland for host communities was also provided to accommodate pre-existing population growth. The initial allocation of land was inadequate resulting in the need for additional land to be made available.

3.5.16. Under RAP 2, five new resettlement sites have been identified in Nurobod region in June 2023, besides those already in use. In December 2024 these are allocated plots which are uninhabited and unnamed. All new sites consist primarily of agricultural fields and pastureland. These new sites will accommodate approximately 2,600 land plots (320 hectares).

PUBLIC INFRASTRUCTURE AND SERVICES IN RESETTLEMENT SITES

3.5.17. DFZ's mandate is to ensure that the construction of all public infrastructure (i.e., water supply, health centers, education facilities, roads, electricity lines, etc.) and utility services in resettlement sites is complete before settlers permanently move in. There have been instances when households relocated before all infrastructure was in place.

3.5.18. Construction of these facilities is the responsibility of the relevant ministry. When resettled people move to host communities, the existing infrastructure is expanded or improved. Connection to utilities is provided at no cost at new resettlement sites. New infrastructure is required to meet national building standards.

3.6. ASSOCIATED FACILITIES

3.6.1. As defined in WB ESS1, the term “Associated Facilities” means facilities or activities that are not funded as part of the project and are:

- (a) directly and significantly related to the project;
- (b) carried out, or planned to be carried out, contemporaneously with the project; and
- (c) necessary for the project to be viable and would not have been constructed, expanded or conducted if the project did not exist.

3.6.2. For facilities or activities to be associated facilities, they must meet all three criteria. The associated facilities applicable to the Project are described in **Table 3-10**.

3.6.3. For the Rogun HPP, the associated facilities are directly and significantly related to the Project and would not have been constructed without the Project being developed. These facilities are either under construction or will be constructed in the future as part of the overarching Project development.

3.6.4. Associated facilities that are identified in future may require an assessment in compliance with International Standards prior to the commencement of construction depending on the funding entity. Where an ESIA is undertaken, the Rogun HPP should be included in the cumulative effects assessment.

3.6.5. As indicated in **Table 3-10**, ESIA have been done for some of the associated facilities; but not for others.

Table 3-10 - Details of the Associated Facilities

Component	Description
International Highway - (Vakhdat - Jirgital) Completed early 2025	The main road from Dushanbe to Obigarm (M41) branches shortly before reaching Obigarm to access the Rogun HPP site. Shortly after Obigarm, short stretches of this road will be submerged in Stage 1 of the reservoir filling while at later stages of the reservoir filling longer stretches of the road, including the only bridge suitable for heavy traffic crossing the Vakhsh River, will be submerged. This road is an important international and national road and will be replaced and, where required, road and bridge access will be provided to villages at higher elevations which will not be relocated. Two major new roads were planned for the area surrounding the reservoir. One along the left bank of the lower part of the reservoir, from the dam to the main bridge which will cross the reservoir, the other on the right bank, upper part of the reservoir, between the bridge and the village of Gharm, located approximately 50 km to the north-east. The new alignment of the M41 will relocate the connection between Obigarm and Nurobod in three construction work packages: ■ Package 1: Obigarm – Tagikamar: Two tunnels, (Kandak and Karagach), four new bridge constructions and two bridge rehabilitations and approximately 30 km of local access roads. This Package is being financed by Asia Development Bank (ADB). An ESIA was prepared to ADB standards and was approved in 2019. https://www.adb.org/sites/default/files/linked-documents/52042-001-eiaab.pdf ■ Package 2: Tagikimar – Nurobod: Tunnel 3 (Tagikamar), 6 new bridge constructions, 1 bridge rehabilitation approximately 40km of local access roads. This Package is being financed by the European Bank for Reconstruction and Development (EBRD). An ESIA was prepared to EBRD standards and was approved in 2019. ■ Package 3: Long Bridge at Darband (known as Bridge 14), forms part of this Project but assessed in an ESIA separately and approved by the AIIB in 2023 (under construction) https://www.aiib.org/en/projects/details/2019/proposed/_download/Obigarm/ESIA-English.pdf The alignment of the new International Highway on the right bank is shown in **Figure 3-10**.
International Highway Bridge (over reservoir) Under Construction	Package 3 will be financed by a USD 75.5 million loan from Asian Infrastructure Investment Bank (AIIB) and covers the long permanent bridge (920 m) over the Rogun HPP Reservoir at Darband over the Surkhob River. The dimensions of the permanent bridge will be approximately 760 m long and 11.5 m wide. Prior to construction of the long bridge across the reservoir / Surkhob River (Package 3), a temporary bridge will be installed (as part of Package 2) by EBRD at the east end of the alignment. An ESIA was prepared to AIIB standards and was approved in 2023. https://www.aiib.org/en/projects/details/2019/proposed/_download/Obigarm/ESIA-English.pdf

Transmission Line (500 kV)	There is the potential for six power lines from the Rogun HPP on-site substation – three lines are operational, two are planned and one is a reserve line which may be required, depending on energy sales to other countries. Completed: (three lines): ▪ Domestic Transmission Lines: Dushanbe Substation - two 100 km 500 kV overhead lines completed in 2018, transporting power from the Rogun HPP to Dushanbe substation. No ESIA was conducted for the overhead lines project. ▪ International: CASA-1000 - one 123 km 500 kV line from Rogun HPP to Sangtuda HPP was completed in March 2025 as part of the Central Asia-South Asia (CASA) 1000 project. The CASA-1000 transmission line and trade project aims to connect the power systems of four countries: Kyrgyzstan, Tajikistan, Afghanistan, and Pakistan. This will take surplus power generated from Rogun HPP for export. CASA-1000 is being financed by a consortium of lenders including World Bank, Islamic Development Bank, EBRD and EIB. The ESIA for the route from Rogun HPP to Sangtuda HPP was prepared in 2011. Planned: (two lines): ▪ Two 500 kV OHLs are planned, one to connect from Rogun HPP to Saikhun Substation approximately 400 km to the north, and one to Khujand substation 350 km to the north. To date, these projects have not been progressed and there is no information regarding the potential source of finance or requirement for ESIA. Reserve: (one line): ▪ Rogun HPP has capacity to provide power for one additional 500 kV line (reserve line).
Transmission Lines 220 kV (local line)	Local Transmission Lines 220kV ▪ Two 220 kV (14.5 km) overhead lines from Rogun HPP to Rogun City were constructed starting in 2022 and were commissioned in Oct 2024. The development was funded by Export-Import Bank of China (ExiM Bank). No ESIA was conducted for the overhead lines project.
Gas Insulated Substation (GIS)	The Dushanbe-500 kV substation was built in 2018 as part of the construction of two 500 kV overhead transmission lines between Rogun HPP and Dushanbe and funded by ExiM Bank. As an extension of an existing substation, no ESIA was conducted.

Table 3-11 - Details of Primary Suppliers

Component	Description
Concrete supply	Two companies in Dushanbe produce concrete that meet Project specifications, Tajik-cement in Dushanbe and Mohir-Cement in Yavan each supply cement to the domestic market. Both companies transport a total of approximately 1000 tonnes of cement per day from Dushanbe and Yavan to the Rogun HPP site in trucks that average about 30 tonnes per load; resulting in approximately 33 return trips between Dushanbe or Yavan and Rogun each day.
Steel liners	Steel liners for intake and penstock shafts and tunnels. These liners are fabricated by TGEM using steel supplied from Russia and Iran.
No other suppliers are considered “primary suppliers” as defined in paragraph and footnote 34 of ESS1 - ‘*primary suppliers are those suppliers who, on an ongoing basis, provide directly to the project goods or materials essential for the core functions of the project. Core functions of a project constitute those production and/or service processes essential for a specific project activity without which the project cannot continue*.’	

3.7. DAM CONSTRUCTION

3.7.1. Excavation on both the left and right banks, along with the elevation of the dam, requires the mobilization of a sizable fleet of vehicles and construction equipment. This fleet is required to relocate substantial quantities of material, including spoil and construction materials for the dam, as well as for transport workers and other construction supplies.

3.7.2. A full list of machinery and plant equipment is provided in **Table 3-12**.

Table 3-12 - Construction Machinery and Equipment

ITEM	EQUIPMENT	MODEL	UNITS
1	Articulated dump truck	XDA40 (or equivalent CAT 745, XGA5900D3T)	20
2	Mixer Truck 10 [m^3]	SHACMAN 10 m^3 (or equivalent (VOLVO 10 m^3)	1
3	Dozer with rubber pads, 6 ways blade & laser guidance system LEICA (or equivalent)	CAT D6N or equivalent	2
4	Vibratory roller 12 tons with single drum	XS122 (or equivalent CAT CS533)	2
5	5 Vibratory roller 3,7 tons with double drums	XMR303 (or equivalent (CAT CB34) 2	2
6	Vibratory roller 1 ton	ATLAS COPCO LP750 or equivalent	2
7	Vibratory roller 160 Kg		2
8	Vibrating plates	ATLAS COPCO LG400 or equivalent	2
9	9 Vibrating plates 150 Kg ATLAS COPCO HC450 or equivalent 2	ATLAS COPCO HC450 or equivalent	2
10	Vertical compactor	-	2
11	Hydraulic Excavator 41 kW	CAT 308C or equivalent	1
12	Wheel Excavator 101 kW equipped with blade	R140W-9S (or equivalent CAT 315D) 1	1
13	High pressure pump 750 bar	-	2
14	Grouting plant (mixer, agitator, injector…)	-	1
15	Vacuum truck	Pump JOHNSTON or equivalent	2
16	Tractor with blade	NEW HOLLAND TL90 or equivalent	1
17	Crane 60 tons	QY70K-I (or equivalent EREX A600 Mobile)	1
18	Core Drilling Machine ϕ150 [mm]	YGL-150 (or equivalent SOILMEC SM5)	1
19	Saw cutting machine ϕ1600 [mm]	TYROLIT FZ-4S or equivalent	1
20	Skid steer loader (wheel or rubber)	XC760K (or equivalent CAT 226B3 (42kw))	1

ITEM	EQUIPMENT	MODEL	UNITS
21	Formwork panels	PERI Formworks	1
22	Nuclear density gauge	MC-3 ELITE	2

STAGE 1

3.7.3. Stage 1 Dam construction commenced in 2014 and the construction schedule comprises:

- Dam wall height to 1,065 masl for installation of units 5 and 6 at reduced capacity (400MW); completed in 2019; and
- Dam wall height to 1,110 masl for upgrade of units 5 and 6 at full capacity (630MW).

3.7.4. Key features of Stage 1 construction are presented in **Table 3-13**. An overview of construction status is shown in **Figure 3-13.**

Table 3-13 - Details of Stage 1 Dam and Reservoir

Stage 1 – Dam	
Dam crest level / elevation	1,110 m asl
Dam height above foundation	143 m
Dam height above thalweg	100 m
Dam length at crest	714 m
Dam width at crest	20 m
Stage 1- Reservoir	
Normal water level (design level)	1,100 m asl
Current water level (Oct 2024)	1,075 m asl
“Overtopping” water level	1,100 m asl
Water volume	0.5 km^3
Current Surface area	12 km^2

Figure 3-13 - The Current Project Site (2023)

		
View of the Dam wall from the clay core	Construction Camp 1	Current reservoir and stockpile areas
		
View of the clay core	Downstream of the Stage 1 dam	Inside Tunnel

STAGE 2

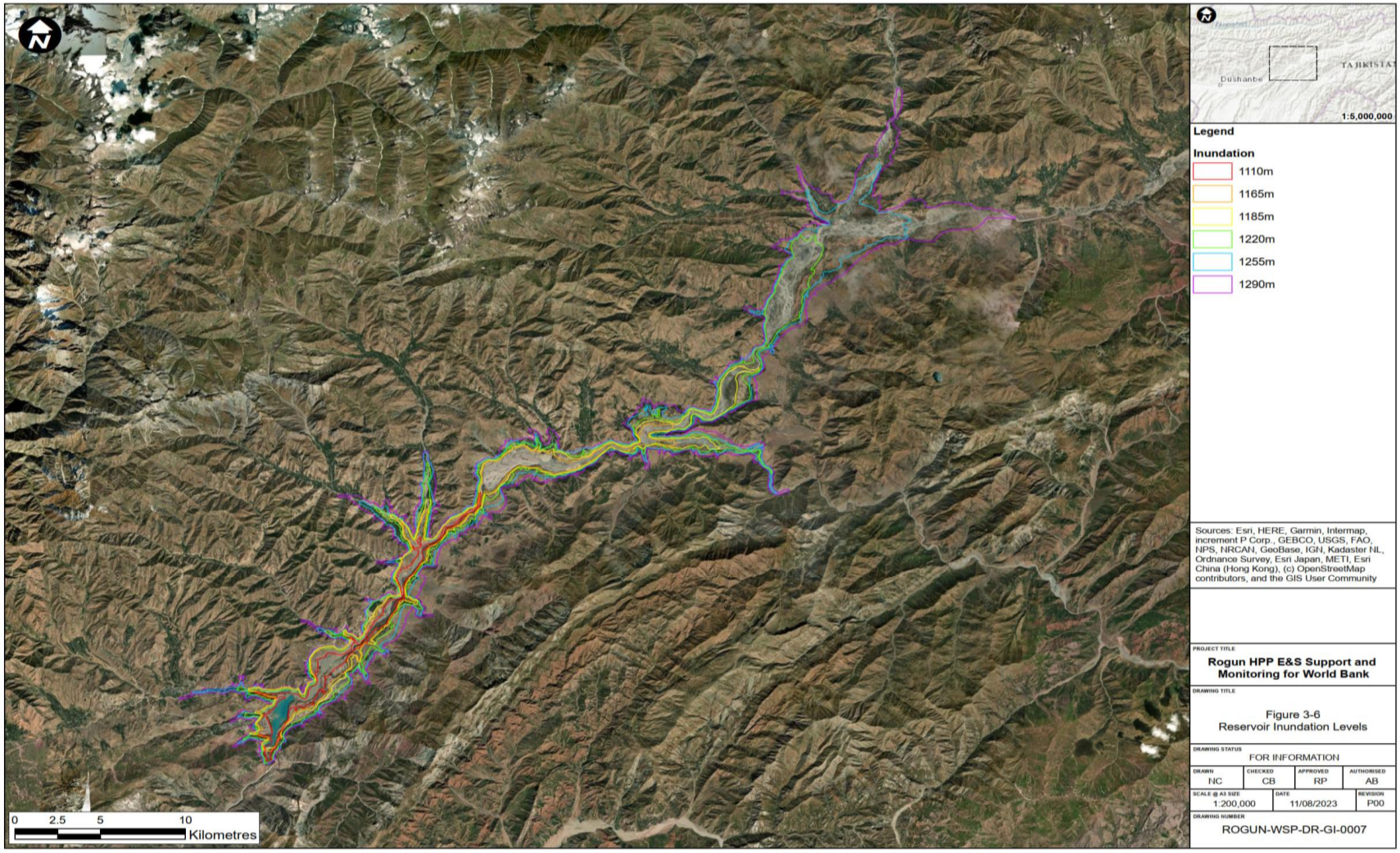
3.7.5. The Stage 2 Dam (also referred to as the Main Dam) will be constructed between 2025 and 2032, and commissioning of all turbines will be done progressively with increasing dam height and inundation level. Turbine units 3 and 4 will be installed when the dam crest reaches 1185 masl, with the final units (1 and 2) installed at 1200 masl in 2028.

3.7.6. The key features of the Stage 2 Dam are presented in **Table 3-14**.

Table 3-14 - Stage 2: FSL 1,290 m asl

Stage 2 FSL = 1,290 m asl	
Dam crest level	1,300 m asl
Dam height	335 m
Total reservoir capacity	13.3 km^3
Total reservoir surface area	170 km^2
Reservoir Length	70 km
Reservoir active storage	10.3 km^3
Total installed capacity	3,780 MW
Crest length	660 m
Crest width	20 m
Maximum water level/final supply level	1,290 m asl
Minimum operational level	1,185 m asl

Figure 3-14 - Reservoir Inundation Levels



3.8. COMMISSIONING

3.8.1. Commissioning of the operational components will be conducted by the Lot Construction contractors prior to handover to the Rogun JSC operations team.

3.8.2. Commissioning will entail a stepwise series of tests to ensure components are functioning within design specifications including:

- Pre-commissioning tests - tests undertaken prior to any component being flooded;
- Pre-commissioning tests - tests undertaken after a component being flooded;
- Initial test run; and
- Full/Final test run.

3.8.3. Commissioning will comprise a series of checks to sign off the grouting works, confirm that all anti-corrosion painting has been completed and that. Readiness tests prior to flooding of components such as the upstream and downstream feeder tunnels headraces, will be undertaken, including a check on the cleanliness, to ensure all components are free from obstructions and debris and that water can flow freely.

3.8.4. Once complete, all mechanical operating equipment, such as brakes, pressure units and runners, will be tested for operational readiness.

3.8.5. Ventilation equipment will be tested and calibrated to ensure operational functionality prior to any turbines being operated.

3.8.6. Redundant tunnels to be flooded will be completed and sealed prior to commissioning and tunnels which are for emergency use will be tested for operation of gates, penstocks, etc., to ensure functionality.

3.8.7. Once all pre-filling tests have been completed the tunnels to be flooded will be filled gradually to allow for the testing of emergency equipment for closure of systems before being filled, and to ensure leak detection systems are operating within design parameters. Tunnels will be also checked for leaks and deformation using mechanical means during this filling period. The turbines will be also checked and tested to ensure they are operational and produce the required outputs.

3.8.8. Once filling is complete an initial test run of the system can be undertaken using manual control mechanisms to ensure components are operating satisfactorily before automation. Once complete, the system can be synchronized with the national electricity grid.

3.8.9. A full automated test run can be initiated, to ensure all systems are fully operational at commercial levels prior to handover.

3.9. RESERVOIR FILLING

3.9.1. The filling of the reservoir has been optimized based on the following mandatory criteria (TEAS 2014):

1. The discharges from the Nurek HPP cannot change from the existing quantities.
2. The quantity of water used to fill the Rogun reservoir must remain within the annual allocation of water to the Vakhsh River as agreed by the Basin Water Organization (BVO “Amu Darya”) of the ICWC and cannot exceed the agreements made within the Almaty Agreement (Protocol

566) and the Nukus declaration (Annual Maximum allocation for Tajikistan is 9.5 million m^3 / year (0.095 km^3) from the Amu Darya basin). The justification for this figure as well as further information on flow rates in the Nurek HPP is set out in **Volume 1: Chapter 13: Water**, of this ESIA.

3.9.2. The estimated time to fill the Rogun reservoir is between nine and 22 years based on a simulation for low and high fill scenarios respectively that is described in **Volume 2, Annex 13-3: Water Resources Modelling** of this ESIA. The staged filling of the Rogun reservoir will be undertaken over an extended period as the annual volume of water available for filling the reservoir is dependent on the differential between the water allocation to Tajikistan as per Protocol 566 and water consumption, especially during periods of lower precipitation and snowpack formation.

3.9.3. The Republic of Tajikistan intends to make use of its full water allocation of 9.5 km^3 per year in terms of Protocol 955 to fill the Rogun reservoir.

3.9.4. A minimum environmental water requirement (EWR) was calculated to ensure that sufficient water is released from Rogun HPP to maintain intake flows to Nurek HPP to generate electricity and maintain ecological integrity of the aquatic ecosystem in the reach of the Vakhsh River between Rogun HPP and Nurek HPP. The simulation showed that, during the filling of the Rogun reservoir, sufficient water is released from Rogun HPP to meet the minimum EWR and the EWR modelling is discussed in **Volume 2, Annex 31-1: Minimum Environmental Flows** of this ESIA.

3.9.5. Once the Rogun HPP is fully operational, the Rogun reservoir will continue to rise following the end of construction. As the dam reaches staged levels, the reservoir will rise each summer, and recede each winter, rising higher each year until FSL 1290 masl, which under average flow regimes is expected to occur in 2038. The incremental filling of Rogun reservoir is shown in **Table 3-15**.

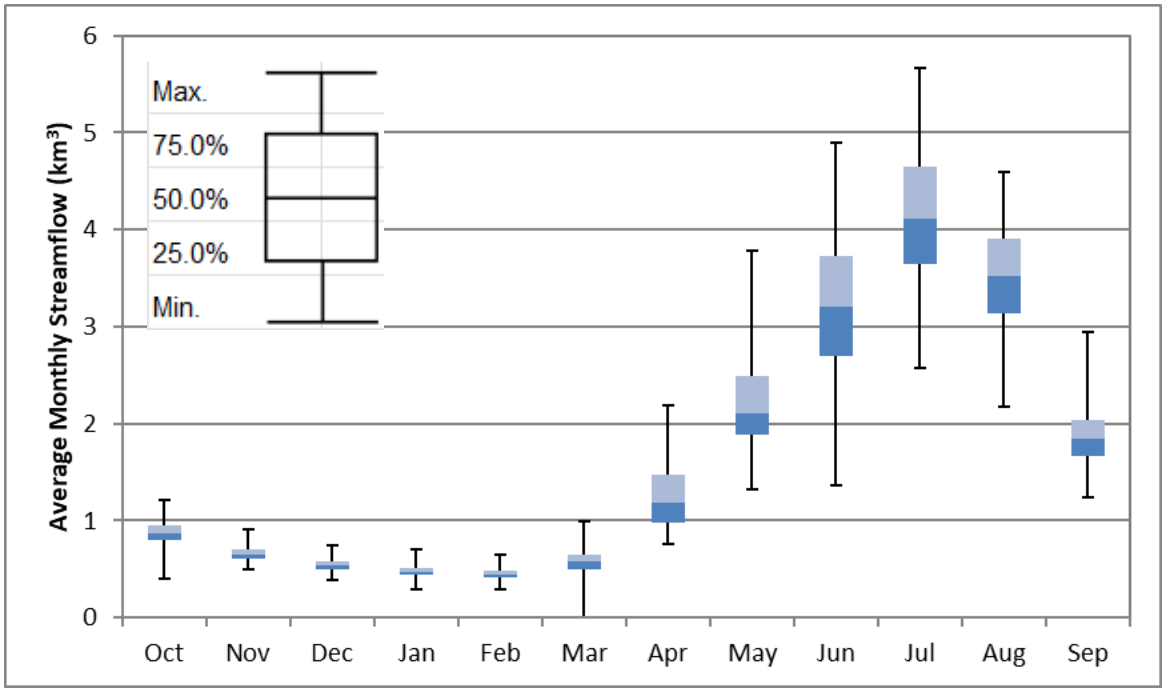
Table 3-15 - Reservoir Inundation Levels

Date	Impounding Elevation (m asl)	Storage Volume (km^3)
1 Jan 2025	1,075	0.56
15 Oct 2026	1,100	0.86
15 Aug 2028	1,175	2.68
15 June 2032	1 230	6.16
15 Nov 2038	1 290	13.30

Reservoir Inundation Levels from **Volume 2, Annex 13-3; Water Resource Modelling of this ESIA, and subject to sufficient progress of construction of the dam embankment and infrastructure.*

3.9.6. The pattern of the monthly average flow and range of flow is shown in the Box and Whisker plot in **Figure 3-15**. The plot shows that flows during the winter period do not vary significantly and range from 0.3 to 0.9 km^3/month. The annual streamflow total is variable ranging from 13 km^3/yr to 26 km^3/yr with an average of 20 km^3/yr (634 m^3/s). The highest streamflow occurs during the month of July.

Figure 3-15 - Box and Whisker Plot of monthly Streamflow Record at Rogun HPP



ELECTRICITY GENERATION

3.9.7. During the reservoir filling period, the Rogun HPP will operate as a storage HPP to provide a constant and reliable supply of electricity that is always available, especially during adverse weather conditions, to meet grid baseload demand and is not subject to interruptions, other than for scheduled maintenance.

3.9.8. In summary, water accumulated in the reservoir is channeled into the penstock that funnels the water to spin the turbines that power a generator to produce electricity.

3.9.9. The total actual electricity production of the Stage 1 Dam between November 2018 and October 2024 is presented in **Table 3-16**. The zero output in June 2024 was due to mud infiltration of the powerhouse following a mud slide upstream of the powerhouse. The zero output in August 2024 was due to annual maintenance.

3.9.10. The installation and commissioning of the turbines is being completed incrementally. Since late 2019, turbines unit No. 5 and No.6 have operated at reduced capacity using temporary runners2. The runners will be replaced in 2024 or early 2025, increasing the capacity of the existing turbines from 400 MW to 630 MW each. The current regime of turbines unit No. 5 and No.6 operating at a reduced capacity allows for a monthly average release of flow downstream of the Rogun HPP based on the requirements of the Nurek HPP operating regime and the maintenance of outflows for the

[2] Runners are the rotating element of the Francis turbine that convert the energy of the flowing water into mechanical energy.

cascade that vary with the seasons.

Table 3-16 - Electricity Production for Stage 1 Dam between November 2018 to October 2024

Month		2018	2019	2020	2021	2022	2023	2024
Jan	MWh (MegaWatt/ Hour	-	81,327	95,086	96,052	97,510	105,749	104,823
	Reservoir Level (m)	-	*1,055*	*1,055*	*1,070*	*1,070*	*1,070*	*1070*
Feb	MWh	-	254	89,255	88,526	89,255	111,777	95,651
	Reservoir Level (m)	-	*1,055*	*1,055*	*1,070*	*1,070*	*1,070*	*1,070*
Mar	MWh	-	0	120,041	127,502	169,468	181,359	125,225
	Reservoir Level (m)	-	*1,055*	*1,055*	*1,070*	*1,070*	*1,070*	*1,070*
Apr	MWh	-	0	128,395	168,452	187,895	187,805	175,716
	Reservoir Level (m)	-	*1,055*	*1,055*	*1,070*	*1,070*	*1,070*	*1,070*
May	MWh	-	23,448	115,463	189,484	187,797	192,219	101,228
	Reservoir Level (m)	-	*1,055*	*1,055*	*1,070*	*1,070*	*1,070*	*1,070*
Jun	MWh	-	107,404	53,989	94,627	184,758	184,791	0*
	Reservoir Level (m)	-	*1,055*	*1,055*	*1,070*	*1,070*	*1,070*	*1,070*
Jul	MWh	-	117,404	55,905	102,252	83,301	94,783	139,230
	Reservoir Level (m)	-	*1,055*	*1,055*	*1,070*	*1,070*	*1,070*	*1,070*
Aug	MWh	-	112,899	85,315	98,313	2,842	90	0
	Reservoir Level (m)	-	*1,055*	*1,055*	*1,070*	*1,070*	*1,070*	*1,075*
Sept	thousand kWh	-	79,148	156,011	113,784	173,603	160,466	122,833
	Reservoir Level (m)	-	*1,055*	*1,055*	*1,070*	*1,070*	*1,070*	*1,075*
Oct	MWh	-	113,055	161,200	160,196	181,515	172,448	184,446
	Reservoir Level (m)	-	*1,055*	*1,070*	*1,070*	*1,070*	*1,070*	*1,075*
Nov	MWh	16,306	104,365	130,299	134.660	165,061	137,076	-
	Reservoir Level (m)	*1,055*	*1,055*	*1,070*	*1,070*	*1,070*	*1,070*	-
Dec	MWh	74,021	107,592	108,919	109,058	131,441	115,307	-
	Reservoir Level (m)	*1,055*	*1,055*	*1,070*	*1,070*	*1,070*	*1,070*	-
Total Production (MWh)		90,374	846,896	1,299,806	1,482,906	1,654,446	1,643,870	1,049,152

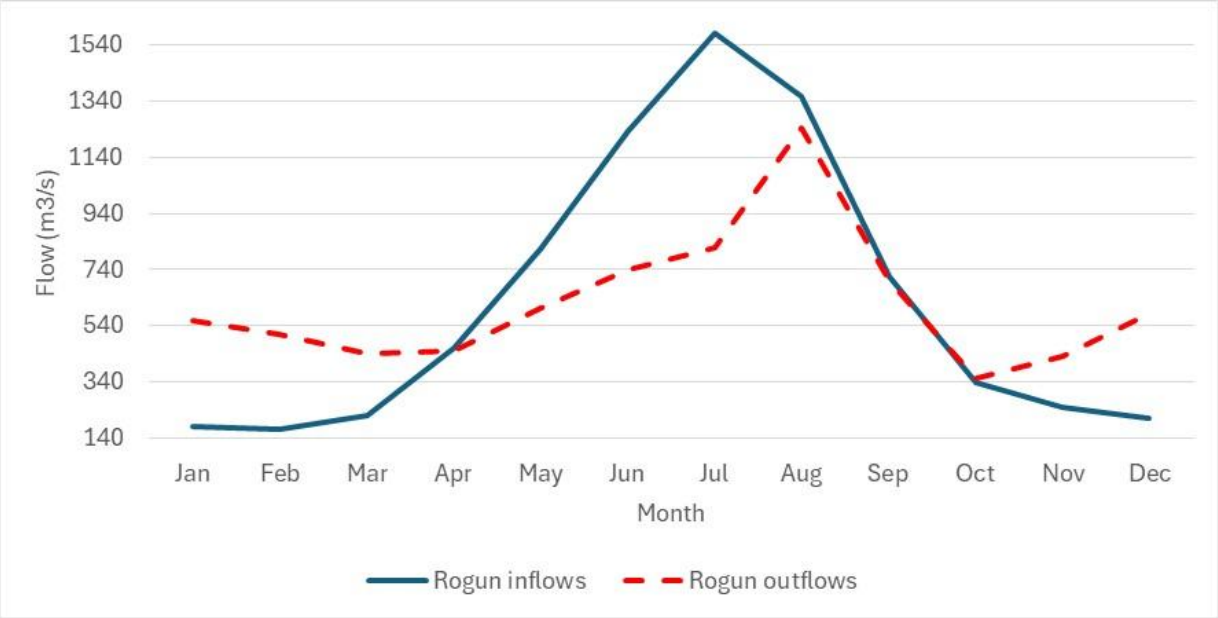
3.10. JOINT OPERATION

3.10.1. Rogun HPP will operate as a storage hydropower facility and the key assumption for the operational design is to maintain the existing outflows from Nurek HPP to ensure compliance with the transboundary agreements, and any change to this regime can only be undertaken in agreement with neighboring countries.

3.10.2. The joint operation of Nurek HPP and Rogun HPP is planned to not impact flows downstream of Nurek HPP. The seasonal water balance between the two reservoirs has been modelled (Refer to **Volume 2, Annex 13-3 (Water Resource Modelling**) based on the annual average statistics and maintenance of the downstream regime from Nurek HPP. Rogun HPP will effectively be the regulating hydropower facility for the cascade and, as such, Nurek HPP will no longer experience significant seasonal drawdown. This will be achieved by the storage of water in the Rogun reservoir during the summer months that will be released during the winter months to achieve an annual seasonal shift of up to 4.5 km^3 of water.

3.10.3. The water resources modelling showed that flows released from Rogun reservoir during the summer months are reduced as water is stored in the reservoir to maintain the releases during winter. During the low-flow winter months, the discharge from Rogun reservoir is higher than the natural flows into Rogun reservoir.

Figure 3-16 - Plot of Average Monthly Inflows and Outflows from Rogun Reservoir



3.10.4. Although Rogun HPP will act as the main regulating reservoir, the Nurek HPP will retain some regulating capacity to ensure the cascade can operate effectively, as well as ensure maintenance of the outflows from the Nurek dam downstream. The minimum reservoir levels for both Rogun HPP and Nurek HPP when operating together are 1185 m asl and 857 m asl respectively.

3.10.5. The Rogun reservoir has been designed to accommodate the Probable Maximum Flood (PMF) having a 100-year return period and the operation of the release facilities would allow the safe management of the PMF, protecting the downstream riparian areas. The diversion and spillway structures have been designed to protect the dam wall regardless of the construction stage and are described in the TEAS report (2014):

- The cofferdam crest at 1035 masl protects the construction site with diversion tunnel (DT) 1 and DT2 diverting the river flow. The capacity of the tunnels is 2900 m^3/s with a water level at 1033 masl;
- The Stage 1 dam protects the site and DT1, DT2 and DT3 divert the river with a water level at 1100 masl and the combined capacity of the three tunnels is 7100 m^3/s;
- At reservoir levels between 1110 masl and 1145 masl, DT2 and DT3 divert the river and the DT2 discharge can be limited to 1800 m^3/s by closing some of its gates;
- At reservoir levels between 1145 and 1185 masl, DT2, DT3 and the remote spillway divert the river;
- Above 1185 masl, the river diversion and flood discharge is ensured by final spillways: OP3; run-of-stream (RS) and open spillway structure (OSS) that have a combined discharge capacity of 7100 m^3/s at water elevation 1290 masl.

3.10.6. The potential for excessive water release from the Project due to dam failure or overtopping was analyzed in a dam break analysis undertaken in 2018 by Stucky for the Stage 1 dam wall height of 1100 masl. A further dam break analysis will be done for the final dam wall height of 1290 masl.

3.10.7. The DSPoE report (Dam Safety Panel of Experts (DSPoE), 2023) concluded that the maximum outflow discharge from Rogun HPP is 5400 m^3/s to allow safe passage of flows through downstream dams. The proposed infrastructure to alleviate the flows of a PMF include a spillway on the left bank and potential right and left bank bypass tunnels; and the required discharge capacity will be confirmed one the configuration is finalized.

3.10.8. The sensitivity of the PMF flood discharge to sedimentation of the reservoir has also been highlighted by the DSPoE in that a 10% loss of reservoir capacity of sedimentation results in a PMF water level at 1297 masl and a 20% loss of capacity results in a water level at the top of the dam wall.

3.10.9. These risks are further considered in **Volume 1, Chapter 23: Major Accidents and Disasters** of this ESIA.

ELECTRICITY GENERATION

3.10.10. As a storage hydropower scheme, the Rogun HPP is designed to reliably generate a guaranteed minimum output, that is generated with a specified level of availability, especially during winter when electricity demand is high. If necessary, it can also operate as a peaking plant, adjusting output to meet fluctuating demand, given the ability to shut down and start up the generating turbines.

3.10.11. By 2039 the Rogun HPP is expected to generate electricity more than 17 billion kWh per year. Rogun HPP will significantly enhance security of supply in Tajikistan by generating an average of 30% of domestic electricity demand between 2020 and 2050.

3.10.12. The Rogun HPP substation has capacity to regulate the maximum 3,780 MW output of the Rogun HPP once fully operational.

3.10.13. Electricity generation that is surplus to domestic demand will be exported to neighboring countries via the CASA-1000 project. The CASA-100 initiative aims to establish a unified market for electricity and allow for trade between Central and South Asia. Key infrastructure comprises:

- A 470 km, 500 kV AC line from Datka (Kyrgyz Republic) to Sugd (Tajikistan);

- A 115 km, 500 kV AC line in Tajikistan between Regar and Sangtuda;
- A 1300 MW AC-DC converter station at Sangtuda;
- An 800 km HVDC (High Voltage Direct Current) line from Sangtuda to Nowshera (Pakistan);
- A 1300 MW DC-AC converter station at Nowshera; and
- A back-to-back HVDC substation in Afghanistan.

3.10.14. Construction is expected to be completed by end 2025 and surplus summer hydroelectricity will be transmitted from Kyrgyzstan and Tajikistan to Afghanistan and Pakistan. The CASA-1000 transmission lines will convey approximately 1300 MW of electricity.

3.10.15. Rogun HPP is expected to export approximately 70% of electricity generated at full capacity to neighboring countries, with Kazakhstan and Uzbekistan the primary export destinations. The intention is to replace fossil-fuel fired electricity generation with cleaner electricity sources.

OPERATIONS AND MAINTENANCE ACTIVITIES

3.10.16. The expected operational lifespan of the hydropower plant is 110 years, dependent on the rate of sediment accumulation in the reservoir. The lifespan will include several major maintenance cycles that will provide the opportunity to upgrade the plant and equipment to increase the operational efficiency.

3.10.17. In general, activities undertaken on-site during the operational phase include:

- Monitoring of various parameters, including water levels, flow rates, temperatures, pressures, and generator performance;
- Inspection of turbines, generators, transformers, switchgear, and other critical components for wear, damage, or abnormal conditions;
- Checking the proper functioning of control systems; and
- Checking for blockages, debris, and structural damage in the intake area, penstock, and associated waterways.

3.10.18. Scheduled maintenance activities include:

- Undertaking routine maintenance based on manufacturer recommendations and historical data;
- Replacing worn or damaged components, such as bearings, seals, and control system parts;
- Identifying and resolving unexpected issues or equipment failures; and
- Implementing refurbishment or upgrade projects to extend the lifespan of plant and improve efficiency or capacity.

3.10.19. Rogun JSC will be the operator of the hydropower plant and will likely subcontract the operation and maintenance (O&M) of equipment and systems to specialist contractors.

PUBLIC

JSC “Rogun HPP”

State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT – UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Chapter 04 – Analysis of Alternatives



MAY 2025

PUBLIC

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT – UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Chapter 04 – Analysis of Alternatives

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4 ANALYSIS OF ALTERNATIVES

4.1 INTRODUCTION

4.1.1 The WB ESF (2018), and specifically ESS1 Assessment and Management of Environmental and Social Risks and Impacts requires an ‘Analysis of Alternatives’ as part of an ESIA.

4.1.2 ESS1 requires the ‘Analysis of Alternatives’ to include:

- A systematic comparison of feasible alternatives to the proposed project site, technology, design, and operation, including the “without project” situation, in terms of their potential environmental and social impacts;
- An assessment of the feasibility of mitigating the environmental and social impacts; the capital and recurrent costs of alternative mitigation measures, their suitability under local conditions and the institutional training, and monitoring requirements for the alternative mitigation measures for all alternatives; and
- Quantification of the environmental and social impacts of the alternatives to the extent possible and the economic values where feasible.

4.1.3 The Analysis of Alternatives enables E&S risks to be considered in the early stages of project planning, as well as the later stages of design and implementation, and describes the basis of selection of preferred alternatives at all stages of the Project.

4.1.4 At the highest level, a "without project" scenario is included to identify the need for the Project as well as the key collateral benefits of the Project. Alternatives to the location and key design features of the Project, sources of energy technology for Tajikistan, dam wall height and reservoir inundation levels and the effect on the riparian environment, the location for resettlement of affected households and fill and Project costs are discussed to demonstrate the potential benefits as well as adverse effects the proposed alternatives may have on environmental and social receptors.

4.1.5 In 2011, the Government of Tajikistan used funding from the WB to conduct a Technical and Economic Assessment Study (TEAS) for the Project. The objectives of the study were to evaluate the technical and economic feasibility of different operational regimes and Project designs.

4.1.6 This chapter has been informed by the *TEAS Phase II Report – Volume 1: Summary – Chapter 3.2: Selection of Site, Powerhouse, Dam Type and Alternative, April 2014*; and the *2014 ESIA*.

4.1.7 The ‘without project Scenario’ has been strengthened with recent information on the energy security and demand situation of Tajikistan and recent trends in fossil fuel usage and increased greenhouse gas (GHG) emissions.

4.1.8 The assessment presented in this chapter discusses the “without project” scenario and alternatives, including the Project location, type of structure and design with various dam heights. It provides a comparison of E&S impacts of various dam height alternatives and the economic and financial cost of the Project.

4.2 WITHOUT PROJECT SCENARIO

4.2.1 The 'without Project' scenario typically considers the potential environmental and social adverse and beneficial effects of not developing the Project and retaining the site with original features.

4.2.2 The Rogun HPP Project has been in development since the 1970s in this location and therefore this assessment considers the scenario against the changes which have occurred to date, including the existing 630 MW HPP, the ongoing construction of the 3,780 MW HPP, the historical legacy and building facilities present on site and resettlement that has been completed to date. It considers the social, financial, and environmental effects of continuing the Project versus the effects of cancelling the Project.

4.2.3 Non-completion of the Project would require an estimated US$818 million of additional costs for decommissioning and mitigation of risks to the Vakhsh cascade, and additional US$2.8 billion to replace the generation from Rogun (to meet the domestic demand), and result in significant lost opportunities to decarbonize the power sectors in Central and South Asia, as well as forgone revenues from electricity exports.

4.2.4 The Government of Tajikistan is highly unlikely to abandon the Project and will continue constructing it with available resources, which is the practice since 2007. However, should decommissioning of the Project be required at this stage to due to insufficient funding, investments would be required to mitigate risks of damage of the civil works and generating plants downstream, consisting of:

- (i) at least US$500 million for Project decommissioning exclusive of the cost to safely decommission the 100 m-high dam; and
- (ii) US$318 million for additional spillways at Nurek HPP to improve flood protection of Vakhsh cascade.

4.2.5 In addition to the cost of decommissioning, capital investments of US$2.8 billion would be required in 2022-2040 to construct new generation capacity (primarily solar PV and wind) to replace energy expected from the Project. Moreover, abandoning the Project would potentially result in US$2.9 billion lower export revenues for Tajikistan (compared to the best available alternatives of solar PV and wind). The revenues from exports are estimated to be higher compared to the scenario without the Project completion because the Project is estimated to have more competitive cost for firm baseload electricity and balancing services compared to replacement projects (solar PV and wind) that would need to be constructed to replace supply from Rogun.

FLOOD PROTECTION

4.2.6 The existing HPPs in the Vakhsh river cascade are not designed to withstand the Probable Maximum Flood (PMF). The 2014 TEAS studies estimate that, if the Rogun HPP Project was not constructed, there would be significant investment required for immediate implementation of large upgrading works to the existing spillway structures of the cascade to achieve protection against the PMF. This is described in **Volume 1, Chapter 3 (Project Description)**.

SEDIMENT CONTROL

4.2.7 The Vakhsh River has a high sediment output. A benefit of the Project is that the retention of sediments by the Rogun reservoir effectively increases the life span of the downstream Nurek HPP reservoir by up to 110 years or more. Without the Project, the Nurek reservoir would fill with sediment and lose its useful capacity for power generation much sooner.

RELIEF IN DROUGHT YEARS

4.2.8 The Amu Darya River is one of the main tributaries feeding to Aral Sea, and the Vakhsh River is a tributary to the Amu Darya.

4.2.9 The Amu Darya catchment drains from five countries namely: Afghanistan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. Approximately 80% of the Amu Darya annual flow volumes are estimated to be generated in Tajikistan, with approximately 8% generated in Afghanistan; 6% in Uzbekistan; 4% in Turkmenistan; and 2% in Kyrgyzstan (Pöyry, 2014). These countries have an intercountry agreement which allocates Tajikistan an annual share of Amu Darya's water.

4.2.10 The Project will use Tajikistan's allocation of water from the Amu Darya, as provided in the Nukus Declaration, Protocol 566 agreement until the reservoir reaches its full capacity of FSL 1,290 m asl by the year 2033. The Project is expected to store the Vakhsh River flow in summer, which will consequently reduce flow to Amu Darya during flood period (March to May) and increase flow in drought period of winter.

EMPLOYMENT AND ECONOMIC GROWTH

4.2.11 Without the Project, the existing infrastructure in the reservoir area (see **Volume 1, Chapter 3**) would be unaffected. However, the investment that has gone into the Project (both in the Soviet period and more recently), including construction of the HPP and connection roads, resettlement operations and the construction of associated infrastructure, would be lost.

4.2.12 As outlined in **Volume 3, A3: Livelihood Restoration Plan (LRP)**, future employment opportunities in the area associated with the Project, including investment in new and expanded settlements where people have resettled or will be resettled in the future would not exist, and the expected economic benefits for the region, the nation, and local communities would be lost.

4.3 ENERGY SECURITY IN TAJIKISTAN

4.3.1 The International Energy Agency (IEA) 2022 review states that approximately 92% of the country's electricity generation is supplied by hydropower (2020). This results in a seasonal variability in the generation and supply of electricity, with a surplus during the summer and a shortage during the winter. This reflects the pattern of river flow, which is highest in late spring and summer and lowest in autumn and winter. The rural poor and remote regions, representing around 70% of the population, are most affected by this seasonal variation.

4.3.2 The IEA also stated that many existing generation facilities in Tajikistan are reaching the end of their design lifespans. To maintain existing capacity, it is estimated that approximately 80% of the country's HPPs will need to be rehabilitated by 2030. Nurek HPP is undergoing rehabilitation and restoration of three power generating units to improve efficiency and strengthen the safety of the dam.

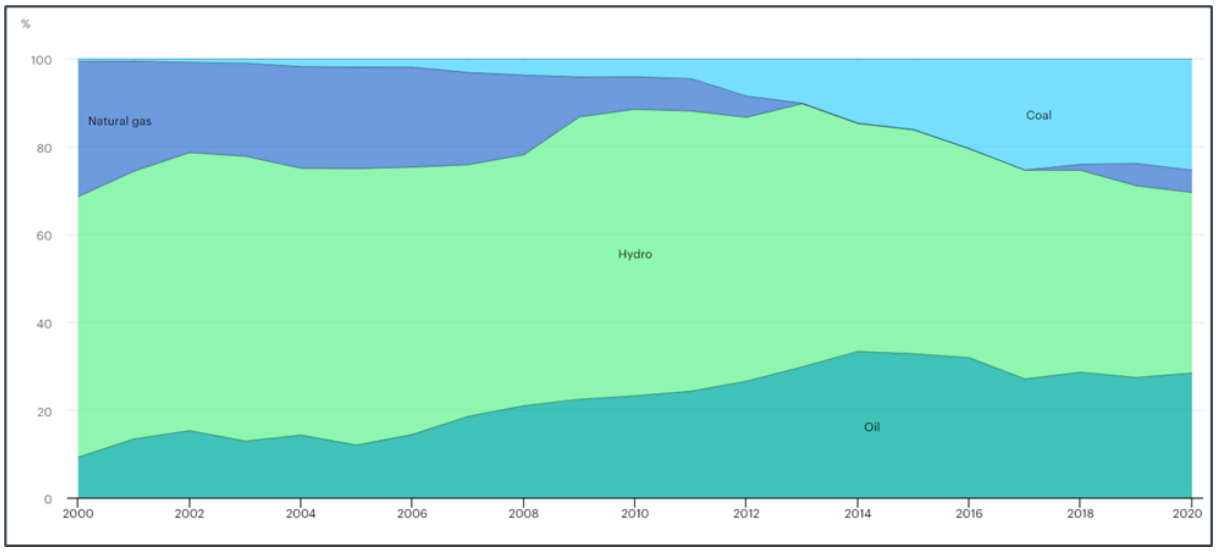
4.3.3 When fully operational, the Rogun HPP Project will have a total installed capacity of 3,780 MW and will produce enough electricity to eradicate winter shortages. In 2024, the total installed capacity of Tajikistan was 5,810 MW, therefore; the Project will increase Tajikistan's installed capacity by approximately 65%. The Project will provide enough energy for domestic consumption, with surplus energy exported during summer months to neighboring countries via the CASA-1000 transmission line (refer to **Volume 1, Chapter 24: Summary of Transboundary Cumulative Impact Assessment** for information regarding this project).

INCREASED USE OF FOSSIL FUELS

4.3.4 To reduce volatility in the country's power generation and meet year-round demand, the Government of Tajikistan has developed, and continues to develop, alternative energy sources and diversify energy production.

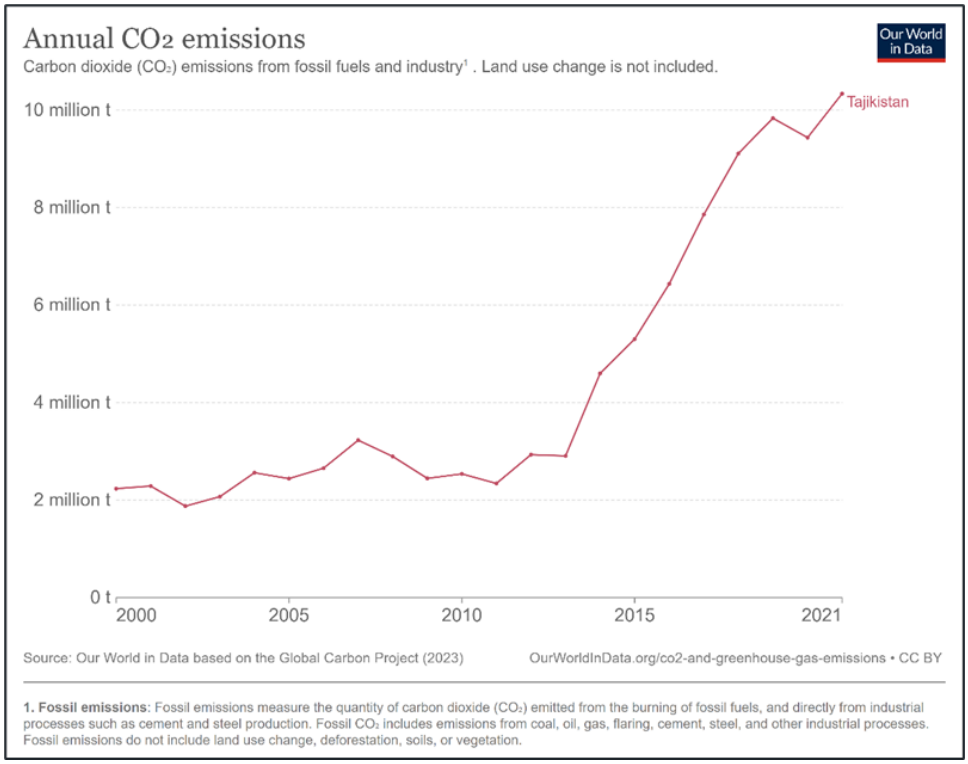
4.3.5 According to the IEA, since 2014 an increasing amount of the country's power demand has been supplied by the combustion of fossil fuels, including oil and coal (refer to **Figure 4-1**). Tajikistan has significant coal reserves, and both the Government and large industries have turned to coal as a fuel to partially resolve severe electricity shortages during winter months and industrial processes. Consequently, Tajikistan's annual carbon dioxide (CO_2) emissions have risen sharply in recent years (refer to **Figure 4-2**).

Figure 4-1 - Total energy supply by source, Tajikistan 2000-2020



Source: https://www.iea.org/countries/tajikistan

Figure 4-2 - Annual CO2 Emissions for Tajikistan



Source: https://ourworldindata.org/co2/country/tajikistan#what-are-the-country-s-annual-co2-emissions

4.3.6 It is estimated that hydropower has an emissions intensity of approximately 24 gCO2e/kWh generated (International Hydropower Association, 2021). Compared to gas (CCGT) at 348 gCO2e/kWh and Coal (IGCC) at 760 gCO2e/kWh (International Finance Corporation, 2008) this is substantially better. This also is much lower than Tajikistan's current grid average at 106 gCO2e/kWh (UNFCCC, 2021) as shown in **Table 4-1**.

Table 4-1 – Indicative emissions intensities of various generation sources

Energy Generated	Emissions Intensity (gCO_2/kWh)
Hydropower	24
Tajikistan Grid Mix (2021)	106
Coal (IGCC)	760
Gas (CCGT)	348

4.3.7 Given an estimated generation when fully operational of 17,000 GWh per year, this Project performs substantially better than alternatives when considering impact over the Project's lifetime. Using the indicative figures in **Table 4-1**, annual emissions from hydropower would be 0.41 MtCO2e/yr compared to 12.9 MtCO2e/yr from coal. This is further described in **Volume 1, Chapter 9: Greenhouse Gases** of this ESIA.

COST OF ELECTRICITY

4.3.8 About 26% of the Tajikistan population lives below the National Poverty Line (ADB 2023). Electricity is crucial for poverty alleviation, economic growth and improved living standards, and the Government has therefore prioritized providing uninterrupted and cost-efficient power.

4.3.9 The 2014 TEAS for the Project analyzed the Least Cost option for meeting the domestic demand between 2014 and 2050 (*TEAS, Phase II: Economic Analysis, March 2014*). The assessment established that the economic benefits of the Project exceed those of other feasible HPPs (run-of-river) and thermal plants (both coal and natural gas).

4.4 RENEWABLE ENERGY ALTERNATIVES

4.4.1 The 2014 TEAS noted that wind and solar energy production cannot make up the forecast shortfall in energy supply in Tajikistan and, as a technology, it remains more expensive than other sources although the cost has declined steadily in recent years (ADB, 2016). The Project is designed to significantly increase the supply of renewable energy, thereby reducing reliance on fossil fuels and supporting the region's low-carbon development goals. The Project, along with other large-scale hydropower projects, is expected to displace gas and coal-fired generation and provide stability services to further enhance the development of variable renewable energy sources like solar and wind.

4.4.2 According to IEA, there is potential for wind and solar energy to complement hydropower in Tajikistan, with limited implementation of renewable technology in some regions.

4.4.3 As of 2024, there is less than 1 MW of solar energy generation in operation. The estimated potential for solar energy in Tajikistan is approximately 25 billion kWh / year. Tajikistan does have favorable conditions for abundant solar energy exploitation and could satisfy up to 10-20% of energy demand, particularly in remote mountainous regions far from centralized power grids. At present, there is ongoing feasibility studies for a proposed 200 MW solar power plant in the Sughd region. The Government of Tajikistan has set a target to develop more than 1 GW of solar capacity by 2030.

4.4.4 As of 2024, there is less than 1 MW of wind energy generation in operation. While the estimated potential of wind is relatively unknown, energy production is promising, with varying forecasts estimated at 30-100 billion kWh per year.

4.4.5 Expected unit costs of hydroelectric power from Rogun remain highly competitive with solar and wind, and when combined with the ability to provide a stable baseload supply, makes hydroelectricity a more viable option for Tajikistan's energy needs.

4.5 ALTERNATIVE PROJECT SITES

4.5.1 The Rogun dam site was selected by Hydroprojekt Tashkent and has not been re-considered since 1981. It is understood three sites were originally considered, and the main reasons for the location of the Project include:

- **Topography**: the very narrow valley at the Project site allows for the construction of a high dam with a minimum quantity of fill material and minimum loss of land; and
- **Seismicity**: The NW-SE trending Ionakhsh and Gulizindan faults run from the Vakhsh fault 10km north of the Rogun Dam to Nurek Dam in the south. After the impoundment at Rogun, these faults will be subject to both the Rogun and Nurek impound. The active Ionakhsh Fault along the

river axis upstream of the Project site precludes the implementation of a dam core across it; and moving the dam axis would place the dam in a tectonically less stable, and thus higher risk, area.

4.6 ALTERNATIVE DAM DESIGN

4.6.1 The 2014 TEAS considered several types of dams including:

- Clay Core Rockfill dam
- Impervious Core Embankment dam;
- Concrete Arch dam;
- Gravity Roller Compacted Concrete (RCC) dam;
- Concrete Face Rockfill dam (CFRD);
- RCC arch gravity dam or RCC arch dam;
- Rockfill dam with earth core dam with upstream concrete block cutting the heel; and
- Rockfill dam with earth core dam with downstream concrete block cutting the toe.

4.6.2 The 2014 TEAS study includes an assessment and comparison of the above-mentioned dam types, as presented in **Table 4-2**.

4.6.3 An impervious core embankment dam was selected as the preferred dam type based on sensitivity to movements along fault lines, risk from salt fill of Ionakhsh fault, where salt moves into the fault, deforming the rock and resulting in potential hazard, rock quality, sensitivity to overtopping and the relative complexity of constructing the dam in stages when compared to other dam types.

Table 4-2 – Technical Assessment of Alternative Dam Types (TEAS, 2014)

Dam Type	References of dams higher than 200 m	Sensitivity to movements along faults	Risk related to salt fill of Ionakhsh fault	Sensitivity to rock quality	Sensitivity to overtopping	Regular reservoir rising during construction
Clay Core Rockfill dam						
Concrete Arch dam						
Gravity RCC dam						
Concrete Face Rockfill dam						
RCC Arch Gravity or Arch dam						
Rockfill dam with earth core dam with upstream concrete block cutting the heel						
Rockfill dam with earth core dam with downstream concrete block cutting the toe						

KEY	Problematic
	Problematic but can be solved by appropriate measures
	Element to be studied carefully
	Not problematic

Source: Assessment Studies for Proposed Rogun Hydropower Project in Tajikistan (2014) – TEAS

ALTERNATIVES FOR DAM HEIGHT

4.6.4 The 2014 TEAS recommended the FSL 1290 m asl as the preferred alternative for the Project. The Assessment of Alternatives remains ongoing during both the design and construction phases of the Project, incorporating design changes for FSL 1290 m asl since the 2014 TEAS study. **Volume 1, Chapter 3** of this ESIA includes the most recent design of the Project.

4.6.5 The 2014 TEAS evaluated three different dam heights, Full Supply Levels (FSL) and installed capacities for each height as presented in **Table 4-3**, and the subsequent E&S impacts of the three options to determine the most appropriate.

Table 4-3- Alternatives Considered for Dam Height and Capacity

Alternative	FSL 1290	FSL 1255	FSL 1220
Dam crest level (m asl)	1,300	1,265	1,230
Dam height (meters)	335	300	265
Total reservoir capacity (Million cubic meters)	13.3	8.55	5.22
Reservoir active storage (Million cubic meters)	10.3	6.45	3.93
Investigated installed capacities (MW)	2800 3200 3600	2400 2800 3200	2000 2400 2400
Surface area at FSL	170 km^2	114 km^2	68 km^2
FSL - Full Supply Levels; m asl – meters above sea level; hm^3 - cubic hectometer; MW – megawatt			

ENVIRONMENTAL AND SOCIAL IMPACTS OF FSL 1220, 1255 AND 1290

4.6.6 The 2014 assessment was for the three dam height options, i.e., FSL 1220, FSL 1290 and FSL 1255. These dam height options differ by their reservoir size and installed capacity, although from geological, seismic and climate change perspectives there is no notable difference between the alternatives.

ENERGY PRODUCTION

4.6.7 The average annual energy production for each alternative:

- FSL 1220 - 10.1 TWh (terawatt hour) (10,100,000 MWh)
- FSL 1255 - 12.4 TWh (12,400,000 MWh)
- FSL 1290 - 14.4 TWh (14,400,000 MWh)

4.6.8 The FSL 1290 option generates an additional two (2) TWh/yr of electricity production compared to the FSL 1255 alternative.

RESERVOIR SEDIMENTATION

4.6.9 The largest reservoir would retain the most sediment and provide the extended life to both Rogun and Nurek HPPs.

4.6.10 As discussed in the TEAS, the annual sediment input to the reservoir could be between 62 and 100 hm^3. Considering a 62 hm^3/yr. sediment inflow, the life expectancy would be 80, 120 and 200 years for FSL 1220, 1255 and 1290 respectively. With 100 hm^3/yr. sediment inflow, the life expectancy would be 45, 75 and 115 years respectively for the three dam heights.

4.6.11 From an economic perspective, the FSL 1290 option provides the longest life span, most efficient energy production and longest regional energy export potential. However, as of September 2024, the design life of the FSL 1290 is projected to be 110 years. This could be extended by maintenance to reduce the impact of sedimentation on the hydropower plant.

FLOOD RISK

4.6.12 According to the 2014 TEAS, the existing Vakhsh cascade was not designed to withstand the Probable Maximum Flood (PMF). The FSL 1220 alternative for Rogun would not be able to protect the downstream cascade in the event of a PMF and substantial investment to the existing cascade would be required for this purpose. However, both the FSL 1290 and the FSL 1255 alternatives allow for the safe evacuation for the entire cascade should a PMF event occur.

4.6.13 The construction of the Project will improve flood routing capacity for the area downstream of the Vakhsh cascade. This positive effect could be increased by appropriate flood management. The inclusion of Rogun HPP in the cascade would also reduce risks of floods of lower magnitude, but with a higher probability of occurrence. Under the intended operating mode, the flood routing capacity of floods of an occurrence probability of 1/10 or 1/100 would be the same for FSL 1220 and FSL 1255 since the winter drawdown of the Project would be 4.4 km^3 in both cases. However, the FSL 1290 option will offer a greater flood retention potential including preventive drawdown.

ECONOMIC

4.6.14 The recommended FSL 1290 provides the total installed capacity with the highest benefits from a least-cost planning and economic perspective. The TEAS found that ultimately the FSL 1290 at full production met the winter energy demand of Tajikistan and allowed export sales of summer electricity. This alternative provides an increase in the operating lifetime for the dam of 115 years (now 110 years) over 75 years for FSL 1255.

4.6.15 Once the reservoir reaches FSL 1290, it is expected approximately 70% of electricity generated at Rogun HPP will be exported to the Central Asian nations developing energy relations between countries' energy systems and bolstering regional energy security and cooperation. Additionally, the construction of CASA-1000 transmission lines between Kyrgyzstan, Tajikistan, Afghanistan and Pakistan will facilitate clean power export in nearby South Asian countries alleviating existing electricity shortages in their regions and contributing to sustainable economic growth.

RESETTLEMENT

4.6.16 The reservoir size will have a direct effect on the magnitude of the socio-economic impact, including the loss of additional agricultural land and increased resettlement.

4.6.17 The increase in reservoir size has a considerable effect on resettlement (For the definition of the resettlement, all villages below the respective FSL of the reservoir and a few villages above FSL which are expected to be affected by flood levels and accessibility have been considered) and loss of agricultural land, as calculated in the TEAS (2014):

- FSL 1220: a resettlement of 13,000 PAPs or 1,825 households; loss of 971 ha of land used for agriculture;
- FSL 1255: a resettlement of 18,000 PAPs or 2,433 households; loss of 1,409 ha of agricultural land; and
- FSL 1290: a resettlement of 42,000 PAPs or 6,065 households; loss of 3,337 ha of agricultural land.

4.6.18 Since 2014, natural population growth has increased the estimated number of potential Project Affected Parties (PAPs). It is currently estimated that the FSL 1290 alternative will displace over 50,000 PAPs, which is likely to increase further in the future due to the high birth rate in the area. The total number of displaced households is currently estimated at 6,788. This is not expected to increase significantly, as the construction moratorium which has been in place in the flooding zone in Rogun City and Nurobod District since Project initiation has now been extended to cover Project-Affected Households (PAHs) in Rasht District.

4.6.19 The WB ESS5 recommends 'avoiding resettlement, or when unavoidable, exploring all options including project design alternatives to minimize displacement of people'. As outlined in the 2014 TEAS studies, resettlement is unavoidable for all dam alternatives, with the technical studies showing both FSL 1255 and 1290 dams being feasible, with the recommended alternative for FSL 1290.

4.6.20 A higher number of resettled PAPs would result with the FSL 1290 alternative, but this is considered acceptable for the power generation and flood attenuation capabilities of this option. Resettled households would receive improved public facilities, such as health centers, schools, water, and power. All affected households would have a choice of different livelihood restoration options, through the Ministry of Labor, Migration and Employment of the Population (MLMEP) support or Volume 3, A3: Livelihood Restoration Plan (LRP) prepared for the Project. In summary, under all alternatives resettled households would suffer no reduction in their standards of living.

RESETTLEMENT SITE SELECTION

4.6.21 According to Resolution No.47, The State Committee on Land Management and Geodesy is responsible for identifying suitable land for resettlement sites. The land is requested via the Hukumats and must be approved by the Jamoats and local community before resettlement can proceed.

4.6.22 Before the land acquisition for the development of resettlement sites can begin, the site must be approved as safe and suitable by government ministries and agencies with appropriate competencies (e.g., the Committee for Environmental Protection (CEP) confirms that the site is not vulnerable to, and will not cause, significant environmental risks). Once all necessary approvals have been granted, relocation to the area can begin.

4.6.23 Site selection is aligned with central government planning for social and economic development.

4.6.24 Sites are selected in areas where the additional population will not cause strain on local resources, earthquake risk is low and where there is sufficient agricultural and pastureland of sufficient quality to accommodate new arrivals and/or access to alternative livelihoods. All new and existing residents have the right to unrestricted use of common pasture lands. In Tursunzoda, it was not possible to provide new pasturelands adjacent to the settlements due to the more urbanized nature of the area,

however pastureland in another district was allocated. In Namuna village (Tursunzoda) there are also plans to provide 0.03 ha Presidential land plots to resettled households.

4.6.25 Five new resettlement sites have been identified in Nurobod District, besides those already in use. All new sites consist of agricultural fields and pastureland. According to the planning documents these new sites will accommodate around 2,600 land plots over an area of 320 ha.

4.6.26 These new resettlement sites are at an early stage of selection and evaluation by multiple government ministries to identify the exact size and location. Once agreed, the CEP will undertake an assessment of environmental and social risks of developing the site.

EFFECTS ON THE RIPARIAN ENVIRONMENT

4.6.27 The Project will allow storage of water and transfer flow from the high flow season (summer, vegetation period) to the low flow season (winter, non-vegetation period) for maximizing winter energy output.

4.6.28 As described previously, the Government of Tajikistan intend to fill the Rogun reservoir using part of the share allocated to Tajikistan under current agreements and practices. Between 2005 and 2011, Tajikistan was not using its full share for irrigation from the Amu Darya (particularly from the Vakhsh river), with an average of 1.2 km^3 of its share unused. This unused share is considered sufficient to fill the reservoir without reducing current irrigation in Tajikistan.

4.6.29 Nurek HPP currently acts as the main regulating dam in the Vakhsh cascade. Once constructed, Rogun HPP will take over this role and the reservoir will manage flows downstream of Nurek, which will retain the ability to regulate flows from Rogun. In this respect, whilst Rogun will be the main dam regulating volumes of water downstream, Nurek will fine-tune the releases such that flows remain the same as currently experienced.

4.6.30 The 2014 TEAS study concludes that the different proposed Rogun dam alternatives will not impact the seasonal flow pattern downstream of Nurek, and the operation of the Project will strictly comply with existing agreements and practices on allocation of water shares and, at FSL 1255 and FSL 1290, will have a large unused live storage capacity. This will create an opportunity to cooperate with the entire Amu Darya basin, creating greater storage capacity that will create the potential for increased availability of water to riparian countries during dry years.

4.6.31 Three main operational patterns were identified for the determining the Minimum Environmental Flow required for the Project (Pöyry 2014):

- **Operation pattern 1**: consists in applying the same water allocation and water use patterns currently in use. This would be achieved by operating Rogun dam with the same principles that are currently applied to Nurek, and by operating Nurek as a run-of-river dam for hydropower purposes only;
- **Operation pattern 2**: aimed at optimizing winter energy production, which would lead to an additional shift of flows from the high flow season to the low flow season. This would have consequences on water availability during the summer months and for irrigation.; and
- **Operation pattern 3**: aims at maximizing the water allocation for all the users in the entire basin, especially during the dry years. This requires a framework to be developed and implemented for the Project under different scenarios of water use.

4.6.32 The outcomes of the 2014 evaluation recommended the continued application of Operation pattern 1 which would result in minimal changes in the flow regime downstream of Nurek dam. However,

adverse climatic conditions could lead to deviations from the envisaged operation pattern, as described in **Volume 1, Annex 13-1: Minimum Environmental Flows** of this ESIA.

4.6.33 Subsequent studies for this ESIA have focused on updating the MEF study with the most recent information and consistent with the Good Practice Handbook for Environmental Flows for Hydropower Projects to determine the resolution for the E-Flow assessment (World Bank, 2018).

BIOLOGICAL

4.6.34 The higher the FSL, the larger the area submerged and the extent of the effect on vegetation and fauna is greater. The inundation has an impact on the biodiversity of floodplain habitat and limited area of woodland habitat, both of which are considered to be Natural Habitat as per ESS6[1]. Natural habitats (ESS6) are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition. Estimates of habitat loss within the Project AoI are provided in **Table 4-4**.

Table 4-4- Habitat types within the Project Area of Influence at 1290m asl

Habitat type	Area (ha)	Relative coverage within AoI (%)
Pasture	15650	55.6
Agriculture	5850	20.8
River/floodplain	4220	15
Settlements	2150	7.6
Woodland	283	1
TOTAL	28153	100

4.6.35 Following updated studies in 2023, a no net loss strategy has been developed (**Volume 3, A5: No Net Loss Framework**) to deliver no net loss for the small areas of floodplain and juniper woodland habitats that will be submerged. An estimate of habitat loss for juniper woodland for each Project alternative is presented in **Table 4-5,** and estimates of habitat loss for floodplain habitats for each Project alternative is presented in **Table 4-6** .

Table 4-5– Juniper Woodland habitat loss for FSL 1220m, 1255m and 1290m

	FSL 1220	FSL 1255	FSL 1290
Total loss (ha)	43.8	92.6	153
Relative loss (in terms of the study area/EAAA) - %	15.5	32.7	54

[1] Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition (ESS6).

Relative loss compared to 1290m - %	28.8	60.5	100

EAAA = ecologically appropriate area of analysis as per ESS6 etc.

Table 4-6 - Floodplain habitat loss for FSL 1220m, 1255m and 1290m

	FSL 1220	FSL 1255	FSL 1290
Total loss (ha)	75	75	75
Relative loss (in terms of the study area/EAAA) - %	100	100	100
Relative loss compared to 1290m - %	100	100	100

EAAA = ecologically appropriate area of analysis as per PS6 etc.

4.6.36 Beyond this, and as reported within the 2014 ESIA, the adverse impact on flora and fauna is predicted to be of minor significance (at worst) with minor positive effects identified. Similarly, and as reported within the 2014 ESIA, aquatic biodiversity is limited in terms of conservation importance, and no significant impacts have been identified following studies in 2023.

PREFERRED ALTERNATIVE

4.6.37 The highest dam alternative, at 1,290 masl, was found to offer the greatest benefits across most economic and environmental sensitivities. This alternative was recommended due to its superior performance in terms of energy generation and overall beneficial impact on the Tajikistan electricity system. Considering the comparison of environmental and social aspects presented, the FSL 1290 alternative with an installed capacity of 3,600 MW (now 3,780 MW) provides additional downstream flood protection to the cascade, and will manage flows out to Nurek, which will retain the ability to regulate flows from the Rogun reservoir. Furthermore, it is anticipated that the impact of resettlement can be mitigated and will in many cases result in beneficial impacts for many affected communities and individuals.

4.6.38 The Rogun Financing Options Study, completed by the World Bank in 2021, further assessed these dam height options and confirmed the rationale for selecting the tallest height. The study highlighted that the tallest dam option (335 meters) would yield the largest system cost savings and provide the most significant benefits in terms of energy generation and economic impact. The tallest height was selected because it maximizes the hydropower potential, ensuring a longer lifespan for the reservoir (100+ years) due to reduced sedimentation rates and providing enhanced flood protection downstream (thus providing enhanced protection to Tajikistan and riparian countries from increased flood risks resulting from climate change impacts). Additionally, the tallest dam height supports the strategic goal of exporting surplus electricity to neighboring countries, thereby enhancing regional energy security and cooperation.

4.6.39 The benefits of electricity for all and a longer life for Rogun and Nurek HPPs avoids the need for additional resettlement due to dam safety risks. To this end, the Government of Tajikistan has put significant effort into identifying and providing choices for suitable resettlement sites, drawing on consultations with PAPs and considering safety and land-based livelihoods. To the extent possible, the government will avoid resettlement, particularly amongst the communities which are further away from the inundation zone.

4.7 COST OF PROJECT ALTERNATIVES

4.7.1 The 2014 TEAS analyzed the least-cost option for meeting the domestic power demand between 2014 and 2050. The assessment considered a regional power market modelling approach to quantify Total System Costs (TSC) in the interconnected Central Asian Power System, and to determine the economic return of the Project. A scenario with the Project and two scenarios without the Project were considered. The TSC for Tajikistan was defined as the sum of annualized capital expenditure repayments, non-fuel operating and maintenance costs, fuel costs and flood protection benefits, less the net financial benefits from net exports.

4.7.2 The TSC savings provided by the Project compared to the no-project option range from approximately 1 to 1.5 billion USD, depending on the project configuration. Since Tajikistan has negligible known indigenous gas resources, the “No large storage hydro, with imported gas” scenario results in an overall increase in the TSC, hence the savings from the Project are comparatively greater.

4.7.3 The 2014 TEAS analysis established that the benefits of the Project exceed those of other feasible HPPs and thermal plants. Regardless of which design option is chosen, the Project will significantly enhance security of supply in Tajikistan throughout the forecasted period, contributing an average of approximately 30% of electricity demand between 2020 and 2050.

4.7.4 According to the reports submitted in 2014 by Coyne et Bellier, Pöyry, Engineering and Dam Safety PoE, and E&S PoE for the Project, the economic and least-cost planning results show a clear preference for the FSL 1290 dam option. This option was further tested for scenarios considering gas imports to Tajikistan, schedule delays, hydrologic variation, sales price variation, and delay in sales of exports from the Project. At a 10% discount rate the highest dam option proved particularly robust to a wide range of scenario sensitivities. For example, given the challenge of cost forecasting for large hydro projects, the FSL 1290 project provides a positive economic return (10% discount rate) even for project cost overruns of 31%, in addition to the inherent 11% contingency allowance.

4.7.5 As such, the FSL 1290 design is considered the preferred alternative

Table 4-7 - Summary of Alternative Dam Designs

	FSL 1220	FSL 1255	FSL 1290
Annual Energy Production	10.1 TWh	12.4 TWh	14.4 TWh
Maximum installed capacities (MW)	2400	3200	3600
Surface area at FSL	68 km^2	114 km^2	170 km^2
Life Expectancy	45 years	75 years	115 years
Juniper Woodland Habitat Loss (ha)	43.8	92.6	153
Floodplain Habitat Loss (ha)	75	75	75
Agricultural Land Loss (ha)	971	1,409	3,337
Number of Project Affected People to be resettled	13,000 PAPs 1,825 households	18,000 PAPs 2,433 households	42,000 PAPs 6,065 households
Safe evacuation for entire cascade from Probable Maximum Flood (PMF) ?	No	Yes	Yes

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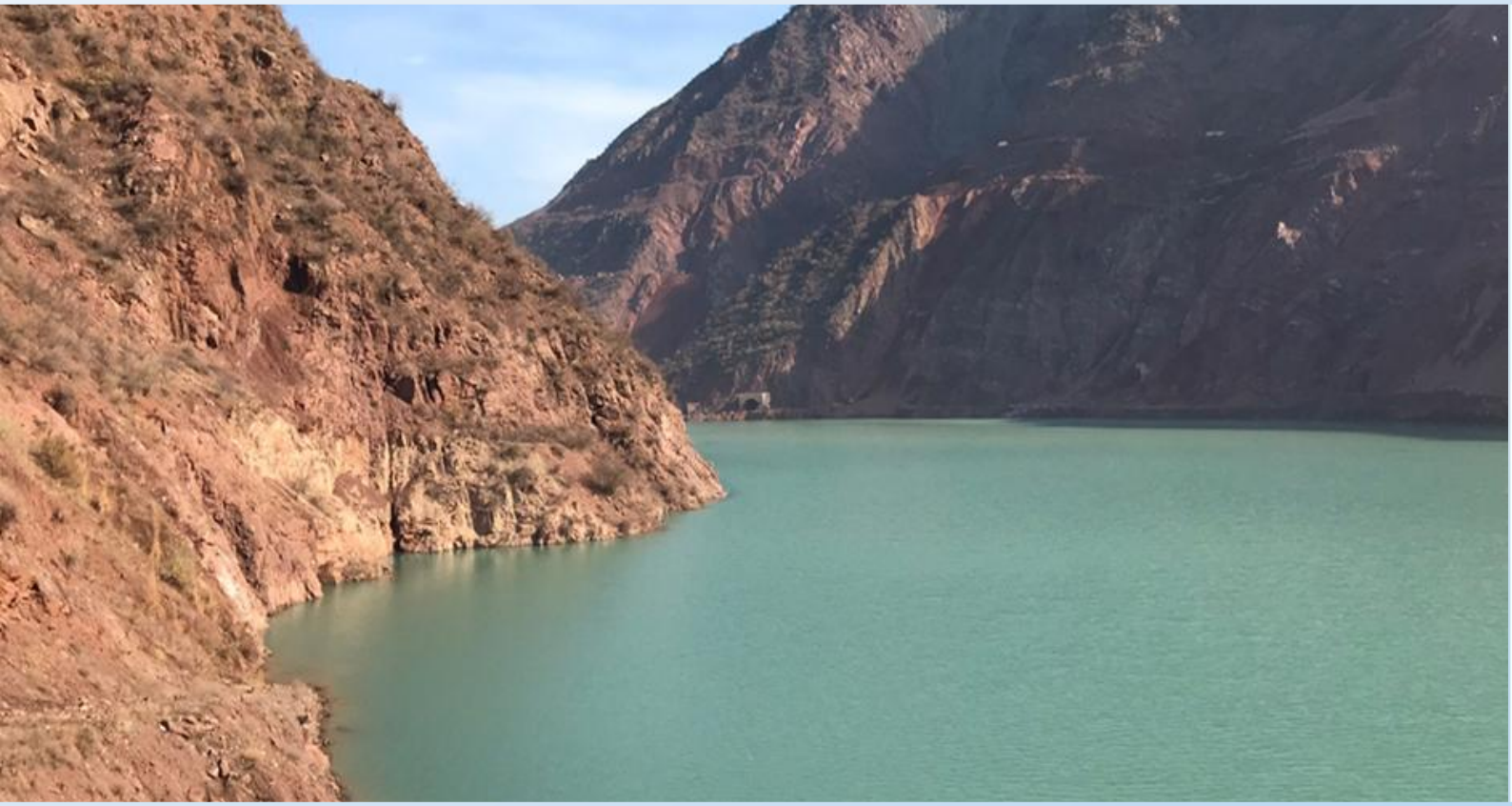
JSC “Rogun HPP”

State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT – UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Volume 1, Chapter 05: Impact Assessment Methodology



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5 IMPACT ASSESSMENT METHODOLOGY

5.1 INTRODUCTION

5.1.1. This chapter outlines the approach to the ESIA. It describes:

- The approach to defining the historical and current baseline.
- The approach to defining the scope of the Project and the Area of Influence (AoI).
- The approach to consideration of impact mitigation measures.
- The assessment of the significance of effects, through consideration of the magnitude of impacts and the sensitivity of the receiving social and biophysical environments and values, including transboundary effects.
- The approach to the consideration of major risks and hazards.
- The approach to the consideration of cumulative effects.
- An overview of the approach to ESIA consultation.

5.1.2. The ESIA process is a systematic approach to predict and evaluate the likely significant effects that a project could have on aspects of the physical, biological, social/socio-economic and cultural environment. It facilitates the identification of management measures that the Project needs to take to avoid, reduce, mitigate, offset, or compensate for adverse effects and enhance positive effects where practicable.

5.1.3. The ESIA process incorporates the following key steps:

- Establishment of the legal, regulatory, and administrative framework for the Project.
- Development of a Project description and identification and assessment of alternatives.
- Stakeholder engagement to ensure their interests are taken into consideration and responded to.
- Identification of physical, biological, socio-economic, and cultural conditions that currently exist and would be expected to prevail in the absence of the Project (i.e., the baseline environment).
- An assessment to establish the way in which the Project will impact the physical, biological, cultural, and human conditions and specific receptors within each of these domains to produce effects. The key steps in the assessment include:
  - *Impact prediction*: to determine what could potentially happen to receptors because of the Project and its associated activities;
  - *Impact evaluation*: to evaluate the significance of the predicted impacts by considering their characteristics such as, magnitude and likelihood of occurrence, the sensitivity and the value and/or importance of the affected receptors;
  - *Receptor sensitivity evaluation* using a ‘source-pathway-receptor’ model;
  - *Evaluation of significance*: Magnitude and receptor sensitivity are considered in combination to identify whether an impact will result in a significant effect, and if so, the degree of significance (described as Positive, or Negligible, Minor, Moderate or Major Adverse);
  - *Mitigation and enhancement*: to identify appropriate measures to avoid or mitigate significant adverse effects and enhance positive effects;

- *Residual evaluation*: to evaluate the significance of effects even with the implementation of the mitigation and enhancement measures;

- A high-level assessment of major hazards, and risks of relevant major accidents and/or disasters resulting from the identified natural or manmade hazards (including operational failure). The assessment of likely significant adverse effects takes into consideration the vulnerability of the Project to Major Events and the Project's potential to cause Major Events; and
- A summary of potential cumulative impacts the Project may have in combination with impacts from other projects and developments.

5.2 HISTORIC AND CURRENT BASELINE

5.2.1. In general, the baseline is the social and environmental characteristics and conditions of the area likely to be affected that are present at the time of the assessment. Environmental and social baseline conditions, including those which are predicted, are assessed either using existing available data (i.e., secondary data) or through data acquired through additional surveys, studies, or modelling (i.e., primary data).

5.2.2. Baseline conditions and associated receptors are summarized in **Volume 1, Chapter 7 (Environmental and Social Baseline Conditions)** and described in more detail in **Volume 2, Annex 7.1 (Environmental and Social Baseline Conditions Report)** of this ESIA.

BASELINE

5.2.3. The Project site comprises the areas that have been subject to construction of the hydropower dam over numerous decades. As such, the historic baseline is no longer reflective of current Project conditions and therefore is no longer relevant for the purposes of this ESIA. Furthermore, the environmental and social receptors that would be potentially affected by the project activities are highly dependent on this fact. In addition, resettlement and alteration of parts of the inundation zone has also occurred historically, as well as in response to current construction.

5.2.4. The baseline for this ESIA is therefore considered to be the conditions in 2019 at the site. Where practicable, historic information, including the baseline from the previous ESIA and other technical documents, has been used to develop the understanding of the historical development and context for the site against which the current conditions can be understood. In addition, this information has been supplemented by primary baseline surveys conducted between 2022-2024.

5.2.5. The dates of site visits for primary data collection and the list of data sources are presented in **Volume 2, Annex 7.1** of this ESIA**.**

5.2.6. Baseline conditions may be established for individual environmental topic assessments as relevant. The current conditions are used to assess activities during the most recent stage of construction (2019 to 2024) and for inundation of the flooding zone (up to 2038). Where relevant, the stages of dam construction and their effects at each stage have also been considered.

5.2.7. Data are from field visits in 2013-2014 and 2023-2024. It was agreed with PMG and decided based on site history and observations, that conditions are not materially different from those described in this ESIA. For that reason, the ESIA is considered to accurately and adequately describe environmental and social conditions and risks. Therefore, more recent data for seepage, wastewater, waste, fuel storage, and overall site management are not considered necessary for the ESIA.

5.2.8. It should also be noted that detailed management plans that will be prepared by Contractors (following guidance in the already prepared frameworks) which will provide much more detailed and up-to-date information on these and many more topics than can be presented in an ESIA of this scale.

5.3 DEFINING THE SCOPE AND AOI

TEMPORAL SCOPE

5.3.1. The ESIA addresses effects that are anticipated to arise during the construction and operation. These effects can broadly be summarized as follows:

- Any effects during the construction period that may arise because of Project construction activities such as demolition, excavation, temporary use of land (e.g., for site compounds), construction of new buildings, changes in traffic movements and temporary closures or diversions to roads.
- Any effects during the construction period that arise due to other activities, including resettlement of households, construction of infrastructure in new locations, demolition of resettled villages, enhancement/restoration of livelihoods.
- Any effects during the operational period that may arise from operational activities such as changes in downstream water releases, seasonal changes in reservoir levels, emissions, materials use, waste generation, energy use, and vehicle movements to and from the Site.

5.3.2. Given the long design life of the Project (110 years) and likelihood of continued maintenance to further extend the lifetime of the project in the future, decommissioning is not considered in this ESIA. Where appropriate, the effects of decommissioning will be subject to an assessment of likely significant environmental and social effects under the Environmental and Social regulations and laws in place at that time.

5.3.3. The baseline year (2019) for the assessment of construction impacts is considered to be the year that construction of the Phase 2 dam commenced and includes current dam operations.

5.3.4. Operational impacts (from 2032) will be assessed for the full operation and inundation of the Project expected by 2038, unless stated otherwise with respect to a particular environmental and social topic within the corresponding chapters of this ESIA.

AREA OF INFLUENCE

5.3.5. The Project footprint is defined in **Volume 1, Chapter 3 (Project Description)**. In general, the maximum extent of the Project footprint / height / depth / length of structures, and inundation zone, including an area surrounding these, have been used to define maximum operating parameters (spatial AoI), to allow for a conservative worst-case scenario analysis of effects.

5.3.6. Transboundary effects have been identified for those receptors which may be affected by operational flows from the Vakhsh River, and under a cascade dam failure.

5.3.7. The spatial scope of the study area for the ESIA will vary, according to the specific assessment requirements for each ESIA topic. The study areas for each topic are outlined in **Volume 1, Chapter 7** of this ESIA.

5.4 APPROACH TO MITIGATION

5.4.1. The ESIA identifies and evaluate measures to avoid, reduce, or offset the significant adverse effects of the Project. The preferred hierarchy of mitigation is as follows:

- Avoid the effect.
- Minimize the effect.
- Mitigate the effect.
- Offset and/or compensate the effect.

5.4.2. Where the design of the Project has not resolved potentially significant effects, control and mitigation measures are identified and outlined in corresponding topic chapters. These measures will relate to actions required to meet the applicable project standards, including GIIP.

5.4.3. As part of the design and implementation of the Project to date, many E&S management measures have already been incorporated into the Project (e.g., design factors for climate change).

5.4.4. Following the assessment of effects on receptors, mitigation measures are defined in order to avoid or minimize adverse effects or enhance beneficial effects.

5.4.5. The mitigation measures reported within the topic chapters are identified and included in **Volume 3, A1: Environmental and Social Management Plan (ESMP)**.

5.5 ASSESSMENT METHODOLOGY

5.5.1. To establish the scope of the Project features and activities, with particular reference to the aspects which may impact the receptors, **Volume 1, Chapter 3** has been developed in sufficient detail to:

- Describe the features and activities proposed by the Project.
- Facilitate a comprehensive identification of the potential interactions between Project activities and receptors, and the impacts and likely effects that could result from those interactions.

5.5.2. **Volume 1, Chapter 4** (**Analysis of Alternatives)** enables environmental and social risks to be considered in the early stages of Project planning as well as the later stages of design and implementation and describes the basis of selection of preferred alternatives at all stages of the Project. The objectives of Project alternative analysis are:

- To describe the basis of selection of preferred alternatives including location, technology, and design; and
- To provide the information of the analysis required in confirming its conclusions and methods to compare Project alternatives.

5.5.3. As has been described, the Project was designed, and construction has been underway, intermittently for decades. The design was reviewed, and some changes made as a result of the 2014 TEAS, and the 2014 and current DSPoE have also impacted changes to design and construction. However; it is not possible to consider alternative locations or major changes in design. Therefore, the primary alternatives are those assessed in the 2014 TEAS and ESIA.

5.5.4. A summary of the Project facilities' design characteristics, planned Project activities and consideration of Project Alternatives, are provided in **Volume 1, Chapter 3** and **Volume 1, Chapter 4**, respectively.

5.6 IMPACT ASSESSMENT

5.6.1. Prediction of impacts is a systematic exercise to determine what could potentially happen due to the interaction of the Project and its activities with the physical, biological, cultural, and human environments.

5.6.2. The diverse range of impacts considered in the impact assessment process requires a wide range of prediction methods to be used, including quantitative, semi-quantitative and qualitative techniques.

5.6.3. It is important to note that the impact prediction considers management measures already embedded in Project design and construction implementation.

IMPACT EVALUATION

5.6.4. Once the prediction of potential impacts is complete, each impact is described in terms of its relevant characteristics. The purpose of the assessment is to identify and evaluate the magnitude of potential impacts on identified receptors (refer to **Table 5-1**).

Table 5-1 Impact Evaluation

Characteristic	Definition	Designation
Type	The type of change (or impact) may be positive, neutral or negative.	Positive or Negative
Extent	Spatial extent (e.g., habitat impacted) or population extent (e.g., proportion of the population/community affected).	Local Regional National Transboundary
Duration	Period over which an impact will interact with a receptor.	Short-term Medium-term Long-term Permanent
Frequency	How often the impact will occur.	Infrequent Periodic Constant
Likelihood	What is the chance of the predicted impact occurring during the project lifetime.	Certain Likely Unlikely
Reversibility	Restoration of the pre-impact status of a receptor.	Reversible Irreversible

5.6.5. Once the impact is evaluated based on its characteristics, each potential impact is assigned a “magnitude”. Magnitude describes the intensity of the change that is predicted to occur on the receptor because of the potential impact. These magnitude designations are defined as:

- Beneficial.
- Very Small adverse.
- Small adverse.
- Medium adverse.
- Large adverse.

5.6.6. An assessment of the overall magnitude of an impact is provided by considering all the dimensions of the impact. In the case of a potential positive effect, no magnitude designation (aside from "beneficial") is assigned. It is considered sufficient for the purpose of the ESIA to indicate that the Project is expected to result in a potential positive effect, without characterizing the exact degree of positive change likely to occur.

DETERMINING RECEPTORS AND THEIR SENSITIVITY

5.6.7. Once the magnitude of an impact is determined, it is necessary to understand the significance of the impact. A 'source-pathway-receptor' concept is used to determine the receptor's sensitivity:

- **Source** - the origin of a potential impact for a certain magnitude (i.e., an activity such as earthworks and a resultant effect, such as contaminated run-off from the earthworks).
- **Pathway** - how the effect of the activity could impact a receptor (e.g., for the example above, changes to the water quality in the receiving waters).
- **Receptor** - the element of the receiving environment that is impacted (this could either be a component of the physical, ecological, or human environment such as water quality, e.g., for the above example, species living on or in the water body or downstream users of the water).

5.6.8. The receptor sensitivity is based on two components:

- Value attributed to the receptor by stakeholders or applicable regulations/policies.
- Degree to which a receptor is resilient to a change.

5.6.9. The sensitivity value considers whether, for example, the receptor is rare, unique, has protected or threatened status, has importance at a local, regional, national, or international scale and, in the case of biological receptors, whether the species has a key role in ecosystem function.

5.6.10. The ability of a receptor to adapt to change, tolerate, and/or recover from potential impacts is key to assessing its sensitivity to the impact under consideration. The overall receptor sensitivity is determined by considering a combination of value, adaptability, tolerance, and recoverability. This is achieved through applying known research and information on the status and sensitivity of the feature under consideration coupled with professional judgement and experience.

5.6.11. Receptor Sensitivity is categorized as:

- **Low Sensitivity** – for example, common species; found in abundance; not a large population/mass affected; can recover from the impact.
- **Medium Sensitivity** – for example, common species; affected in large numbers/mass/area and takes a long time to recover.

- **High Sensitivity** – for example, where the receptor is internationally / nationally important, particular to the area affected, large population is impacted, and does not have capacity to recover.

EVALUATION OF SIGNIFICANCE

5.6.12. The significance of the effect is predicted as presented in the matrix provided in **Table 5-2**. For the purpose of this ESIA, major and moderate impacts are deemed to be significant, while minor impacts are not considered significant pre-mitigation.

5.6.13. The evaluation of impacts presented in the ESIA is based on professional judgement and experience, informed by legal standards, national and regional government policy, current industry good practice and the views of stakeholders. Where specific standards are either not available or provide insufficient information on their own to allow grading of significance, the evaluation of significance has considered the magnitude of the impact and the quality, importance, or sensitivity of the affected receptor.

5.6.14. Magnitude and receptor quality/importance/sensitivity are looked at in combination to evaluate whether an impact is, or is not, significant, and if so its degree of significance (defined in terms of Positive, Negligible, Minor, Moderate or Major). Impacts classed as negligible include those that are slight or transitory, and those that are within the range of natural environmental and social change.

5.6.15. Where the assessment identifies that an aspect of the development is likely to give rise to significant effects, mitigation measures in addition to measures that are currently being employed are identified to avoid, prevent, or reduce impacts to acceptable levels.

5.6.16. Following the initial assessment, if the effect does not require additional mitigation (or none is possible) the residual impact will remain the same. Where mitigation measures are identified, impacts are re-assessed, and all residual impacts are clearly described.

Table 5-2 Impact Significance Matrix

Impact Magnitude	Receptor Sensitivity		
	Low	Medium	High
Beneficial	Positive	Positive	Positive
Very Small	Negligible	Negligible	Minor
Small	Negligible	Minor	Moderate
Medium	Minor	Moderate	Major
Large	Moderate	Major	Major

5.7 CUMULATIVE IMPACT ASSESSMENT

5.7.1. Cumulative impacts are those that arise due to an impact from the Project building upon, and thus exacerbating, impacts arising from both similar and un-related developments, activities and projects.

Such interactions could create an additional, or more significant, impact. A Cumulative Impact Assessment (CIA) is an assessment of these impacts.

5.7.2. Environmental and social impacts arising from existing, planned, and foreseeable future developments within the Project AoI might individually be less significant, but when combined, could amount to a significant cumulative effect.

5.7.3. The assessment of cumulative impacts is an integral part of the ESIA process to ensure that multiple effects on people, heritage and environmental receptors arising from the Project combined with impacts from other projects/activities have been identified and addressed.

5.7.4. In the context of the Project, the transboundary risks and impacts are those that could affect countries and users, with mitigation measures defined as the management of the hydrological regime to avoid impacts on downstream countries and users due to filling of the reservoir or future operation of the HPP.

5.7.5. The assessment methodology of potential transboundary impacts is presented in **Volume 2, Annex 24-1**, and summarized in **Volume 1, Chapter 24** of this ESIA.

5.8 STAKEHOLDER ENGAGEMENT

5.8.1. Stakeholder engagement forms an integral part of the impact assessment process and provides an opportunity to share information with stakeholders, to receive information from stakeholders, and to identify stakeholder concerns. Engagement involves communicating with stakeholders to ensure they are informed and that their interests are taken into consideration and responded to. ..

5.8.2. Stakeholder concerns are fed into the assessment process, so that they can be systematically considered and mitigated or managed as appropriate. Engaging stakeholders early provides the opportunity to recognize and then avoid or otherwise address potential issues early and prevent them from becoming bigger issues that can impact the success of a project.

5.8.3. Good relations between a project and its surrounding communities and relevant stakeholders are an essential condition in acquiring what is known as the “social license to operate.”

5.8.4. Stakeholder engagement may be achieved by:

- Providing relevant information to stakeholders in a timely manner;
- Receiving relevant information from stakeholders in a timely manner;
- Facilitating two-way discussions to identify and address stakeholder issues;
- Feeding stakeholder issues and priorities into program decision-making processes and demonstrating how stakeholder concerns have been addressed, including changes in project decision making;
- Maintaining a mechanism for grievances to be raised and resolved in a timely manner;
- Involving affected stakeholders in monitoring the implementation of mitigation measures or other environmental and social programs; and
- Reporting and follow-through to the stakeholders.

5.8.5. In achieving an effective stakeholder engagement, the Project has committed to an ongoing consultation and engagement process throughout all phases of its development. The process focuses on a broad range of activities, including information sharing, consultation to negotiation and

partnership building and is captured in an existing Stakeholder Engagement Plan (SEP). The SEP is a live document, and as such it will continue to evolve as engagement is conducted.

5.8.6. .

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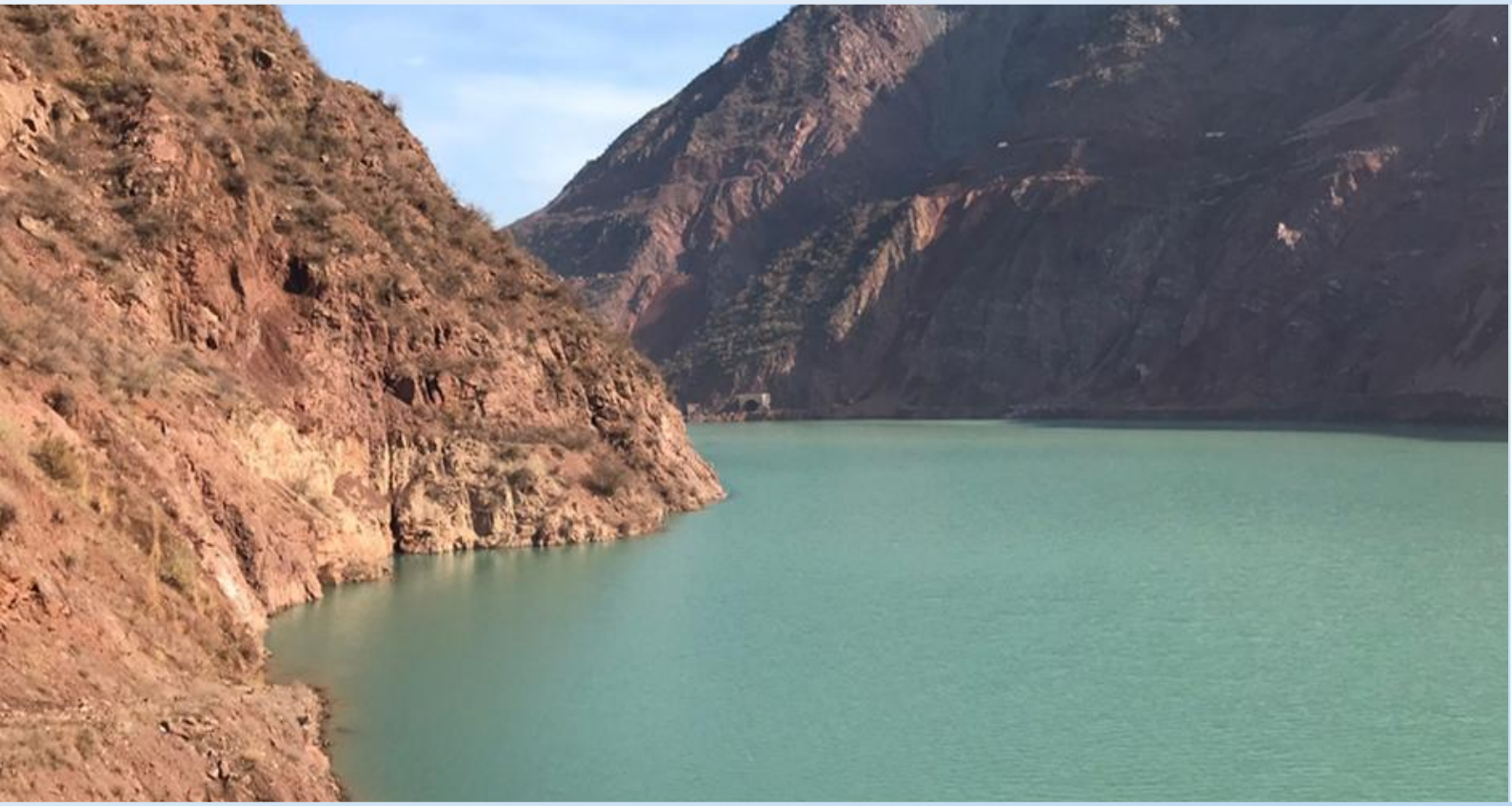
JSC “Rogun HPP”

State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT – UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Volume 1, Chapter 6: Stakeholder Engagement



PUBLIC

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6 STAKEHOLDER ENGAGEMENT

6.1 INTRODUCTION

6.1.1. Stakeholder engagement is critical in the ESIA process, acting as an essential channel for meaningful involvement and collaboration among groups of Interested and Affected Parties (I&APs).

6.1.2. Stakeholder engagement within the ESIA process serves to foster inclusive and participatory decision-making, ensuring that stakeholders' perspectives are considered and integrated into project planning and implementation. By engaging stakeholders, the ESIA aims to identify any issues and concerns related to the Project's likely significant environmental and social effects and identify opportunities for sustainable development.

6.1.3. This chapter summarizes the Stakeholder Engagement Plan (SEP), which has been consulted upon and disclosed in June 2024 and updated and re-disclosed in May 2025. PMG, with support from other key implementing agencies, such as DFZ and Rogun OJSC, is updating the SEP periodically.

6.2 STAKEHOLDER ENGAGEMENT PROGRAM

Objectives of the Stakeholder Engagement Process

6.2.1. The stakeholder engagement program aims to inform and consult with stakeholders about the Project. As well as answering questions regarding the Project, it addresses concerns or questions that may arise. As a result, stakeholder engagement activities will:

- Identify the Project stakeholders that could be adversely affected or may have an interest in the Project.
- Consult with stakeholders to determine their views regarding impacts and implications.
- Provide sufficient opportunity for the stakeholders to express their opinions and concerns.
- Communicate regularly with Rogun HPP stakeholders, provide information, and solicit feedback on the project.
- Collect feedback from stakeholders on the Project including their concerns, suggestions and questions on the potential impacts and address these in a timely manner through the appropriate channels.
- Describe the Project and identifying benefits to the national economy, region, people, and Rogun HPP employees.
- Explain possible hazards and the systems in place to prevent adverse impacts at the Rogun HPP.
- Identify mitigation measures for environmental and socio-economic effects.
- Provide the functionality of grievance mechanisms and other channels available for all stakeholders to address any project-specific concerns and requests.
- Provide regular updates on Rogun HPP progress.

Stakeholder Engagement Techniques

6.2.2. The stakeholder consultation and information disclosure are covering the following main activities:

- **Inform:** Timely disclosure of Project information in Tajik, Russian and English to the key stakeholders;
- **Consult and Involve:** Informed participation and meaningful two-way consultation with the affected stakeholders; and
- **Collaborate:** Development and implementation of a Grievance Mechanism to ensure that the affected stakeholders' concerns and issues are addressed.

Information Disclosure Activities

6.2.3. In addition to the previous stakeholder consultation and engagement undertaken for the Project, PMG and DFZ has disclosed and will continue to disclose relevant information about the Project in an ongoing manner as the Project continues. The following documents are being disclosed for public review and comment:

- ESIA (including the Environment and Social Management Plan (ESMP));
- Non-Technical Summary (NTS);
- SEP;
- Gender Action Plan; and
- Resettlement & Livelihood Restoration Policy Framework (RLRF).

6.2.4. Consultation materials will be adapted depending on the point of interest of the different stakeholder groups. During disclosure and throughout the implementation of this SEP, engagement will incorporate the following key aspects to ensure effective engagement:

- The Project is initiating communication and information disclosure to ensure stakeholders are to be promptly notified and provided with the opportunity to influence decisions before events unfold.
- The Project is ensuring that the communicated information is both meaningful and easily understandable for project stakeholders, taking into account the cultural relevance and the language, and literacy levels of the beneficiaries.
- The Project is adopting an open and transparent approach to communicate and disclose information throughout the project.
- The Project is emphasizing effective communication and disclosure regarding Project activities, negative impacts, potential risks, and positive impacts.
- The Project is making project documentation and associated information accessible by strategically placing it in publicly accessible locations. The Project is also integrating the disclosure process closely with stakeholder engagement, utilizing existing and appropriate methods and mechanisms.
- PMG, Rogun JSC, and DFZ are documenting and reporting all aspects of the information disclosure process.

6.2.5. The types of information to be disclosed as the Project proceeds include:

- A Final ESIA that summarizes comments received on the draft and how they have been responded to, including revisions to the draft documents.
- Information on the progress of HPP construction and of the resettlement program.
- Summary of ongoing environmental and social performance, in particular information on biodiversity management and water releases.
- Decisions made by the Tajikistan regulatory authorities and the Lenders regarding the Project.

Consultation Methods

6.2.6. As described above, the Project is using different consultation approaches and methods for different stages of the Project activities and stakeholder groups. The main communication methods and mechanisms that will be used to consult with key stakeholders are:

- Meetings, such as with the affected individuals and communities, including the affected Jamoats;
- Telephone calls, letters and emails;
- TV, radio and newspapers;
- Information disclosure (as described above);
- Regular press releases; and
- Regular consultation with local communities to be undertaken by the DLEOs and by Rogun JSC.

Principles of Stakeholder Engagement

6.2.7. The stakeholder engagement process for the Project aims to establish effective communication channels and collaborative relationships with a diverse range of stakeholders. The process is iterative and aims to ensure transparency, inclusivity, and responsiveness throughout the Project lifecycle, while respecting the unique needs and perspectives of each stakeholder group.

6.2.8. This approach is guided by several principles, including facilitating meaningful participation, promoting socio-economic development, and safeguarding the environment and the well-being of affected communities.

6.2.9. The stakeholder engagement strategy recognizes the importance of engaging transboundary governments, national bodies, contractors, workers, affected communities, women, NGOs and other relevant stakeholders, to ensure their active involvement and to address their concerns and aspirations. By incorporating these principles, the ESIA process fosters sustainable development and creates a positive experience for all stakeholders involved. An internal and external Grievance Redress Mechanism (GRM) has been developed to ensure the timely and successful resolution of stakeholder concerns, as well as to monitor the Project's relationship with stakeholders throughout the Project lifecycle (see **section 6.11**).

Table 6-1 Stakeholder Engagement Principles

Principle	Description
Accessibility	Stakeholder engagement actions should be held at venues that are easily reachable and accessible to the affected stakeholders. Logistical assistance should be provided to enable all stakeholders to attend. Relevant logistical support must be provided, particularly to vulnerable groups and those from far away.
Engagement Continuity	Ensure that stakeholder engagement is an ongoing process, not just a one-time event. Engage stakeholders at different project stages, from planning to implementation and beyond.
Fairness	Ensure that all parties are treated fairly during the engagement process. There should be no preference given to one party over another.
Fit for purpose	The stakeholder engagement approach must meet the needs and expectations of the stakeholders and the Rogun HPP. Customize the engagement approach to suit the preferences and interests of different stakeholder groups. For instance, some stakeholders might prefer face-to-face meetings, while others prefer group or social media interactions.
Inclusivity	Engaging all stakeholder groups, mainly the most vulnerable and marginalized, is essential. Channels of engagement are both formal and informal.
Informed engagement	Stakeholders have enough time to analyze the documents and implications of the information correctly and to determine appropriate mitigation measures. Feedback from stakeholders is encouraged to enable effective communication and avoid misunderstandings. Rogun HPP stakeholders must be informed of progress and given feedback on surveys and decisions taken by Rogun HPP or the government.
Integrity	Engage stakeholders in a manner that fosters mutual respect and trust.
No cost	Participation should be free. Stakeholders should not be expected to pay for entrance, transport or refreshments. Appropriate support must be provided.

Principle	Description
Partnership	Establish partnerships with the community, government, and civil society institutions to provide social projects with shared value.
Proactive	Actively engage before problems arise.
Reliability	Ensure that promises are always kept. It is essential to communicate challenges and good stories.
Respect	Engage respectfully and refrain from being arrogant. It would be preferable to engage in Tajik or Russian. Engage in a manner that is sensitive to cultural norms.
Responsiveness	Respond to grievances promptly and efficiently.
Transparency	Encourage stakeholders to share their thoughts, concerns, and feedback without fear of reprisals. Active listening is essential during these interactions.
Trust	Maintain an open, meaningful dialogue that respects and upholds all stakeholders' beliefs, values, and opinions.
Understand Stakeholder Needs:	Conduct thorough research and analysis to understand each stakeholder group's concerns, needs, and expectations, as different stakeholders will likely have different priorities and needs.
Visibility	Establish trust by being visible in the community. The focus is on 'being seen' and avoiding using printed materials to replace face-to-face interactions.
Learning and Improving	Stakeholder engagement is a dynamic and iterative process. Actively use stakeholder feedback and experiences to learn from and improve the overall stakeholder engagement approach. Continuous improvement is key to maintaining a fit-for-purpose process.

6.3 REGULATORY CONTEXT

6.3.1. Tajikistan has an established regulatory framework that governs stakeholder consultation and disclosure requirements for large-scale infrastructure development projects. Project compliance with the relevant legislation is crucial to ensuring transparency, accountability, and meaningful stakeholder engagement throughout the ESIA process. Key laws and regulations are outlined in **Chapter 2** of this ESIA.

6.3.2. In addition to the national requirements, the Project is also being developed in accordance with international standards and guidelines and these are described in **Chapter 2** of this ESIA.

6.4 STAKEHOLDER ENGAGEMENT PROCESS

6.4.1. Stakeholder engagement was part of the development of the 2014 TEAS and ESIA and involved engagement with 2011-2014 and involved engagement with communities that would be economically or physically displaced, with nongovernmental organizations, and with riparian countries.

6.4.2. A SEP was produced in June 2022 for the Project’s financing framework technical assistance (TA). A second SEP for the project was prepared in 2024 and revised in 2025.

6.4.3. The SEP developed and disclosed as part of the TA focused primarily on institutional stakeholders, including potential financiers and government bodies. Under the project SEP, PMG engaged with

national and local authorities as well as international finance institutions to discuss the economic and financial feasibility of the Project.

6.5 STAKEHOLDER IDENTIFICATION AND ANALYSIS

6.5.1. The identification of stakeholders plays a pivotal role in facilitating meaningful engagement throughout the Project. This process involves a systematic approach to identify individuals, groups, organizations, and communities that could be impacted by or hold an interest in the Project.

6.5.2. Through a review of Project plans, objectives, and potential impacts, stakeholders have been categorized based on direct and indirect effects, considering both environmental and social aspects. A systematic approach has been used to map the stakeholders based on the Project social AoI, identifying stakeholders by area of impact. Project stakeholders have been categorized into two main groups[1]:

- Project Affected Parties – Individuals and groups, including local communities, who may be affected by the Project due to actual impacts or potential risks to their physical environment, health, safety, cultural practices, well-being, or livelihoods; and
- Other Interested Parties – Persons, groups, or organizations with an interest in the Project, which may arise from the location of the Project, its characteristics, impacts, or issues of public interest. These include those who have influence over the project, such as authorities or decisionmakers.

6.5.3. The 2025 SEP sets out the list of stakeholders, including individuals and groups in the project area and beyond, local and national authorities, international organizations, international financiers and donors, and contractor companies. This stakeholder database is being expanded during the further stakeholder engagement process as new stakeholders emerge, while others may choose not to participate.

Directly Affected Settlements

6.5.4. As of July 2025, of the 69 settlements affected by the resettlement process, 17 communities have been resettled, seven are in the process of resettlement, and the resettlement process for 45 communities is yet to start. There are ongoing consultations with the Project-Affected Persons (PAPs) involved in the resettlement process.

Vulnerable Groups

6.5.5. Due to their intrinsic characteristics, vulnerable groups include those who would be disproportionately affected by the Project. Vulnerable groups may be less capable of managing project impacts and require particular attention throughout the consultation process. Emphasis is therefore placed on vulnerable groups (including women and disabled persons), families, and individuals throughout the Rogun HPP project lifecycle and associated stakeholder engagement processes.

[1] World Bank Environment and Social Framework (2017). Available at: https://thedocs.worldbank.org/en/doc/837721522762050108-0290022018/original/ESFFramework.pdf

6.5.6. Engagement with vulnerable groups and individuals often requires the application of specific measures and assistance to facilitate their participation in project-related decision-making so that their awareness of and input to the overall process are proportional to those of the other stakeholders.

6.5.7. The RLRF and forthcoming resettlement instruments, socio-economic baseline surveys were undertaken by the Project's International E&S Consultant to provide quantitative and qualitative insight on the affected population, their livelihoods, vulnerabilities their experiences relating to the Project and the resettlement process.

6.5.8. The socio-economic baseline surveys were conducted in two stages and focused on the second phase of resettlement, involving 1,710 households (16,919 people):

1. First-stage primary data collection took place between 8th-10th July 2023 involving:

- 12 Focus group discussions (FGDs) (six women-only and six men-only) in Lughuri Poyon (Sicharogh Jamoat, Rogun City), Khakimi (Khakimi Jamoat, Nurobod), Mehrobod (Mehrobod Jamoat, Nurobod), and Kachimandi (Shahrisabz) / Furudgoh (Nusratullo Makhsum Jamoat, Rasht) and Navobod (Navobod Jamoat, Rasht); and
- In-depth interviews with 15 Jamoats from the flood zone districts (Rogun, Nurobod and Rasht) that are affected by the resettlement, and also receiving resettlers in new resettlement sites. The objectives of these interviews were (i) to obtain socio-economic data from affected Jamoats that cover both incoming and outgoing migrants from the affected settlements; and (ii) to understand both experiences and perceptions of resettlement and the Project. The focus was on Jamoats that are undergoing resettlement or that will be affected by resettlement in the near future.

2. Second stage primary data collection, which took place in July-August 2023 for the socio-economic baseline, covered 900 household surveys and included an additional 24 FGDs (12 women-only and 12 men-only) to provide more information on the resettlement experience, perceptions and expected benefits of the Project.

3. From January to June 2024, DFZ, drawing on the data of the July 2023 survey, undertook a more focused analysis of 1401 (out of 1710) project-affected households: those that had been resettled (363 PAHs); those which were in the process of relocating (21); and, those which were commencing the resettlement process (1017).

6.5.9. Based on the socioeconomic data collected through household surveys, FGDs and secondary data sources, the following groups have been identified as vulnerable within the Project Area of Influence[2]:

- **Elderly** – Households with members aged over 60 living in the resettlement areas that require additional care. The household survey found that 28% of households have a member that is over the age of 60. The health of some of them could be negatively affected due to relocation, and the caring burden on families could increase (see the RLRF for details on the associated mitigation measures to reduce impacts on vulnerable groups).

[2] Detailed vulnerability framework has been provided within the RLRF and has been included in the SEP.

- **Persons with disabilities and chronic illness** – The household survey found that 19% of households have members with disabilities or suffer from chronic illnesses. These PAPs who may need to relocate may find the move difficult or may become increasing vulnerable to Project impacts in terms of their health due to their sensitive physical and wellbeing status.
- **Women-headed households** - Widowed women with no provision of social security, or women-headed households if they are categorized as 'Poor'. Women-headed households are more likely to live in poverty and may be more adversely impacted by the need to resettle and build houses due to a lack of funds to hire construction labor in the absence of relatives (see Gender Assessment displayed in Vol. II, A12). The proportion of female-headed households within the Project affected area is 17.8% and additionally, a number of men have migrated abroad in search of jobs, leaving women as sole carers for children and elderly family members.
- **Poorer households** – Households that are reliant on social assistance/social aid or have insufficient money for food. 19% of the households surveyed indicated that they are struggling to buy food due to insufficient family income. Poorer households are more susceptible to economic shocks and changes in their environment due to a lack of financial resources which may impact their capacity to adapt to resettlement.
- **Children and orphans** – Children in households of resettlement and displacement are particularly vulnerable due to their developmental vulnerability and their dependence on caregivers. Any impacts on caregivers such as changes to income will directly affect children. and may find the move difficult, which has the potential to affect their physical and mental well-being. According to data provided on orphans by two Jamoats, including N. Makhsum in Rasht, which will be affected by reservoir inundation and is home to 110 orphans. It is not known at this stage how many of these orphans will be required to relocate, as the extent of resettlement in Rasht has yet to be determined pending the outcome of geotechnical studies. It was reported by DFZ that orphanages are provided in all resettlement sites.
- **At risk youth aged between 15-24** – 41.3% of the youth aged 15-24 are neither in education or employed (27.5% of males and 57.8% of females). The at-risk youth is an important indication for the future skills and jobs market and also a risk of potential social exclusion if they cannot seize the Project opportunities equally as others.
- **Households with informal jobs** – 11% of those with an income amongst the sample population are engaged in irregular daily or seasonal work. Due to low social security coverage of the population, it is likely that those relying on informal jobs earn lower incomes.
- **Households with illiterate heads –** Although Tajikistan is reported to have close to 100% literacy, 6% of the head of households (HoH) affected by the Project were reported to be illiterate based on the socio-economic household survey results. The project communication with communities have mostly relied on TV, visual media and verbal face to face communication. In addition, illiterate HoH will need support in understanding the THP preparation, asset valuation and compensation process.

6.5.10. Ongoing engagement with the vulnerable groups identified and set out within this SEP is being facilitated by DFZ to ensure minimum impact on these groups. Continual contacts will be made with vulnerable groups through the Jamoats. Specific focus groups and workshops targeting vulnerable groups, including women, will be conducted by DFZ as part of the stakeholder engagement

activities for the Project (refer to Table 6-2). To promote the inclusion of vulnerable groups, consultation processes will be designed to support equal participation, including the provision of free transportation to the engagement sessions, childcare support, appropriate meeting times and accessible meeting venues.

Table 6-2 Stakeholder Groups and Interests within the Project

Type	Stakeholder Category	Name	Role / Influence on Project	Method of Engagement
National Stakeholders	Project Affected Parties	Project Management Group (PMG)	PMG for Energy Facilities Construction under the President of the Republic of Tajikistan is the implementing entity for the Rogun HPP Project.	Regular meetings with lead riparian and community stakeholders , including government officials, to discuss Project progress and address concerns. Conducting open forums and workshops to provide updates on the ESIA process and gather feedback.
	Project Affected Parties	Rogun JSC	Manages all contractors and subcontractors. Rogun JSC report monthly to PMG on technical progress, however, they are also in day-to-day communication with PMG.	Monthly meetings with all contractors and subcontractors to discuss Project updates, progress, EHS monitoring and compliance.
	Project Affected Parties	Committee for Environment Protection Under the Government of Tajikistan	The committee's major duty is the implementation of public policy in the field of environmental protection, protection of forestry, securing protected natural areas, hydrometeorology and rational resource use. The committee has a function of control over environmental protection practice, use of natural resources and monitoring compliance with environmental requirements.	Formal consultations and workshops to discuss the Project's potential impacts and proposed mitigation measures. Providing written reports and documentation to relevant ministries to keep them informed. Official letters and emails to the relevant National Government Authorities as required.
	Project Affected Parties	Ministry of Finance	The Ministry oversees handling all international financial matters, spending, financial services policy, organizing funding for various programs; addressing domestic policy and delivering strategies to ensure domestic economic growth.	
	Other Interested Parties	Ministry of Energy and Water Resources	The Ministry is in charge of developing and implementing policies in the field of energy and water resources.	
	Other Interested Parties	Ministry of Economic Development and Trade	Ministry develops public policy in the field of social-economic sector, implements public policy, norms, and regulations in the field of analysis and development of strategies of social-economic development of the country.	
	Other Interested Parties	Ministry of Labor, Migration and Employment of Population of the Republic of Tajikistan	Responsible for labor standards and market. Interested in creating jobs and monitoring compliance with the provisions of the labor code.	
	Other Interested Parties	Ministry of Health and Social Protection	Governs and manages healthcare and the health industry in Tajikistan, including the nation's public health system.	

	Project Affected Parties	State Enterprise of Directorate for Flooding Zone of Rogun HPP (DFZ)	Responsible for developing and implementing the resettlement and livelihood restoration program.	
	Project Affected Parties	Local Authorities	Local authorities of host and resettled communities require additional resources and facilities to support the influx of resettled households..	Face-to-face meetings to explain the Project's objectives, potential impacts, and benefits for their communities. Encouraging community members' participation in discussions and decision-making.
	Project Affected Parties	Public Security (Military guards)	Provision of security for the Rogun HPP construction site.	Specialized meetings on security aspects.
International Organizations	Other Interested Parties	Interstate Commission for Water Coordination (ICWC)	Collective body of Central Asian States to coordinate water allocations and improve the principles of common water resources management and measures.	Joint meetings and consultations. Addressing cross-border environmental concerns.
	Other Interested Parties	International Labor Organization (ILO)	Can provide insights into labor practices and issues in Tajikistan. Promote labor rights, encourage decent employment opportunities, enhance social protection and strengthen dialogue on work-related issues e.g., children's rights, forced labor etc. Ensure compliance with ILO conventions and guidelines.	Official letters and emails. Press conferences and roundtables.
Riparian Countries	Project Affected Parties	Government of Uzbekistan	Potential beneficiaries of power and water management improvements. Concerns over dam safety and continued availability of water flows for commercial agriculture.	Transboundary roundtable meetings and press conferences on Project updates. Joint impact assessments and planning.
	Project Affected Parties	Government of Kazakhstan	Potential beneficiaries of power. Concerns over water availability. Highly interdependent with regard to water and energy resources.	
	Project Affected Parties	Government of Afghanistan	Potential beneficiaries of power. Part of the Amu Darya River basin.	

	Other Interested Parties	Government of Kyrgyzstan	Part of the Amu Darya River Basin and highly interdependent with regard to water and energy resources. However, limited potential affects due to upstream position.	
	Project Affected Parties	Government of Turkmenistan	Share the river basin of Rogun HPP. Highly dependent for irrigation flows from the upstream countries.	
	Project Affected Parties	Transboundary Project-Affected Persons (PAPs)	Concerns over dam safety, water management and reservoir operation, implementation and risks, environmental and social impacts.	
Rogun HPP Contractors and subcontractors	Project Affected Parties	**JSF "Sokhtmoni Asosi"** **JSC "Tojikhydroelektromontazh" (TGEM)** **JSC "Tojikhydromontazh" (NGM)** **LLC "Mirshah Construction"** **LLC "Elitstroy"** **LLC "Yoqubjon 2016"** **LLC "Inventor"** **LLC "Nursoz"** **LLC "Samand Construction"** **LLC "Nekzod"**	Directly affected by decisions regarding financing, continued construction, changes in contract terms. Technical understanding of the range or issues associated with Rogun HPP, including financial issues.	Bulletin updates (via email, SMS & notice boards) on Project developments and Worker Grievance Procedure. Training on social and environmental responsibilities. Worker feedback mechanisms.

		LLC "Jom-co"		
		LLC "Binokor"		
		LLC "Farrab"		
		LLC "Development of mountain areas"		
		LLC "Sahili-Nur"		
		JSC "ZTM (EMZ)" Norak		
		LLC "Repair and protection of concrete"		
		LLC "Nur-81"		
		LLC "Nurafzo 2010"		
		LLC "Hydromontage of Central Asia"		
		FC "EKK No. 3"		
		JSC "TojikSGEM"		
		LLC "Farkhunda-2014"		
		LLC "Expert-Sanoat"		
		LLC "Khurshed-2000"		
		LLC "Hingob"		
		LLC "Bunyodi Rogun"		
		LLC "Hydrospecproject"		
		LLC "Orui Ahmad"		

		JSC "TADES"		
		LLC "Usmon-2007"		
		LLC "Rogun-Sokhtmon"		
		LLC "Orion Sokhtmon"		
		LLC "SKIF"		
		LLC "Intersokhtmon"		
		Trevi company (Trevi)-Webuild		
		LLC "Energostroy-LTD"		
		FJSP "Tunel Saddi Ariana"		
		JSC "Hydroproject Institute"		
		LLC "Westtransstroy"		
		Webuild (SALINI)		
		JSP FSHM "Somoniyan"		
		Tractebel-Elektroconsult		
		JSC "Tojik Kon"		
		LLC "Vahsh-Sokhtmon"		
		Afry Design Company (AFRY)		
		FJSP "Khokrud"		

		FJSP "Tono Energy Engineering Company"		
Construction Workforce	Project Affected Parties	Construction workers on site	Directly affected by decisions regarding financing, continued construction, changes in contract terms. Technical understanding of the range or issues associated with Rogun HPP, including financial issues. Risks associated with construction and operational phase of the Rogun HPP, including work accidents (use of explosives), occupational diseases (skin irritation, noise, etc.), contamination of soil, water, and health due to hazardous and non-hazardous waste.	Bulletin updates (via email, SMS & notice boards) on Project developments and Worker Grievance Procedure. Training on social and environmental responsibilities. Worker feedback mechanisms.
Impacted Community Members	Project Affected Parties	Mayor of Rogun	Represents affected people and pool of potential Project employees. Facilitator for local development opportunities.	Consultation meetings and workshops. Information dissemination in local government channels. Official letters and emails.
		Hukumats and Jamoats of all affected villages: ▪ Mujikharf; ▪ Khakimi; ▪ Qal'ai Surkh; ▪ Mehrobod; ▪ Nusratullo Maksum; ▪ Khumdon; ▪ Safedchashma; ▪ 10 Years of Independence; ▪ Jura Rahmonov;	Support for Project implementation at the local level, including allocation and withdrawal of land use rights. Protect the rights of inhabitants in the Project area. Represent local communities and PAPs. Receive and address any feedback and grievances from communities.	Face-to-face consultation meetings and workshops. Information dissemination in local government channels.

		▪ Buston; ▪ Obi Mehnat; ▪ Sicharogh; ▪ Navobod village; ▪ Boqi Rahimzoda; and ▪ I. Halimov.		
		Population of Rogun	Livelihood impacts (loss of land, assets, infrastructure etc.). Directly affected by the construction of civil works (noise, dust air quality), presence of work camps and influx of workers. May be affected by the long-term operations of the Vakhsh cascade principally by changes to water availability downstream of the dam(s). May be indirectly affected by economic development triggered by Rogun HPP. Receive the direct benefit of assured electricity supply after the Project is completed. Employment opportunities. Pressure on community services.	Regular face to face meetings and focus groups with individuals and communities, to ensure that local communities' concerns are understood. Bulletin updates about potential disruptions, health and safety risks and construction activities prior to any planned activities or changes.
		Resettled Communities	Physical and economic displacement due to being resettled . Livelihood Impacts (loss of land, assets, infrastructure etc.)	Monthly face-to-face meetings and focus groups with individuals and communities to ensure that local communities' concerns are understood. Frequent interactions with DLEOs as required throughout construction and operation to resolve grievances raised via the GRM.
		Host Communities receiving resettled households	Potential effects associated with the influx of resettled households on host communities. Concerns over increased pressure on local infrastructure and public facilities due to influx of resettled communities.	Regular face-to-face meetings and focus groups with individuals and communities to ensure that local communities' concerns are understood.

		Other Local Communities Living within the Project Area of Influence	Labor and service provision opportunities. Benefit from stable electricity supply. Positive and negative impacts associated with the development of the region. Livelihood impacts associated with rise in water levels e.g., recreational fishing. Potential impacts due to construction of associated facilities e.g., road closures.	Community consultations and town hall meetings. Project leaflets.
		Local Businesses	Economically interested business entities (conclusion of contracts, economic damage due to competition, etc.). Benefit from stable electricity supply.	Community consultations and town hall meetings addressing potential impacts on local enterprises. Project leaflets.
		Children and Young People	Risks associated with child labor, community resettlement and the relocation of schools.	Liaise with local universities on potential graduate employment opportunities and capacity building, where suitable attend careers fairs and face to face meetings.
		Women-Headed Households	Women-headed households may be more adversely impacted by the need to resettle and build their new houses, for example due to reduced ability to source labor from within the household if there are no or few adult males present. Women may have reduced input into decision making if consultations are not designed and scheduled to be convenient for both men and women in terms of timing and location. Women also have higher rates of economic inactivity and lower levels of higher education relative to men, and more likely to generate income from informal activities. The influx of Project workers also increases risks of Gender-based violence.	Women-only focus groups and consultations. Female focal points within each district to encourage women to raise any potential concerns.
		Persons with disabilities (incl. long-term chronic illness)	Engagement can be challenging as people with disabilities may be 'invisible' due to social taboos. Their physical and/or psychological conditions may require specific engagement methods.	Accessible engagement methods, such as providing written materials in accessible formats.

		Elderly People	Accessibility issues in relation to engagement. Particularly vulnerable during resettlement as they may have cultural ties and/or connections to the land.	Focus group discussions with visual aids and resources. Short radio programmes, video materials or documentary broadcasts on TV.
		Local CSOs	They often provide local support and services to help farmers/pastoralists and migrant workers' families, protect natural resources and cultural heritage. They also include farmers'/trade/artisans'/business cooperatives.	Community consultations and town hall meetings. Focus group discussions, Face-to-face meetings.
International Finance Institutions and Donors	Other Interested Parties	World Bank European Investment Bank European Union Asian Infrastructure Investment Bank Asian Development Bank Islamic Development Bank Eurasian Development Bank Kuwait Fund for Arab Economic Development Saudi Fund for Development Qatar Fund for Development OPEC Fund for International Development	Interested in the successful development of the Project and the achievement of development goals. Potential financial support and funding of the Rogun HPP and supervision of compliance with applicable international EHS standards.	Bi-annual/periodic virtual meetings, emails, and occasional face-to-face meetings to discuss updates on Project development.
Other relevant parties	Other Interested Parties	International NGOs and National NGOs	Monitor Project performance in areas of their respective concerns. Represent the interests of different interested parties. Concerns over ensuring the protection of biodiversity, human rights, labor rights etc.	Liaise face to face with NGOs on social issues such as health, safety, security, local livelihoods, gender-based violence and sexual exploitation and abuse and sexual harassment. Sharing draft ESIA and other environmental and social reports for feedback.
		Subject Matter Experts (e.g., Academics and Journalists)	Scientific understanding of the potential concerns regarding environmental and social impacts associated with the Project. Potential educational/outreach	Regular press releases to disclose Project information.

			opportunities to increase awareness and acceptance of the Project.	Post regular updates on Project website.
		Mass Media	Intermediaries for informing the general public about planned activities and information disclosure concerning Project developments.	
		International Hydropower Association (Industry Peers, Competitors, and Associations)	IHA champions best sustainable practices within the hydropower sector through advocacy, research and policy initiatives. IHA members include the world's leading hydropower developers, operators and manufacturers. Additionally, the IHA developed its own sustainability standards in 2021. Therefore, the IHA sustainability standards can be a helpful reference for the Rogun HPP.	Roundtables and press conferences on Project updates. Sharing draft ESIA reports for feedback.

6.6 STAKEHOLDER ENGAGEMENT CONDUCTED TO DATE

6.6.1. The Project has been under development since the 1980s and the current phase of the Project commenced in the mid-2010s. Before 2011, the Resettlement Unit managed the resettlement program of the Project and led a series of community consultations as part of the process. However, prior to the formation of DFZ in 2011, limited stakeholder engagement records are available. Nonetheless, it is clear the Project has been and is well-known to people throughout Tajikistan due to its strategic importance and scale.

6.6.2. Since its official formation in 2011, DFZ has undertaken a series of consultation meetings with communities affected by resettlement between 2011 and 2025. No consultations were conducted during 2020 due to COVID-19 related restrictions. In addition to Project-affected people, engagement has also been carried out with NGOs, CSOs, Riparian governments, local authorities, national authorities and International Finance Institutions.

6.6.3. **Table 6-3** summarizes engagement with stakeholders that has been conducted to date, including by DFZ, under the 2014 ESIA and TEAS and under the updated ESIA and RPF (2022-2024). Detailed summaries and records of all engagement sessions conducted to date are presented in full in the Project SEP, which was updated and re-disclosed in May 2025.

Table 6-3 – Summary of Stakeholder Engagement

Past and Ongoing Stakeholder Engagement

Timeframe	*Information Source*	*Stakeholders*	*Information Conveyed / Primary Concerns*
2011-2014	2014 ESIA and TEAS	Affected people, authorities, interested parties, Lenders	Under the previous WB TA and the 2014 ESIA and TEAS, an RPF and associated action plans were developed to guide the resettlement of communities. Under this framework, the first resettlement action plan (RAP), RAP 1, was developed to guide resettlement activities. 2017-2026 RAP 2 is being finalized.
		Riparian governments and CSOs	A series of ESIA consultation meetings with representatives of the governments of riparian countries and with domestic and international Non-governmental Organizations were undertaken. The main topics of concern focused on: Resettlement; Alternatives; Agreement and practice on the Amu Darya; Operation of Rogun; Nurek HPP; Climate change; Aral Sea; Construction and completion; Dam safety; Geological structure and seismicity; and

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Past and Ongoing Stakeholder Engagement

			Technical questions.
	2014 RAP1	Project-affected people	A program of stakeholder engagement was undertaken during RAP 1 resettlement, including consultation with PAPs during RAP 1 to consider their views and to provide them with a choice of prepared resettlement sites. The active participation of PAPs was essential for resettlement site selection, community infrastructure and amenities planning and construction, and crop and tree value assessments. The key risks highlighted by communities include the following: Concerns over availability and timing of public infrastructure (e.g., schools, roads, mosques, cemeteries, libraries, sports fields) and utilities (e.g., electricity, drinking water, irrigation water) in new settlements; Compensation amounts, adjustments (e.g., in line with changing item costs and inflation), and payment schedule; Amount of agricultural land being provided in resettlement locations for themselves and family members; Livelihood restoration requests, such as building of bakeries and workshops for sewing; and Low incomes of certain impacted households and registration for social support services.
2021-2024	Initial technical assistance / planning	National authorities, International Financial Institutions	Throughout the period of 2021-2024, representatives from the WB and Rogun engaged with various stakeholders. These engagements include: National Authorities: Meetings were held between September and November 2021 with key officials such as the President of Tajikistan, Prime Minister, Deputy Prime Ministers, Minister of Finance, Minister of Energy and Water Resources, Director of Rogun JSC, Director of PMG, and technical staff. These discussions primarily focused on technical studies and financing for the dam; and International Finance Institutions (IFIs): Technical discussions involving the Project have taken place with institutions such as the European Union, EIB, AIIB, ADB, USAID and US Embassy, IsDB, Islamic Corporation for the Development of the Private Sector, EDB, KFAED, Saudi Fund for Development, UK Foreign, Commonwealth and Development Office, EBR, and KfW. During the consultations, the National Authorities were interested to find out from international Lenders their willingness to cooperate and

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			provided information as needed in the interest of complying with national laws. The prospective Lenders were interested in the development and status of the Project, including initial conclusions regarding potential E&S impacts and plans for development of the updated ESIA and the updated 2017-2025 Phase 2 RAP and LRP.
	2023 ESIA and updated 2017-2026 RAP2	International and national stakeholder groups	Engagement sessions have also been conducted with international and national stakeholder groups. This includes: Deputy Mayor of Rogun and members of the cabinet at the Mayor's Office; Rogun JSC; Representatives of women's NGOs active in Tajikistan on the potential role of district level and Jamoat level women councils in increasing women's voice for the Project and sharing information about the Project and its opportunities; UN Women; Committee of Women and Family Affairs; State Committee of Land and Geodesy; State Investment Committee/Bureau of Technical Inventory; Ministry of Labor, Migration and Employment; and Committee for Environmental Protection under the Government of the Republic of Tajikistan.
		Affected people	A series of consultation meetings to disclose the draft ESIA for public review and comment were conducted between the 13th – 17th of January 2024. In total, 9 public disclosure meetings were held in Dushanbe and within the Project affected districts. Some of the key feedback included: Requests for additional female focussed livelihood restoration measures to enhance the employment opportunities for resettled women, including sewing workshops. Queries over when the road conditions will be improved on the roads between Faizobod and the resettlement villages which have deteriorated due to Project trucks. Some resettled communities stated that they have not been provided with the infrastructure promised, including local schools and water supply. In Dangara, some resettled persons have still not received land certificates, 10 years after they initially received this land.

			Additional information was requested on the filling of the reservoir and whether climate risk factors have been considered, such as the rate of evaporation and reduced rainfall affecting the viability of Rogun HPP.
		Project workers	In March 2023, a labor audit was completed to assess the labor and working conditions of the Rogun HPP. The assessment involved engagement and interviews with Contractor and Subcontractor HR Managers, Project Managers and Directors, from 22 contractors that were active on the Rogun construction site, and also interviews of workers. During the consultations, key topics discussed included workforce statistics, labor contracts, labor management systems, collective bargaining, company policies, supply chain management, worker facilities and monitoring and reporting requirements. Informal worker focus groups were also held to allow workers to provide feedback on the labor conditions and facilities provided. The following is a summary of the key topics raised during the labor audit: Overall satisfaction among workers with their wages, which exceed the national minimum and are deemed favorable in the current labor market. Some instances of delayed payments of wages by a number of contractors. Unexpected expenses for a number of workers on transportation and food.
		Riparian governments and CSOs	On the 8th and 9th of November 2023, following disclosure of a preliminary draft ESIA, PMG hosted consultation meetings with international stakeholders in Almaty, Kazakhstan. For the meeting on the 8th, PMG issued invitations to all riparian countries, including Afghanistan, Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan. For the meeting on the 9th, PMG invited regional Civil Society Organizations (CSOs). The purpose of these consultations was to disclose the findings and recommendations of the updated ESIA and obtain feedback from the riparian nations and CSOs. Key concerns raised during these consultations included: Concerns surrounding the management of the resettlement process; Potential reduction of downstream water flows resulting in adverse effects for livelihoods and economies dependent on adequate summer water flows for agriculture and managed winter flows to prevent flooding;

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			Concerns over water quality due to potential land contamination associated with the Rogun HPP operations; Concerns over the seismic and other risks that could lead to downstream flooding; Plans for a cascade failure emergency warning system; and Concerns over the appropriate management of gender issues and working conditions during the construction activities of the Rogun HPP. A riparian consultation was held in Tashkent, Uzbekistan in October 2024, involving Uzbek government and CSO representatives. Discussions focused on Rogun's impact on downstream water flows and supply, as well as managing any impacts associated with a failure of the cascade.
		Project-affected people	A series of focus group discussions were undertaken while the household socio-economic surveys were being undertaken in July and August 2023. There discussions are summarized in the Resettlement and Livelihood Restoration Framework (RLRF) (2024).
	2024 RLRF, 2017 RAP2/LRPs	Project-affected people	In September 2024, additional engagement sessions were held with resettled communities, host communities and to be resettled communities. Key issues raised during the meetings included: Identification of new vulnerable groups (orphans, psychiatric patients) for which relocation will be challenging due to the vulnerability of the service users, and challenges around maintaining staffing levels if the new location is not accessible to previous workers and/or key workers from resettled communities are resettled far away, and suitable new workers cannot be found. Some smaller settlements are scheduled for resettlement significantly later than larger 'hub' settlements which they depend on. The living standards of some to be resettled communities are higher than in the communities resettled to date, so maintaining / improving quality of life after resettlement may be more challenging and expensive (due to higher replacement cost of homes) once resettlement begins in this area. There is a risk of road severance in Kamar Ob Valley if the road constructed does not include slip roads which are accessible to people within the valley. In some resettlement areas, key infrastructure and services such as schools and roads are

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			incomplete, posing health and safety risks to the communities.

6.7 SUMMARY OF KEY ISSUES

Resettlement Issues

6.7.1. The stakeholder engagement process to date has yielded valuable information regarding RAP implementation, GRM implementation, resettlement impacts including on vulnerable groups, and land allocation and compensation for PAPs. The following key issues and themes identified across the process so far are:

- Level of engagement with communities not affected by the resettlement program;
- Impacts of the resettlement program;
- Land allocation and compensation; and
- Infrastructure, utilities, and services.

Engagement with Communities not Affected by the Resettlement Program

6.7.2. Engagement to date conducted by DFZ has primarily focused on communities directly impacted by the resettlement program. However, there has been limited engagement undertaken with other potentially affected communities, including within the buffer zone.

Impacts of the Resettlement Program

6.7.3. Challenges associated with the construction of houses in relocation settlements have been highlighted by resettled persons during consultation meetings. This includes poor quality roads, the availability, and transportation, of construction materials (such as sand and gravel), and accessibility issues. DFZ addressed these issues with specific resettled communities by providing machinery for communities to use, including an excavator for transporting sand and gravel, ensuring suitable transportation provisions, and enhancing access roads (including providing iron sheets for channel crossings). The GRM provides a channel for future complaints to be raised and aims to ensure that all Project-related issues are resolved in a timely manner.

6.7.4. A small number of women affected by resettlement, who are the heads of their household, were concerned over the provision of support to construct their new homes. However, the Jamoats have arranged for local contractors in the communities to provide construction assistance to women-headed households throughout the construction of their new homes. Ongoing engagement with vulnerable groups will be facilitated by DFZ to ensure minimum impact on these groups.

Land Allocation and Compensation

6.7.5. During consultation meetings, PAPs questioned the land plot allocation process and economic impact reimbursement. Concerns have been raised regarding compensation amounts, adjustments (e.g., in line with changing item costs and inflation), and the payment schedule. In 2024 the one-time transitional allowance paid to resettlers was increased to account for inflation (for the first time since it was introduced in 2009). With regard to land issues, some PAPs have expressed concern about the amount of agricultural near the towns and villages to which they have resettled. In some cases, agricultural land may not be available in the immediate resettlement area. DFZ and its resettlement

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consultants have been engaging with resettled communities to provide up-to-date information on the Project, land acquisition process and RAP studies, and to identify compensation and resettlement assistance requirements (please see RAP 2).

Infrastructure, Utilities and Services

6.7.6. At some of the relocation sites, communities who were initially relocated under the first stages of RAP 2 experienced issues with water and electricity supply. However, these issues have since been addressed and no recent reports of insufficient utilities have been raised during recent engagement.

6.7.7. Some resettled communities have also raised concerns over the availability and construction progress of public infrastructure (e.g., schools, roads, mosques, cemeteries, libraries, sports fields) and utilities (e.g., electricity, drinking water, irrigation water) in the new relocation settlements. Follow up consultations and discussions with district authorities concerning infrastructure development have ensured that affected communities remain informed about that construction progress and utilities at relocation sites. In some instances, temporary facilities have been provided when construction delays have meant new facilities are not ready in time for resettlers (e.g. the provision of temporary classrooms).

General Attitude towards the Project

6.7.8. Overall, while there have been complaints and issues relating to the resettlement process and other matters, resettled communities, host communities and local stakeholders are also positive about the Project. Residents and businesses are positive towards the benefits that the Project will bring, including stable electricity supply, particularly during winter months, improved road conditions and updated public infrastructure services.

Further information will be provided to potentially affected persons during continuous engagement and during the ESIA disclosure period. Following SEP implementation, the stakeholder engagement process will also continue throughout the construction and operation of the Project.

Non-Resettlement Related Issues

6.7.9. In addition to engagement associated with the resettlement process, the engagement that has been undertaken with CSOs, NGOs, local and national authorities, Riparian Governments and International Finance Institutions has also contributed to an enhanced understanding of the Project. key themes and issues. Key themes and concerns raised during consultations with Riparian governments and CSOs included:

- Potential reduction of downstream water flows resulting in adverse effects for livelihoods and economies dependent on adequate summer water flows for agriculture and managed winter flows to prevent flooding;
- Concerns over water quality due to potential land contamination associated with the Rogun HPP operations;
- Concerns over the seismic and other risks that could lead to downstream flooding;
- Plans for a cascade failure emergency warning system; and
- Concerns over the appropriate management of gender issues and working conditions during the construction activities of the Rogun HPP.

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6.8 STAKEHOLDER ENGAGEMENT PROGRAM

6.8.1. In addition to the previous stakeholder consultation and engagement undertaken for the Project (as summarized in **Section 6.7**), PMG and DFZ will disclose relevant information about the Project during the disclosure period (dates to be determined), and ongoing as the Project evolves.

6.8.2. The Project will have one DFZ-assigned District Livelihood and Engagement Officer (DLEO) and one supporting Engagement Officer (one male and one female) for each affected district (Rasht, Rogun City, Nurobod, Faizobod, Tursunzoda, Danghara, and Rudaki) to ensure regular consultation (visiting, and leading consultations in, each village on a monthly basis) and interaction with affected local communities. The appointment of female DLEOs on the Project will facilitate women in the local community directly approaching the DLEOs in relation to any concerns. The DLEOs will report to DFZ's Senior Community Relations Manager, who will report to PMG's Stakeholder Engagement Lead. PMG's Stakeholder Engagement Lead will have overall responsibility for;

- All external stakeholder (including the general public) engagement activities;
- The implementation and management of the Project Grievance Redress Mechanism (GRM); and

6.8.3. Monthly reporting on all Project-related grievances to PMG senior management.

6.8.4. The Project will use different consultation approaches and methods for different stages of the Project activities and stakeholder groups. The stakeholder engagement activities that will be undertaken throughout the Project lifecycle are presented in Table 6-4 below.

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Table 6-4 - Stakeholder Engagement to be Undertaken

Activity	Stakeholders	Information Materials	Timeframe / Frequency	Responsibility	Location
Project Implementation Phase					
Using the Project disclosure website, hosted on the PMG website, provide: ▪ Disclosure documents (available in Tajik, Russian & English); ▪ A mini video / webinar which is recorded in Tajik, Russian & English; ▪ A feedback form / form to submit questions; ▪ DFZ DLEO contact details; ▪ Information on the GRM; and ▪ Responses to frequently asked questions (to be updated throughout disclosure). This website will be advertised by means of: ▪ Notices provided to the District and Jamoat offices, and circulated to Makhallas; ▪ Notice boards in affected community centers, such as halls, schools, tea houses and mosques; ▪ SMS messaging, (which will contain links to the website, DFZ DLEOs' contact details, and advice as to how to obtain hard copies of disclosure documentation); ▪ Rogun HPP Twitter account and Rogun HPP Facebook account; ▪ Press conference; and ▪ TV, radio, and local newspaper adverts.	All	▪ ESIA (including ESMP); ▪ Non-technical Summary (NTS); ▪ SEP (this document); and ▪ RPF.	At time of ESIA disclosure	PMG Stakeholder Engagement Lead DFZ DLEOs	▪ PMG office; ▪ DFZ offices; ▪ PMG website: http://energyprojects.tj
DFZ to appoint 1 Senior Grievance Manager to oversee all community grievances. DFZ to allocate 1 DLEO and 1 supporting engagement officer (1 male and 1 female) for	Affected Communities	▪ Project Leaflets; ▪ Posters; ▪ NTS; and ▪ SEP.	Upon approval of international financing	DFZ	▪ DFZ office.

Activity	Stakeholders	Information Materials	Timeframe / Frequency	Responsibility	Location
ongoing Project consultations and to manage community grievances relating to the Project, for each of the following districts: ▪ Nurobod; ▪ Rogun; ▪ Rasht; ▪ Faizobod; ▪ Tursunzoda; ▪ Danghara; and ▪ Rudaki. These individuals should have experience in dealing with stakeholder engagement and community grievances.					
Place hard copies of Project leaflets and documentation within all affected settlements (resettled communities, communities to be resettled, host communities, and other affected communities within the Project Area of Influence). Hard copies to be displayed on notice boards and made available in community hubs, including halls, mosques, and tea houses, affected municipality offices and local DFZ offices. To be distributed by the DLEOs in liaison with Jamoats. A minimum of 3 hard copies of the NTS, SEP & RLRF will be retained at DFZ offices, and extra copies will be made available if affected people would like to take a copy with them.	Affected Communities	▪ Project Leaflets; ▪ NTS; ▪ RLRF; and ▪ SEP.	At time of ESIA disclosure	DFZ DLEOs	▪ Notice boards (with visual aids) in all affected communities within the Rasht, Rogun City, Nurobod, Faizobod, Tursunzoda, Danghara, and Rudaki districts. ▪ TV broadcasts / Radio / Newspaper.
Hold public consultation meetings for host communities, affected businesses and other affected communities within the Project area. These consultations will present: ▪ Project construction updates;	Affected Communities / Businesses	▪ Project Leaflets; ▪ ESIA (including the ESMP); ▪ NTS; ▪ SEP;	At time of ESIA disclosure	DFZ DLEOs PMG Stakeholder Engagement Lead	All affected communities within the Rasht, Rogun City, Nurobod, Faizobod, Tursunzoda, Danghara,

Activity	Stakeholders	Information Materials	Timeframe / Frequency	Responsibility	Location
▪ GRM; ▪ Temporary impacts (traffic, noise, vibration, dust etc.); and ▪ Restrictions or diversions caused by Project-related activities. All consultations and meeting minutes should be recorded.		▪ RLRF; and ▪ Maps (showing potential locations of diversions and environmental constraints)			and Rudaki districts; and DFZ office and website.
Hold public consultation meetings and a series of focus groups for resettled people in the following more significantly affected communities: ▪ Chorsada; ▪ Aligalaboni Poyon; ▪ Sicharogh; ▪ Talkhakchashma; ▪ Tagi Agba; ▪ Tagi Kamar; ▪ Mirogh; ▪ Chanor; ▪ Saripul Yak; ▪ Khakimii Bolo; ▪ Khakimi Miyona; ▪ Khakimii Poyon; ▪ Obiboriki Bolo; ▪ Roghuni Poyon; ▪ Aligalaboni Bolo; ▪ Bedikho; ▪ Lughuri Poyon; ▪ Saidon (Khodzhaalisho); ▪ Qal'ai surkh; ▪ Kaznok; ▪ Mujikharfi Mayda; ▪ Devlokhak; ▪ Dehai Shokh; ▪ Ayni; ▪ Dushokhazamin; ▪ Dakhana; ▪ Dakhani Gumush; ▪ Kh. Sherozi; ▪ Kavlokho; ▪ Magzori Sir; ▪ Labi Jar; ▪ Yusti Poyon; ▪ Yusti Bolo; ▪ Yakhak; ▪ Iston; ▪ Ayni-Khojaayni; ▪ Miyondara; ▪ Sari Dzhu; ▪ Zoroni Kalon; ▪ Mehrobod (formerly Komsomolobod);	Resettled Communities / to be Resettled Communities	▪ Project Leaflets; ▪ ESIA (including the ESMP); ▪ NTS; ▪ SEP; and ▪ RLRF.	At time of ESIA Disclosure	DFZ DLEOs	All resettled/ to be resettled communities in Nurobod, Rogun and Rasht.

Activity	Stakeholders	Information Materials	Timeframe / Frequency	Responsibility	Location
▪ Kachamandi; ▪ Bini Sufiyon; ▪ Sangi Maliki; ▪ Shulmak; ▪ Shule; ▪ Yashm; ▪ Shohindara; ▪ Pojei Bolo; ▪ Pojei Poyon; ▪ Navobod; ▪ Amirbek Village; ▪ Navdonak; ▪ Sari Kosh; ▪ Mujikharfi Kalon; ▪ Pandovchii Dekhi-Khochi; ▪ Pandovchii Sari Dasht; ▪ Zarda; ▪ Dehai Gulmon; ▪ Loyoba Village; ▪ Yakhch; ▪ Zoroni Mayda; ▪ Shahtuti Miyona; ▪ Shahtuti Poyon; ▪ Khasandara; ▪ Kofara; ▪ Sangdevor; ▪ Novako; ▪ Sangi Kar; and ▪ Yapoloki ▪ The number of focus groups will be increased, if necessary, to ensure that all those interested in attending are able to participate.					
Implement and undertake RAP, including: ▪ Appropriate distribution of the RAP and ESIA disclosure; ▪ Negotiation with landowners and users (formal and informal) to agree entitlements and compensation amounts, in line with the RAP; ▪ Continue consultation with PAPs to ensure effective compensation disbursement; ▪ Further consultation during legal challenges, if required; ▪ Consultation stipulated as part of the GRM;	Affected Landowners and Formal / Informal Users	▪ RLRF; and ▪ ESIA.	Throughout resettlement program (RAP 2 and subsequent RAPs)	DFZ DFZ DLEOs	▪ DFZ offices; ▪ Affected municipality offices; and ▪ Affected Hukumat and Jamoat, administrations.

Activity	Stakeholders	Information Materials	Timeframe / Frequency	Responsibility	Location
▪ Consultation to inform update Project schedule and progress; ▪ Consultation with PAPs as part of effective RAP monitoring; and ▪ Final evaluation of RAP implementation (completion audit).					
Develop and implement an online GRM form available to the public.	All	GRM (and related forms)	At time of ESIA disclosure	PMG Stakeholder Engagement Lead	▪ PMG website.
Conduct consultations with Riparian States, including one virtual scoping meeting prior to the ESIA disclosure period and one in-person consultation at the time of ESIA disclosure.	Riparian States	▪ Project Leaflets; ▪ ESIA; ▪ SEP; and ▪ GRM.	At time of ESIA disclosure.	PMG Stakeholder Engagement Lead	▪ Virtual / in-person consultation.
Conduct roundtables and press conferences on Project updates, including: ▪ Project schedule; ▪ Project development / progress; ▪ Impact management; ▪ GRM; and ▪ Notification of forthcoming major events or commencement of specific Project activities. Electronic publications and press releases to be shared on the Project website.	Riparian States International NGOs	▪ Project Leaflets; ▪ ESIA; ▪ SEP; and ▪ GRM.	Throughout construction period biannually	PMG Stakeholder Engagement Lead	▪ Virtual / in-person conference; ▪ Radio / newspaper / TV; ▪ PMG website; and ▪ Rogun HPP / PMG social media (such as Twitter and Facebook).
Conduct public meetings, prepare press releases on Project updates, including: ▪ Project schedule; ▪ Project development / progress; ▪ Impact management; ▪ GRM; and ▪ Notification of forthcoming major events or commencement of specific Project activities.	Local NGOs / Community-Based Organization; and Public.	▪ Project Leaflets; ▪ ESIA; ▪ SEP; and ▪ GRM.	Throughout construction period biannually	PMG Stakeholder Engagement Lead	▪ Public venues; ▪ Notice boards in public venues (mosques, libraries, offices of local administrations and NGOs); ▪ Radio / newspaper / TV;

Activity	Stakeholders	Information Materials	Timeframe / Frequency	Responsibility	Location
Summary of hearings to be presented on short radio programs and broadcasted on TV. Dissemination of hard copies at designated public locations.					▪ PMG website; and ▪ Rogun HPP / PMG social media (such as Twitter and Facebook).
Submit official letters and emails to the relevant National Government Authorities as required. Facilitate biannual face-to-face meetings with National Government Authorities to discuss regulations, permitting and updates on Project development.	▪ Committee for Environment Protection Under the Government of Tajikistan; ▪ Ministry of Finance; ▪ Ministry of Health and Social Protection of Population; ▪ Ministry of Energy and Water Resources; ▪ Ministry of Economic Development and Trade; ▪ MLMEP; and ▪ Ministry of Agriculture.	ESIA (including the ESMP).	During Construction (as required)	PMG Contractors (where required)	▪ Committee for Environment Protection Under the Government of Tajikistan; ▪ Ministry of Finance; ▪ Ministry of Health and Social Protection of Population; ▪ Ministry of Energy and Water Resources; ▪ Ministry of Economic Development and Trade; ▪ MoLMEP; and ▪ Ministry of Agriculture.

Activity	Stakeholders	Information Materials	Timeframe / Frequency	Responsibility	Location
Consult and collaborate with local emergency services.	Local Emergency Services	EPF	Throughout construction and operation	PMG Stakeholder Engagement Lead Rogun JSC	Local Emergency Services (fire stations and police stations).
Conduct women-only focus groups and workshops to ensure that women's views are considered and to share details of gender-sensitive GRM. Seek specific feedback from women on their desires in terms of employment, skills and training and preferences around vocations.	▪ Women employed in Project structures; ▪ Women in host communities; ▪ Women who have/will be resettled; and ▪ Women in rural areas of the wider Project area.	GAP	During construction, approximately biannually	Female Gender Focal Points from Rogun JSC Female DLEOs	All affected communities within the Rasht, Rogun City, Nurobod, Faizobod, Tursunzoda, Danghara, and Rudaki districts.
Facilitate focus groups and workshops for affected vulnerable groups and facilitate ongoing consultation with vulnerable PAPs. Inform about Project benefits, grant opportunities and available support services.	Vulnerable Groups (including minorities, people living with disabilities and the elderly).	▪ Project Leaflets; ▪ ESIA (including the ESMP); ▪ NTS; ▪ SEP; ▪ RLRF; and ▪ Visual aids.	During Construction Regularly, as needed	DFZ DLEOs	▪ DFZ office; ▪ Affected municipality offices; ▪ Affected Jamoat offices; and ▪ Easily accessible community spaces in affected communities within the Rasht, Rogun City, Nurobod, Faizobod, Tursunzoda, Danghara, and Rudaki districts.

Activity	Stakeholders	Information Materials	Timeframe / Frequency	Responsibility	Location
Formally consult and coordinate with the Academy of Sciences of the Republic of Tajikistan (the A. Donish Institute) to provide supervision regarding potential heritage assets.	Academy of Sciences of the Republic of Tajikistan (the A. Donish Institute).	▪ ESIA (including the ESMP); and ▪ Construction Program.	During Construction (as required)	PMG Stakeholder Engagement Lead DFZ DLEOs Contractors (where required)	▪ PMG office; ▪ DFZ office; and ▪ A. Donish Institute.
Benefit sharing consultation focus groups to discuss and record benefit sharing opportunities and challenges to implementing the Benefit Sharing Program.	Local communities and PAPs, Ministry of Finance; Ministry of Health and Social Protection of Population; MLMEP; National NGOs	▪ Benefit Sharing Program; and ▪ SEP.	During construction (as required).	PMG Stakeholder Engagement Lead DFZ DLEOs	Easily accessible community spaces in affected communities within the Rasht, Rogun City, Nurobod, Faizobod, Tursunzoda, Danghara, and Rudaki districts.
Provide employment advertisements and advertisements for local employment fairs on Rogun HPP and MLMEP websites, on municipality offices bulletin boards and consult with Jamoat Heads on the Project employment opportunities. Where possible, promote women's involvement in the Project. Liaise with local universities on potential graduate employment opportunities and capacity building, where suitable attend careers fairs and face to face meetings.	Local Communities PAPs Local businesses Contractors	▪ Employment Adverts; and ▪ Local Procurement and Employment Plan	Monthly throughout Construction	Rogun JSC Contractors DFZ DLEOs (to connect those seeking employment e.g. vulnerable groups with hiring companies)	▪ Contractor website; ▪ Municipality offices notice board; ▪ Employment fairs; ▪ Affected Jamoat community notice boards; and ▪ Radio / newspaper / local TV.
Conduct regular meetings with Project employees and provide bulletin updates (via email, SMS &	Project workers	▪ Project leaflets; and ▪ Staff Handbook.	During construction (monthly)	Rogun JSC Contractors	▪ Rogun JSC offices;

Activity	Stakeholders	Information Materials	Timeframe / Frequency	Responsibility	Location
notice boards) on Project developments and Worker's GRM.					▪ Worker accommodation camp notice boards; ▪ On-site notice boards; ▪ Emails; and ▪ SMS messaging.
Post hotline number for reporting gender-based violence and harassment.	Local Communities Project workers	▪ Hotline Leaflet.	At time of ESIA disclosure	DFZ DLEOs Rogun JSC Contractors	▪ Worker accommodation notice boards; ▪ Construction site notice boards; and ▪ Affected Jamoat village notice boards.
During Operation					
Conduct round tables, prepare press releases for all stakeholders to sum up results of Project. Disclose information about the Project operation program, benefits, risks, health and safety signs. Information to be presented in Russian, Tajik and English for local, national, and international stakeholders.	All Stakeholders / Public	▪ Leaflets; ▪ Advertisements; ▪ Announcements; ▪ Link to online monitoring system for the Vakhsh Cascade; and ▪ Maps.	Six months prior to commissioning	PMG Stakeholder Engagement Lead	▪ Affected Jamoats; ▪ Affected Districts; ▪ Notice boards in public venues (mosques, libraries, offices of local administrations); ▪ Radio / newspaper / TV; ▪ PMG website; and ▪ Rogun JSC / PMG social media (such as Twitter and Facebook).

Activity	Stakeholders	Information Materials	Timeframe / Frequency	Responsibility	Location
Undertake regular community meetings with communities around the reservoir to monitor ongoing impacts of the Project, changes in quality of life and implementation of Project community development activities.	Communities surrounding the reservoir	▪ Community development plans; and ▪ ESMP.	Annually during operation	DFZ DLEOs	Buffer zone communities.

6.9 BENEFIT SHARING CONSULTATION

6.9.1. The Project will implement a Benefit Sharing Program to maximize the development impact of the dam for stakeholders living in the AoI. The program will focus on community development and poverty alleviation, complementing the livelihood restoration activities planned in the LRPs to accompany the RAPs. Consultation with communities that are directly and indirectly affected by the dam alongside broader members of civil society to discuss benefit sharing opportunities will be undertaken (see the Project **SEP** for full details on consultations under the Benefit Sharing Program).

6.10 CITIZEN ENGAGEMENT

6.10.1. Citizen engagement, as defined by the WBG, involves two-way interaction between citizens and the government to identify methods for the inclusion of citizens and to assess priorities for intervention, design, and implementation of the Project and to improve its outcome[3]. Citizen engagement plays a critical role in advocating for the transparency and accountability of public institutions and the effectiveness of solutions implemented. Further details on citizen engagement as part of the Project are presented within the accompanying **SEP**.

6.11 GRIEVANCE MECHANISM

6.11.1. A Grievance Redress Mechanism (GRM) has been developed to ensure the timely and successful resolution of stakeholder concerns, as well as to monitor the Project's relationship with stakeholders throughout the Project lifecycle. The GRM includes the processes of receipt, acceptance, investigation, resolution, and closure of operational issues, concerns, problems, or grievances (after this, referred to as "grievances").

6.11.2. This GRM is only for the external stakeholders affected by the Rogun HPP, not the Rogun HPP employees or workers. A separate internal GRM for employee and labor-related grievances is in place for use by employees of PMG, Rogun JSC, DFZ, and contractors. The worker GRM is detailed in the **Labor Management Procedures** (LMP).

6.11.3. Purpose and Principles of the Grievance Mechanism

The purpose of the present GRM is to:

- Ensure that issues raised by stakeholders are addressed in a credible, predictable, transparent, and fair way;
- Provide prompt resolution to grievances;
- Ensure that concerns and grievances of vulnerable groups, who often lack access to legal processes and grievance procedures, are addressed; and
- Increase accountability to stakeholders.

[3] Strategic framework for mainstreaming citizen engagement in World Bank Group operations (2014): engaging with citizens for improved results: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/266371468124780089/strategic-framework-for-mainstreaming-citizen-engagement-in-world-bank-group-operations-engaging-with-citizens-for-improved-results

The GRM is based on the following fundamental principles:

- **Accessibility:** The GRM must be readily available to all external stakeholders, considering confidentiality, legal obligations, and the vulnerability of individuals.
- **Accountability:** Ensure that members of the affected community know who is responsible for the GRM.
- **Awareness:** Stakeholders must know the GRM and receive report on its implementation regularly.
- **Communication:** Provide grievants with prompt and continuing updates on the progress in addressing the grievance, including the reasons for any delays.
- **Cultural sensitivity**: Existing lines of communication using the Mahalla and Jamoat representative systems will be used for raising and resolving grievances, and communications will be in Tajik and Russian.
- **Effective and efficient**: Address grievances effectively, promptly, discretely, objectively, sensitively, responsively, and transparently.
- **Freedom from reprisal**: Participants in the GRM must be free from reprisal, whether from authorities, Rogun HPP, DFZ, communities, or other community members.
- **Impartiality**: Those who are responsible for addressing grievances must not have any reason to favour one solution over another, or one party over another, and no outside parties must be permitted to interfere with the grievance resolution process.
- **No cost**: Grievances must be resolved at no cost to the party that originated the issue or concern.
- **No limitation in civil or legal rights**: Participation in a GRM shall not prevent or hinder a grievant' s right to other judicial, administrative, civil, or traditional remedies.
- **Confidentially**: All grievances shall be treated confidentially throughout the process, with no one not involved in addressing the grievance receiving any information at all.
- **Quick responses**: Address grievances as quickly as possible, with a maximum of 30 days unless there is no alternative.

6.12 PROJECT GRIEVANCE MECHANISM PROCEDURE

6.12.1. PMG and DFZ have initiated a formal project-specific grievance (complaint) procedure to receive the affected communities' and stakeholders concerns and views. The complaints procedure is being used as a tool to assist the timely and successful resolution of stakeholder concerns, as well as to monitor the Project's relationship with the affected community during the different phases of the Project.

6.12.2. The GRM process follows a two-tiered process:

- **Tier 1 -** Tier 1 is the initial process where the Rogun HPP and the grievant are in direct consultation. Tier 1 of the grievance mechanism is an internal process where the grievances are addressed and resolved directly by the Rogun HPP in consultation with the grievant.

- **Tier 2 -** The grievance procedure moves to the Tier 2 level if no mutually satisfactory resolution is found. The Tier 2 process involves third parties, where the participants agree on the process, the parties involved, and the remedies available.

6.12.3. Details of the grievance procedure have been disseminated in English, Russian and Tajik. Information about the existence of the grievance mechanism will be readily available to all communities in all Jamoat offices, the offices of PMG, Rogun JSC, and DFZ, at the HPP construction site gate, and in affected municipality offices. Additionally, GRM posters will be displayed at key locations within the Project affected communities.

6.12.4. It must be underscored that participation in a GRM shall not prevent or hinder a complainant's right to other judicial, administrative, civil, or traditional remedies. The grievant can stop participating in the GRM at any time and elect to follow other remedies.

6.12.5. **Grievance Channels**

6.12.6. The Project grievance procedure (**see Figure 6-3**) builds on the existing communication methods and channels used by communities to raise grievances. The District Livelihood and Engagement Officers (DLEO's), supported by the Senior Grievance Manager (SGM), are responsible for managing all resettlement-related grievances, whilst the PMG Stakeholder Engagement Lead manages all other grievances. Affected community members can raise Project-related grievances through the Jamoats or the DLEOs. All Project-related grievances communicated to Jamoats are reported to the DLEOs who are responsible for recording the grievance in the logbook. The DLEOs share the GRM with the heads of the Jamoats and explain the process, ensuring the Jamoats record all the necessary information which is then communicated to the DLEO to be formally recorded. The SGM monitors and oversees this process.

6.12.7. The PMG Stakeholder Engagement Lead is responsible for collecting and managing grievances from all other stakeholders, such as NGOs or Riparian representatives. All sensitive grievances, such as those relating to sexual harassment, are directed to and managed by a Third-Party Sensitive GRM Officer. Figure 5 presents a summary of the different grievance communication channels for all the Project stakeholders. Further information on the specific roles and responsibilities associated with grievance management is detailed in Table 6-5.

6.12.8. **Tier 1 Approach**

6.12.9. Tier 1 of the GRM is an internal process where grievances are addressed and resolved directly by the Rogun HPP in consultation with the grievant. The underlying assumption of the Tier 1 process is that the grievance will be addressed to the satisfaction of all parties.

6.12.10. The Tier 1 approach includes:

- A unilateral resolution, where Rogun HPP provides an acceptable solution.
- A bilateral approach, where Rogun HPP and the grievant resolve the grievance through discussion or negotiation.
- Appeal to a higher Rogun HPP management level if a grievance cannot be resolved.

6.12.11. The Tier 1 GRM will be performed according to the following steps:

6.12.12. Step 1: Grievance Uptake

Any verbal and written complaints can be raised through the contact details that follow. Anonymous complaints can be raised as well. “Complaint/Comment” boxes have been placed in all Jamoat offices, the offices of PMG, Rogun JSC, and DFZ, at the HPP construction site gate, and in affected municipality offices. These boxes are checked weekly (for DFZ) by the heads of Jamoat and sent via photograph or phone call to the DLEO for recording and management and for PMG and Rogun JSC by the respective Engagement and Grievance Managers. Posters have been prepared and displayed at key locations within the Project affected communities.

Complaints and grievances can be raised via the following channels during the construction phase:

- Grievance Mechanism Paper Form: Stakeholders can fill grievance forms (see **Annex 4**) that will be posted with the Complaint/Comment boxes as well as distributed by Jamoat Heads and made available in affected settlements, affected municipality offices and public venues (mosques, schools, libraries, teahouses).
- Face to Face: Stakeholders can voice their grievance to any DLEO, Jamoats or to assigned personnel of DFZ at local offices. In practice, they may also communicate with Contractor supervisors or with any representatives of PMG, DFZ, or Rogun JSC (who will receive training on handling such communications).
- Online: Stakeholders can submit forms to esia.rogun.hpp@gmail.com
- Company website: https://energyprojects.tj/index.php/en/rogun-hpp
- By telephone at: +992 37 235 74 16 or +992 37 235 74 17.
- By post: Grievance Manager, Project Management Group for Energy Facilities Construction. 5/1 Shamsi str., 6th floor, 734064, Dushanbe, Tajikistan.

6.12.13. Step 2: Sort and Process:

6.12.14. The DLEOs categorize and sort DFZ grievances, while the EGMs will categorize and sort for PMG and Rogun JSC. They determine the relevance of the grievance, categorize the grievance, identify the grievance type, and allocate the redress process and responsibilities for resolving. A broad grievance categorization is used to ensure that the grievance management procedure is "fit-for-purpose" and easy to use. Table 6-5 indicates typical grievance categorizations, with some examples.[4]

Table 6-5: Grievance Categorization

Category	Example of Grievance
Relatively minor and one-time problems related to Rogun HPP impacts.	• Minor damage to a building or structure. • Rogun HPP equipment causes minor damage to an individual's livestock or crop.
Relatively minor but repetitive problems related to Rogun HPP impacts.	• Destruction of landscape, local greenery, not removing rubbish or waste. • Noise and dust complaints.

4 (International Finance Corporation, 2009, p. 23)

Category	Example of Grievance
	• Rogun HPP traffic blocks the local access roads.
Significant, larger problems related to Rogun HPP impacts.	• Worker misbehavior. • Concerns about the security arrangements and acts of security personnel[5]. • Damage to crops, fields, forests and related livelihood impacts. • During construction, the Rogun HPP uses some land beyond the initial agreement with a community for temporary land use.
Major claim, significant adverse impact on a larger group or several groups.	• Conflict between members of the host community and newcomers. • Job opportunities do not meet local communities' expectations or respect social agreements. • Human rights impacts, including security and violence, and child labor. • Significant environmental contamination and degradation. • The Rogun HPP harms cultural or heritage artifacts and practices. • Violence against women as a result of shifting power roles in the community. • Water-related (polluted water, river flow reduction, fewer fish, and so on).
Major allegations regarding policy or procedure.	• Issues relating to land acquisition and compensation. • Accusations of partiality and lack of confidentiality from Rogun HPP stakeholders. • Allegations of systematic inadequate land compensation. • Rogun HPP information not disclosed to affected people and communities. • A GRM that is ineffective or not trusted by affected people and communities.

6.12.15. Step 3: Acknowledge and Follow Up.

6.12.16. The DLEOs contact the complainant within 3 working days following complaint registration to explain the Project response process for the grievance. If the grievance is not well understood or if

[5] (International Finance Corporation, 2012, p. 30)

additional information is required, clarification will be sought from the complainant by the DLEOs during this step.

6.12.17. Step 4: Verification, Investigation and Action

6.12.18. All grievances are verified via obtaining information about the grievance to verify its legitimacy and the facts surrounding it. Depending on the nature of the grievance, the process may include site visits, document reviews, a meeting with the grievant and meetings with others (both project-related and non-project-related) who may have knowledge or otherwise assist in resolving the problem. The grievant must agree to any such consultation. If the resolution is mutually acceptable, the SGM, assisted by the relevant DLEO, will discuss the proposed remediation with the grievant and develop an agreed timeline for the remediation process.

6.12.19. The DLEOs prepare a grievance resolution form which includes the nature of the grievance, date of its submission, actions implemented to resolve the grievance and date of implementation, or proposed actions to be implemented to resolve the grievance along with the timeline for their completion. The grievance resolution form is submitted within 20 days of receiving the grievance. The DLEOs have 10 working days to investigate and respond to the complaint. If the case requires a more complex investigation, updated information will be provided to the complainant explaining the actions required to resolve grievance, and the likely timeline.

6.12.20. Upon senior management and SGM approval, the outcomes of the grievance resolution form are communicated to the complainant by the DLEOs in accordance with the preferred method of communication specified. The grievance resolution form must be signed-off by the DLEOs or SGM and the complainant.

6.12.21. When the grievance resolution form identifies proposed actions to be implemented; the DLEOs monitor and follow up to ensure that such actions have been implemented in accordance with the timeline proposed within the grievance resolution form.

6.12.22. Upon resolving the grievance, including the completion of required actions, a grievance closeout form is prepared to be signed off by the DLEOs and the complainant that will detail the solution that was implemented to resolve the grievance.

6.12.23. The DLEOs ensure that the grievance forms, grievance resolution forms and grievance closeout forms are always updated and maintained onsite (i.e. DFZ offices, community hubs in affected settlements, municipality offices etc.).

6.12.24. The grievance mechanism allows submission of anonymous complaints and sexual exploitation and abuse/sexual harassment (SEA/SH) complaints by community members. Senior management at DFZ/PMG also monitor the way in which grievances are being handled by their staff and ensure they are properly addressed within deadlines specified on their website. The DLEOs keep a confidential grievance log of all grievances. The DLEOs response to grievances is monitored by the SGM, who advises on corrective actions, such as awareness raising, further training and disciplinary measures. In case of receiving SEA/SH complaints, an allocated Gender Focal Point addresses and raises the issue with the dedicated Third-Party Sensitive GRM Officer. The Third-Party Sensitive GRM Officer investigates the complaint and identify appropriate corrective measures. The case is referred to a relevant service provider (i.e. authorities) in severe cases.

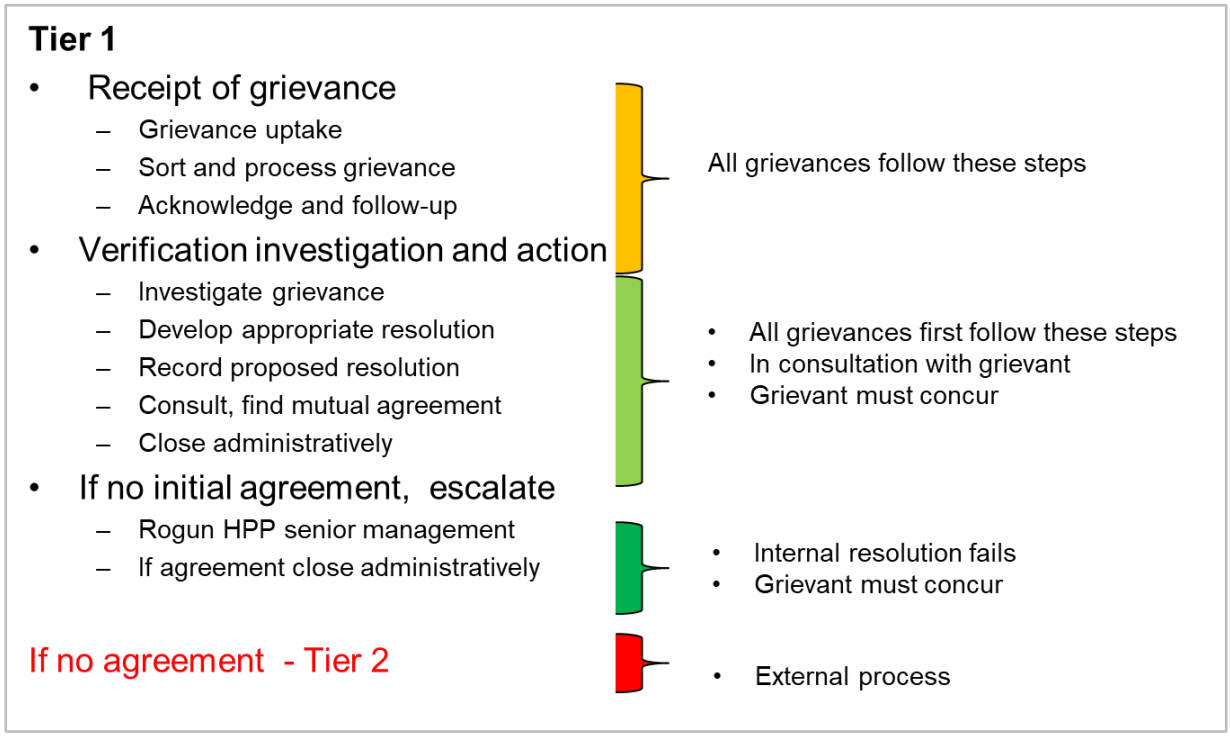
6.12.25. Where required or requested by the complainant, investigations are escalated to Senior Management for resolution, with support from the DLEOs, and the involvement of a civic representative, such as a Jamoat Head.

6.12.26. If the grievance is not resolved to mutual satisfaction, there will be further consultation toward finding an acceptable resolution. The objective is to resolve all grievances at this stage. However, if the appeal process is unsuccessful or broader external consultation is required to resolve the grievance, the Tier 2 approach will be implemented (subject to the grievant approval).

6.12.27. The grievant may also opt to seek other legal or procedural remedies. The GRM will not prevent the grievant from seeking any such alternative remedies or approaching a court or any other party for assistance.

6.12.28. A summary of the Tier 1 approach is presented in Figure 6-1.

Figure 6-1- *Tier 1 GRM Approach*



6.12.29. **Tier 2 Approach**

If the Tier 1 process does not resolve the grievance to the complainants or Rogun HPP's satisfaction or if broader consultation is necessary, the grievance procedure will enter the external Tier 2 process. The Tier 2 resolution process involves a third party or parties. The Tier 2 process will be subject to recognized national regulatory, cultural and independence requirements. The Tier 2 approach is implemented on a case-by-case basis. An overview of the Tier 2 approach is presented in Figure 7.

The grievant and the Rogun HPP or DFZ must formally agree to enter the Tier 2 process and on the participants to the Tier 2 process. A third party should be neutral, well-respected, and acceptable to the Rogun HPP and the grievant. The third parties may include public defenders, legal advisers, local or international NGOs, technical experts, Jamoat and village leaders or any

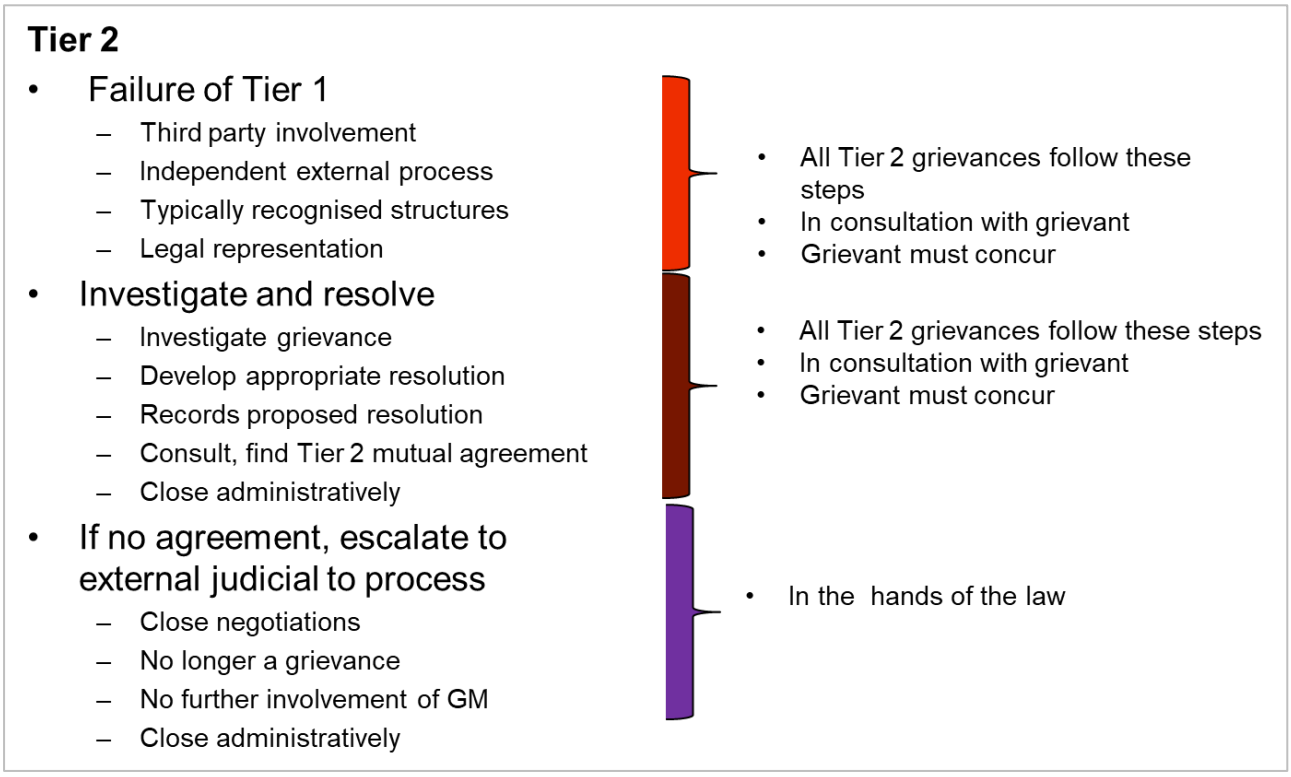
such acceptable institution. In the case of a Tier 2 procedure, the Rogun HPP legal team will be consulted.

On initiation of the Tier 2 approach, the grievant, the Rogun HPP, and the third party develop a roadmap with associated time frames, venues and associated procedures. The participants determine the nature of the process. This process can include facilitation, mediation, arbitration, resolution by the third party, or any procedure deemed acceptable by the participants. There must be agreement on the fees and payment aspects. Regarding the "no-cost" principle, grievances must be resolved at no cost to the grievant. The Tier 2 process must be documented, transparent and inclusive.

After agreement on the roadmap and associated aspects, the third party driven Tier 2 procedure is implemented. The outcomes can lead to an agreement or fail to achieve a mutually acceptable resolution.

- If the outcome is acceptable to the grievant and the Rogun HPP, the General Director and the grievant complete and sign a grievance resolution agreement. This action closes out the grievance and should be logged as such.
- The grievant or Rogun HPP may choose not to be bound to or not to accept the outcomes of the Tier 2 approach. In such a case, Rogun HPP or the grievant may seek other remedies, including those under the Tajikistan legal framework. In this event, Rogun HPP will terminate the grievance procedure and log the action as terminated.

Figure 6-2 - Tier 2 GRM Approach



6.12.30. **Grievance Management Timeframes**

6.12.31. Every effort will be made to solve each complaint within 10 working days, but for more complex investigations may take longer. The complainant is informed in writing of the reasons for any delay

past 10 days and updated on a fortnightly basis of progress on a delayed grievance. The time frames indicated in Table 6-5 will be followed in the administration of the GRM. The DLEOs must ensure that all parties stakeholders are aware of these time frames.

Table 6-6 - Grievance Resolution Time Frames

Action	Time frame	Responsible
Register grievance.	Within two working days of submission.	DLEO
Acknowledge grievance.	Within three working days of submission.	DLEO
Issue grievance rejection, resolution or further consultation notice.	Within ten working days of registration of the grievance.	DLEO and SGM
The target date for grievance resolution.	Within ten working days.	DLEO
Initiate internal processes to resolve the grievance.	Within two working days of submission.	DLEO and SGM
Issue notice of delay if grievance time frames are exceeded, or the resolution needs action from outside of Rogun.	Three working days before the expiry of the resolution target date.	SGM
Issue grievance closure letter – also signed by the grievant.	On completion of grievance remediation.	DLEO and SGM
Report on progress with grievances to senior management (General Director).	Monthly.	SGM

6.12.32. **Contractors' Role in Implementing the Grievance Redress Mechanism**

All contractors are required to implement the GRM procedures if they receive a grievance, escalating to the relevant DLEO or PMG Stakeholder Engagement Lead as needed.

All worker grievances are covered in the separate Worker Grievance Mechanism, including in the **Labor Management Procedures**.

6.13 MONITORING AND REPORTING

6.13.1. The planned engagement program presented in **Figure 6-3** is set out in the **SEP**, alongside the GRM and how this can be used by stakeholders. Additionally, the budget (approximately USD 368,000) required to carry out the engagement program and detailed description of the key roles and responsibilities for implementation is set out within the SEP. The PMG Stakeholder Engagement Lead, Senior Grievance Manager (SGM) and DLEOs are reviewing the **SEP** regularly to ensure that all the consultation activities are implemented and are in accordance with the planned schedule.

6.13.2. In terms of the monitoring and review of the stakeholder engagement program, the PMG Stakeholder Engagement Lead, assisted by the SGM and PMG Social Specialists, is responsible for producing progress updates on the SEP within semi-annual reports submitted to the World Bank. The reports summarize stakeholder interactions and consultations, grievances and decisions, new stakeholders, partnership progress, and plans for the next period.

6.14 ROLES AND RESPONSIBILITIES

6.14.1. Stakeholder engagement for a project of this scale requires a well-resourced team with experienced staff for effectively implementing and managing stakeholder engagement activities and grievances. Therefore, a number of additional roles that require specialist expertise have been created to ensure that there is sufficient capacity to conduct continuous and effective coordination and engagement.

6.14.2. The PMG Stakeholder Engagement Lead and the SGM are periodically assessing stakeholder engagement activities and ensuring that all consultations and disclosures are properly accounted for.

- The DLEOs, supervised by the SGM, are responsible for all community-related and resettlement stakeholder engagement activities and GRM implementation and management.
- The Rogun JSC Stakeholder Engagement Lead is responsible for all Project worker related stakeholder engagement and GRM implementation and management.
- The PMG Stakeholder Engagement Lead is responsible for all other external stakeholder engagement activities and GRM implementation and management.

6.14.3. The key roles for implementing the engagement program and their key responsibilities are presented in Table 6-7.

Table 6-7 - Engagement Roles and Responsibilities

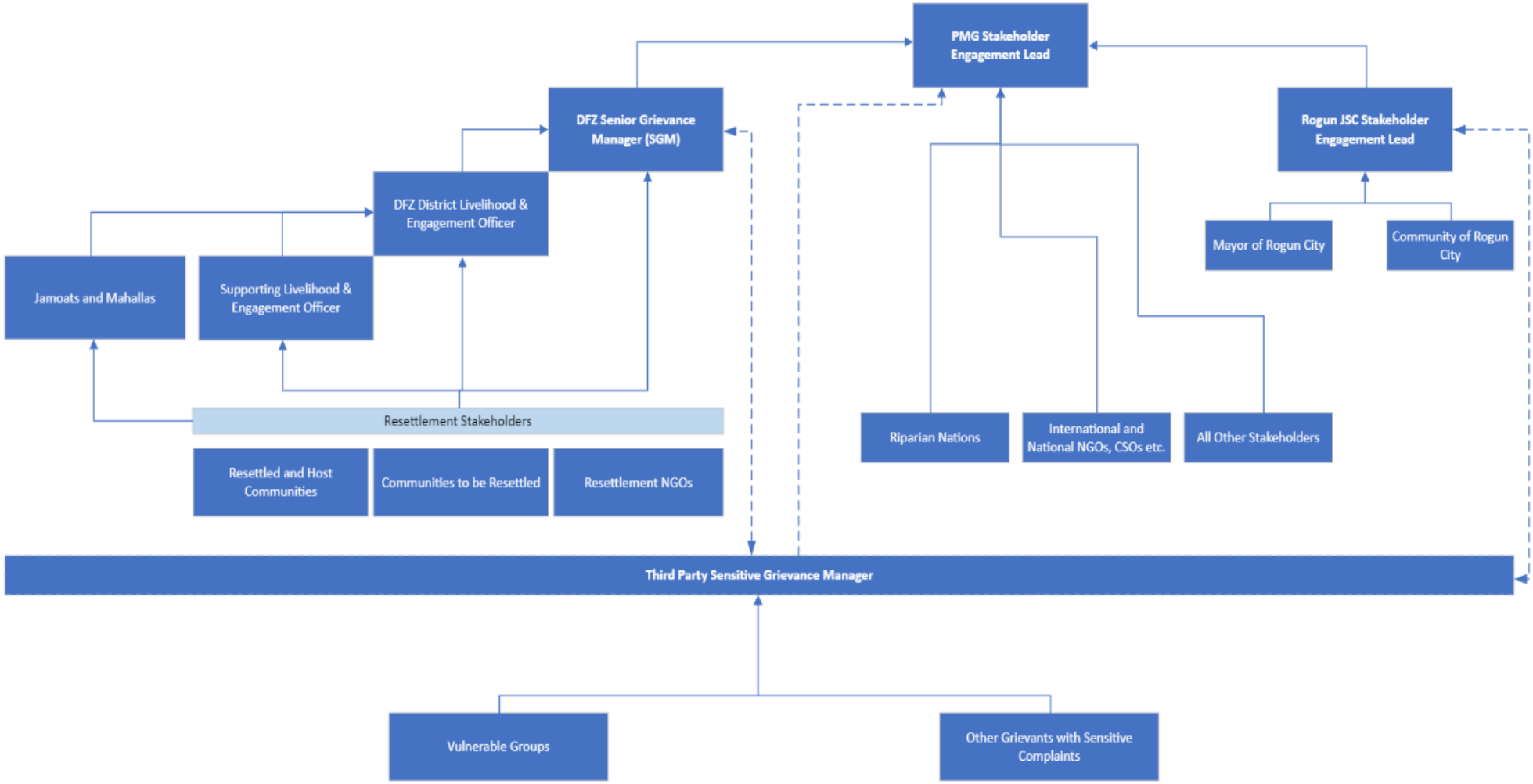
Name	Responsibility	Proposed Staffing
DFZ District Livelihood & Engagement Officer (DLEO)	Serve as a point to receive grievances and coordinate the consultation process. DLEOs will work closely with Jamoats. The appointed DLEOs should preferably be from/based in the districts that they are responsible for. DLEOs will be responsible for: • Registering community grievances. • Consulting with DFZ contractors to receive grievances they may receive. • Maintaining grievance forms, grievance resolution forms and grievance closeout forms. • Conducting consultations in affected settlements and promote GRM. The DLEOs will need to visit and lead consultations in each village every month.	1 DLEO and 1 assistant Engagement Officer (1 male and 1 female) for each of the following affected districts: • Rasht • Rogun • Nurobod • Faizobod • Tursunzoda

	• Identifying resolution or assigning responsibility to a qualified person, then leading or monitoring resolution, consulting with grievant. • Reporting on grievances to head of DFZ.	• Dangar • Rudaki
DFZ Senior Grievance Manager (SGM), also called the Community Engagement Manager,	• Manage and oversee community grievance procedure. • Approve grievance resolutions. • Monitor, evaluate and report on community grievances. • Monthly reporting on community grievances to PMG Stakeholder Engagement Lead.	1 SGM
Rogun JSC Grievance Manager	• Manage and oversee non-resettlement related community grievance procedure. • Consult with Rogun and other municipal authorities and with PMC and contractors to receive grievances submitted to them (other than those concerning resettlement). • Receive grievances submitted to PMC and contractors by external parties. • Maintaining grievance forms, grievance resolution forms and grievance closeout forms. • Leading or supporting resolution. • Monthly reporting on grievances to PMG Stakeholder Engagement Lead.	1 Grievance Manager
Grievance Committee	All unresolved grievances will go to the Grievance Committee, comprised of representatives from DFZ, PMG, affected Jamoats, SGM and the appropriate DLEO. The complainant will be invited to an appeal meeting within a defined period, after which the Grievance Committee will give the grievant a decision on the outcome of the appeal.	Grievance Committee, comprised of representatives from DFZ, PMG, affected Jamoats, SGM and the appropriate DLEO.
PMG Stakeholder Engagement Lead	• Monitor and report on grievances received from all DFZ, Rogun JSC, and directly from external stakeholders (e.g. NGOs, general public, riparian nations etc.) • Monthly reporting on all Project-related grievances to senior management.	1 Stakeholder Engagement Lead
Third-Party Sensitive GRM Officer	• Manage and implement sensitive GRM. • Monitor and report on SEA/SH risks and grievances.	1 Sensitive GRM Officer, supported by

	• Ongoing monitoring of the support and safety needs of survivors and any witnesses and/or Whistleblowers.	female focal points from each district.

6.14.4. Further information on the specific engagement activities to be carried out by each unit is contained within the **SEP**.

Figure 6-3 - Stakeholder Engagement Communication Channels



6.15 GRIEVANCE RECORDKEEPING AND MONITORING

GRIEVANCE RECORDKEEPING

6.15.1. The grievance management procedure must be recorded accurately[6]. Any grievances with discrepancies or lacking interventions must be highlighted and submitted for managerial intervention. The DLEO's, SGM, Rogun JSC, and PMG Stakeholder Engagement Lead will maintain grievance logs to ensure that each grievance is individually referenced and properly tracked, and actions recorded are followed. The log will only be accessible to these designated individuals and will contain the following information:

- Grievance reference number
- Name and contact details of the person receiving the grievance.
- Name, gender and contact details of grievant (unless the complaint has been submitted anonymously).
- Date of the submission of the grievance.
- Date of the response to the grievance.
- Location of the grievance.
- Details of the grievance.
- Grievance Category
- Re-occurrence
- Reporting action and schedule (target and achieved).
- Agreed Response by Date.
- Response provided.
- Final outcome.
- Final Response Date.
- Status of grievance.
- Escalation of grievance to managerial review.
- Escalation of grievance to Tier 2 level.
- Date when the resolution is implemented (if any).
- Was the grievance closed out or not.
- Comments.

6.15.2. Confidential grievances or grievances submitted anonymously will be accessed only by authorized personnel. Anonymous grievances will include the selected option of communication method

[6] This includes recording complaints by gender, where the grievant is not anonymous.

(whether the complainant would want the response via phone, to a different email, or to a different postal address).

6.15.3. Sensitive grievances, such as those relating to SEA/SH, will be referred immediately to the Sensitive GRM Officer, who will maintain a separate grievance logbook that will not be accessible to anyone else).

GRIEVANCE MONITORING

6.15.4. The grievance management procedure will be monitored continuously, with monthly progress reports submitted to management. The overall effectiveness of the grievance management procedure will be assessed on a six-monthly basis. Aspects to be considered include Project stakeholder feedback on the use and effectiveness of the procedure, awareness of the grievance management procedure, unresolved grievances and adherence to process time frames.

6.15.5. PMG may consider revising the mechanism depending on the stakeholder feedback. If many grievances are unresolved, PMG may reconsider its approach rather than only increasing efforts to resolve individual grievances. If many similar grievances are recorded, it may indicate that the PMG, DFZ, and/or Rogun JSC need to undertake appropriate management interventions.

6.15.6. PMG may consider involving an external group or NGO in evaluating the impact of the grievance management procedure. Such involvement can add to the independence and robustness of the GRM.

6.15.7. All grievances will be stored in the grievance logbook when first recorded and updated with key findings and actions during assessment and after being resolved. If the same or similar grievance is submitted, it can be attached to a previously closed grievance and re-opened.

6.15.8. Grievance Reporting

6.15.9. The DFZ and Rogun JSC SGMs report to their respective managers on a monthly basis on the operation of the GRM. This includes (but is not limited to):

- number of grievances received by gender,
- number resolved to the grievance's satisfaction by gender,
- number not resolved at the end of the month by gender,
- number not resolved after 30 days by gender, and
- the number that will go to Tier 2 or are referred to the legal system by gender.

6.15.10. DFZ and Rogun JSC review the respective reports and submit them to PMG. PMG is including in its quarterly reports to Lenders a summary of the GRM's operation.

6.15.11. PMG and OJSC finalized the establishment of a GRM for workers in January 2025.

6.16 WORLD BANK GRIEVANCE REDRESS SERVICE

6.16.1. Through the World Bank Grievance Redress Service (GRS), the World Bank accepts grievances from individuals and communities who believe a project has negatively impacted them. Complaints may be submitted in English, Russian, or Tajik. Note that additional processing time will be needed

for grievances not in English. GRS grievances are reviewed promptly to deal with concerns related to the project as soon as possible.

6.16.2. A grievance must clearly state the adverse impacts the World Bank-supported project has caused or is likely to cause. The grievance should contain as much supporting documentation and correspondence as possible. The grievant may also indicate the desired outcome of the grievance. The grievance should describe the complainant or the assigned representative's identity and provide contact information as a final step.

6.16.3. Grievances may be submitted to the World Bank GRS through any of the following channels:

- Online: https://wbgcmsgrs.powerappsportals.com/en-US/new-complaint/
- By email: grievances@worldbank.org
- By hand: The World Bank,1818 H Street, Northwest Washington, DC 20433, USA
- By post: Grievance Redress Service, MSN MC10-1018, 1818 H Street, Northwest, Washington, DC 20433, USA
- Through the World Bank Tajikistan Country Office in Dushanbe:

  Business Center "Sozidanie" 3rd floor

  48 Ayni Street

  Dushanbe

  Tajikistan.

  Tel: +992 48 701 5810.

6.16.4. **Monitoring, Reporting, and Responsibilities**

6.16.5. Successful stakeholder engagement depends on systematic dialogue, performance monitoring and adapting to changed circumstances and stakeholder information needs. Monitoring of interaction with the stakeholders, including the operation of the GRM, will be carried out on an ongoing basis.

6.16.6. The PMG Stakeholder Engagement Lead, SGMs, and DLEOs review this SEP regularly to ensure that all the consultation activities are implemented and are in accordance with the planned schedule.

- The DLEOs, supervised by the SGM, are responsible for all community-related stakeholder engagement activities and GRM implementation and management.
- The PMG Stakeholder Engagement Lead are responsible for all other stakeholder engagement activities and GRM implementation and management.

6.16.7. The PMG Stakeholder Engagement Lead and the SGM periodically assess stakeholder engagement activities and ensure that all consultations and disclosures are properly accounted for.

6.16.8. The PMG Stakeholder Engagement Lead, assisted by the SGM and PMG Social Specialists, is responsible for the general compilation of progress reports and SEP results and their synthesis in quarterly reports that are submitted to the lenders. The reports include a summary of stakeholder interactions and consultations, new grievances, resolved and unresolved grievances, new stakeholders, partnership progress, and plans for the next period.

6.16.9. Record Keeping and Monitoring

6.16.10. All engagement consultations are recorded by the DLEOs and PMG Stakeholder Engagement Lead, along with minutes of the engagements and records of the attendance. The minutes and any other proof of participation are uploaded to DFZ's and PMG's internal filing systems.

6.16.11. Engagement effectiveness analysis is performed based on the SEP and the indicators presented in Table 6-8:

Table 6-8 Stakeholder Engagement Key Performance Indicators

Aspect	Key Performance Indicator (KPI)	Monitoring Frequency	Parties Responsible[7]	Means of Verification
Grievance Mechanism	• Grievances and resolutions database. • Number of registered grievances received through the Grievances Mechanism, by category (with gender-disaggregated data). • Number of grievances resolved / unresolved within the stipulated timeframe. • Timeline / period required to solve grievances. • Number of grievances that are on hold / disagreed. • Repetition of the same grievance. • Repeated grievances from the same location.	Monthly	DFZ Senior Grievance Manager (SGM) Rogun JSC Grievance Manager (non-resettlement related grievances)	Grievance Logs of PMG, Rogun JSC and DFZ
Stakeholder Engagement	• The number of meetings, public consultations and other events held with the stakeholders, including the number of participants with a gender breakdown. • Meeting records of all consultations, workshops and trainings held. • Stakeholder database. • Number of project events published/broadcasted in the local, regional and national media. • Type and frequency of public engagement activities.	Monthly	PMG Stakeholder Engagement Lead	Consultation records of PMG, Rogun JSC and DFZ

6.16.12. Routine Evaluation

6.16.13. Various indicators and validation methods are used to evaluate the stakeholder engagement process. The following questions must be considered during the external evaluation process:

- Are the Rogun HPP strategy, policy, and principles of engagement aligned with the requisite standards?

[7] Full grievance management responsibilities are detailed in Table 6-3.

- Is there a stakeholder identification and analysis process?
- What is the effectiveness of the stakeholder engagement process?
- Is information disclosure comprehensive and transparent?
- Are free and prior informed consultation principles applied, particularly in the RAP processes?
- Are vulnerable groups receiving specific support to participate in the various processes?
- Is the grievance mechanism compliant with international standards and functioning effectively?
- Is there an effective communication and feedback process between the Company and the Project stakeholders?

6.16.14. External evaluations will be carried out by an independent stakeholder engagement specialist at a minimum every three years.

6.16.15. Internal Reporting

6.16.16. The DFZ SGMs, assisted by the DLEOs, report to the PMG Stakeholder Engagement Lead on all community stakeholder engagement consultations and grievances on a monthly basis. Additionally, both the Rogun JSC Stakeholder Engagement Lead and the third-party Sensitive Grievance Manager also report on a monthly basis to the PMG Stakeholder Engagement Lead on consultations and grievances received.

6.16.17. The PMG Stakeholder Engagement Lead produces monthly summary reports for the PMG on all responsibilities included within this SEP. The monthly reports include stakeholder engagement information, grievance information and management of the issues and grievances. The stakeholder engagement team (DLEOs and PMG Stakeholder Engagement Lead) are using an internal reporting template for monthly reports as set out by the PMG Stakeholder Engagement Lead, which covers all work areas, e.g., socio-economic projects delivered, quantitative and qualitative information about stakeholder engagements and platforms and grievances, RAP progress updates, etc. PMG is responsible for producing quarterly reports, based on the updates provided by the PMG Stakeholder Engagement Lead, that will be submitted to the lenders, if requested.

6.17 BUDGET

6.17.1. Table 6-9 provides an initial budget for implementing this SEP. These figures are estimates only based on roles and not actual salaries of individuals, to provide an indication of an approximate budget for SEP implementation. As the SEP is a live document, this budget will be continually adapted to reflect the additional staffing requirements as the Project progresses.

Table 6-9: Yearly Stakeholder Engagement Budget

Activity	Description	Unit Cost (USD)	Number	Total (USD)
Additional staffing (yearly salaries)	1 DFZ District Livelihood & Engagement Officer (DLEO) for each of the following affected districts: • Rasht • Rogun • Nurobod • Faizobod	20,000	7	140,000

Activity	Description	Unit Cost (USD)	Number	Total (USD)
	• Tursunzoda • Dangar • Rudaki			
	1 Assistant Engagement Officer (AEOs) for each of the following affected districts: • Rasht • Rogun • Nurobod • Faizobod • Tursunzoda • Dangar • Rudaki	15,000	7	105,000
	DFZ Senior Grievance Manager (SGM)	25,000	1	25,000
	PMG Stakeholder Engagement Lead	30,000	1	30,000
	Third-Party Sensitive GRM Officer	25,000	1	25,000
Disclosure activities *(only Year 1)*	Website development	5,000	1	5,000
	Disclosure document and notice/advertisement printing	2,000	1	2,000
	Media costs – press conferences, TV, radio and local newspaper adverts	2,000	1	2,000
	Public consultation costs – refreshments	2,500	1	2,500
	Transboundary consultation event in Almaty, Kazakhstan – flights, venue hire	5,000	1	5,000
	Consultation sessions with local and international NGOs – refreshments	50	2	100
	Consultation sessions with contractors and sub-contractors on site	50	4	200
Ongoing consultation	Round tables	500	2	1000
	Public meetings	1000	2	2000
	Meetings with National Government Authorities	50	2	100
	Women-only focus groups	250	2	500
	Vulnerable group focus groups	250	2	500
	Consultation with the Academy of Sciences of the Republic of Tajikistan (the A Donish Institute)	50	1	50
	Employment advertisements and advertisements for local employment fayres	1000	1	1000
	Employee meetings	100	4	400

Activity	Description	Unit Cost (USD)	Number	Total (USD)
Further logistics	Fuel	3,000	7	21,000
YEARLY TOTAL				**368,350**

6.17.2. Please note the following points regarding the above budgeting:

- Grievance Committees are comprised of representatives from DFZ, PMG, affected Jamoats, SGM and the appropriate DLEO (all hired staff members). Therefore, no additional budget is included for these committees.
- Standalone costs for public consultation (e.g. public meetings and focus groups) are limited for refreshments as it is expected that venues will be provided for free by the Jamoats.
- The purchase of further vehicles is not included.
- Monitoring and evaluation of the SEP has not been provided within the breakdown as these are included within job descriptions of the additional staff required (and therefore covered in the staffing costs).

6.18 COMPLIANCE WITH NATIONAL LEGISLATION

6.18.1. Through the development and implementation of the SEP under the updated 2025 ESIA and SEP, stakeholder engagement is meeting national EIA requirements regarding disclosure, consultation, and access to information.

6.19 ESIA AND SUPPLEMENTARY DOCUMENTATION DISCLOSURE

6.19.1. PMG, supported by DFZ and Rogun JSC, is disclosing relevant information about the Project during implementation. The ESIA and supplementary documentation are being disclosed with sufficient time allowed for review and consultation and thereafter will remain in the public domain. The disclosed information includes:

- ESIA (including the ESMP);
- Non-Technical Summary (NTS) of the ESIA;
- SEP and GRM; and
- RLRF.

6.19.2. Consultation and disclosure materials, including the relevant management plans, will be adapted depending on the point of interest of the different stakeholder groups. The ESIA report will be available for review and comment by stakeholders through a variety of mechanisms outlined in the SEP. All documents will be prepared in English, Russian and Tajik. During the disclosure period, consultation will be undertaken with those likely to be affected by the Project, as outlined in the SEP. Further information on the disclosure process is set out in the SEP.

6.20 POST DISCLOSURE OF ESIA AND SUPPLEMENTARY DOCUMENTATION

6.20.1. Following completion of the disclosure period, feedback gained throughout will inform the continued development of the Project through updating the ESIA and relevant mitigation measures and

management plans. The disclosure documentation (such as the ESIA and SEP) will be updated to capture the feedback gained throughout the disclosure period.

6.20.2. The full program for disclosure activities is provided within the SEP document and the agenda for undertaking the program is being shared with the Project Lenders for comment prior to its implementation in the first week of the disclosure period.

6.20.3. After the disclosure period, feedback from the engagement sessions presented within the SEP will be circulated by the PMG to relevant departments of the supporting and implementing agencies, and the mitigation measures contained within the relevant management plans will be updated as appropriate.

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JSC “Rogun HPP”

State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT – UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Chapter 07 – Environmental and Social Baseline

PUBLIC

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DATE: SEPTEMBER 2025

QUALITY CONTROL

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7 ENVIRONMENTAL AND SOCIAL BASELINE CONDITIONS

7.1 INTRODUCTION

7.1.1. This chapter provides lists the sources of the secondary baseline information for the environmental and social baseline conditions for the Project, presented in terms of each topic.

7.1.2. A full description of the primary baseline conditions is presented in **Annex 7-1** of this ESIA.

7.1.3. The baseline data of this ESIA was used to inform the Impact Assessment process. These results are presented in **Chapters 8** to **24** of this ESIA by topic, including a summary of the Cumulative Impact Assessment.

Table 7-1 - Baseline Summaries

Baseline Summary	Aspect
Figure 7-1	Air Quality
Figure 7-2	Climate
Figure 7-3	Noise and Vibration
Figure 7-4	Soils and Geology
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Figure 7-7	Landscape and Visual
Figure 7-8	Biodiversity
Figure 7-9	Economy and Employment
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Figure 7-11	Labour and Working Conditions
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Figure 7-15	Cultural Heritage
Figure 7-16	Materials and Waste
Figure 7-17	Traffic and Transport
Figure 7-18	Area of Influence (AoI)

7.2 SOURCES OF DATA

Table 7-2 – Key Secondary Baseline Data Sources

Summary	Topic	Data Source	Link
Figure 7-1	Air Quality	World Health Organization	https://www.who.int/publications/i/item/9789240034228
Figure 7-1	Air Quality	Open Air	https://davidcarslaw.github.io/openair/
Figure 7-1	Air Quality	NASA EarthData	https://www.earthdata.nasa.gov/search
Figure 7-2	Climate	Met Office	https://www.metoffice.gov.uk/weather/climate/climate-explained/what-is-climate
Figure 7-2	Climate	Office of Energy Efficiency and Renewable Energy	https://www.energy.gov/eere/water/tracking-carbon-footprint-hydropower
Figure 7-3	Noise	WSP Noise Survey May 2023	N/A
Figure 7-4	Soils and Geology	Rogun Techno-Economic Assessment Study	
Figure 7-4	Soils and Geology	Environmental and Social Impact Assessment for Rogun Hydro Power Plant	https://www.worldbank.org/content/dam/Worldbank/Event/ECA/central-asia/ESIA%20Rogun%20Vol%20I%20_eng.pdf
Figure 7-5	Contaminated Land	Journal of Health and Pollution	https://www.researchgate.net/publication/323649901_Inventory_of_Obsolete_Pesticide_Warehouses_in_Tajikistan_and_Implications_for_Removal_of_Contaminated_Soil/citations
Figure 7-5	Contaminated Land	Environmental Pollution	https://www.sciencedirect.com/science/article/abs/pii/S0269749117306097
Figure 7-5	Contaminated Land	Food and Agriculture Organisation of the United Nations	https://www.fao.org/countryprofiles/news-archive/detail-news/en/c/1619889/
Figure 7-6	Water Environment	Environmental and Social Impact Assessment for Rogun Hydro Power Plant	https://www.worldbank.org/content/dam/Worldbank/Event/ECA/central-asia/ESIA%20Rogun%20Vol%20I%20_eng.pdf
Figure 7-7	Landscape and Visual	WSP Site Visit	N/A
Figure 7-8	Biodiversity	Plants (journal)	https://www.mdpi.com/2223-7747/13/2/286

Summary	Topic	Data Source	Link
Figure 7-8	Biodiversity	First National Report on Biodiversity Conservation	https://www.cbd.int/doc/world/tj/tj-nr-01-p02-en.pdf
Figure 7-9	Economy and Employment	CIA World Factbook	https://www.cia.gov/the-world-factbook/about/archives/2023/countries/tajikistan/
Figure 7-9	Economy and Employment	United Nations Development Program	https://hdr.undp.org/sites/default/files/Country-Profiles/MPI/TJK.pdf
Figure 7-10	Land Acquisition and Resettlement	WSP primary data	See Resettlement and Livelihood Restoration Framework and Resettlement Action Plan https://energyprojects.tj
Figure 7-11	Labor and Working Conditions	Khovar	https://khovar.tj/rus/2024/01/kak-v-tadzhikistane-snizhayut-uroven-neschastnyh-sluchaev-na-promyshlennyh-i-gornyh-predpriyatiyah/
Figure 7-11	Labor and Working Conditions	International Labour Organisation	https://ilostat.ilo.org/data/country-profiles/
Figure 7-12	Community Assets and Infrastructure	Asian Development Bank	https://www.adb.org/sites/default/files/linked-documents/45229-001-taj-oth-02.pdf
Figure 7-12	Community Assets and Infrastructure	World Health Organisation	https://data.who.int/countries/762
Figure 7-12	Community Assets and Infrastructure	World Bank	https://www.worldbank.org/en/news/press-release/2022/06/23/tajikistan-to-improve-access-to-safe-drinking-water-with-world-bank-support#:~:text=Although%20access%20of%20the%20population,safely%20managed%20water%20supply%20services.
Figure 7-13	Community Health, Safety and Security	World Health Organisation	https://platform.who.int/mortality/countries/country-details/MDB/tajikistan
Figure 7-13	Community Health, Safety and Security	CIA World Factbook	https://www.cia.gov/the-world-factbook/about/archives/2021/countries/tajikistan/images/a95f5d0a-f5e3-5b92-89ec-d9ab368a3d97
Figure 7-14	Inclusion, Vulnerabilities and Gender Issues	World Bank/UK Aid	https://documents1.worldbank.org/curated/en/874641637562869105/pdf/Tajikistan-Country-Gender-Assessment.pdf
Figure 7-15	Cultural Heritage	PloS ONE (jounral)	https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0259151

Summary	Topic	Data Source	Link
Figure 7-15	Cultural Heritage	Current anthropology (journal)	https://www.researchgate.net/publication/259710331_Multiregional_Emergence_of_Mobile_Pastoralism_and_Nonuniform_Institutional_Complexity_across_Eurasia
Figure 7-16	Materials and Waste	National minerals information centre	https://www.usgs.gov/centers/national-minerals-information-center/europe-and-central-eurasia#tjk
Figure 7-17	Traffic and Transport	Asian Development Bank	https://www.adb.org/sites/default/files/institutional-document/755636/tajikistan-transport-sector-assessment.pdf
Figure 17-18	Area of Influence	N/A	N/A

Accessed 22 October 2024 – Data Source Links may be unavailable or since revised after the publication of this ESIA

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Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT - UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Volume 1, Chapter 08: Air Quality



JUNE 2025

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8 AIR QUALITY

8.1.1. This chapter describes the assessment of potential impacts of the Project activities on air quality (AQ) in line with the requirements of the World Bank's Environmental and Social Standards (ESS) 1: Assessment and Management of Environmental and Social Risks and Impacts.

8.1.2. A description of ambient and indoor air quality conditions is presented in **Volume 2, Annex 7.1: Baseline Conditions Report** and a summary is provided in **Volume 1, Chapter 7: Baseline** of this ESIA. An assessment of the potential Project activities on ambient and indoor air quality conditions for the construction phase is presented in **Section 8.6**. For the operational phase, only indoor air quality is considered in **Section 8.7**; given that limited outdoor works will be undertaken during the operational phase. Where necessary, mitigation measures for the avoidance of impact, impact minimization and/or long-term management of activities are included.

8.1.3. An Environmental and Social Impact Assessment for Rogun Hydro Power Plant was undertaken by Poyry and completed in 2014. The 2014 ESIA report discusses the findings of the assessment within the Project Area of Influence (AoI). The air quality assessment is focused on emissions comprising dust[1] and fine particulates, collectively known as total suspended particulate (TSP) and exhaust gases including nitrogen oxides (NOx) and Particulate Matter (PM_{10}) generated by quarries, construction activities and transportation activities.

8.2 LEGISLATIVE FRAMEWORK, POLICY AND GUIDANCE

NATIONAL REQUIREMENTS

8.2.1. Article 7 of the Law of the Republic of Tajikistan on the Protection of Atmospheric Air (2012) mandates the Government to establish, among other, maximum permissible concentrations for ambient pollutants.

8.2.2. Government Decree No. 297 of June 26, 2023 'Standards for Maximum Permissible Concentrations of Pollutants in the Atmospheric Air and the Level of Harmful Physical and Other Impacts on it; provides the maximum permissible concentration for a long list of AQ determinants. The maximum permissible concentration is also known as Maximum Allowable Concentration (MAC) and one-time exceedance (allowable concentration) and daily average MAC values relevant to the Project are shown in **Table 8-1**.

[1] Solid particles either suspended in air or settled on surfaces (deposited dust).

Table 8-1 - Tajikistan Air Quality Standards

Pollutant	Maximum One-Time Allowable Concentration (mg/m^3)	Daily Average Allowable Concentration (mg/m^3)	Annual Average Allowable Concentration (mg/m^3)
Suspended Particles PM_{10}	0.3	0.06	0.04
Suspended Particles $PM_{2.5}$	0.16	0.035	0.025
Nitrogen Oxide	0.4	0.06	-
Nitrogen Dioxide	0.085	0.04	-
Sulfur Dioxide	0.5	0.05	-
Carbon Monoxide	5.0	3.0	-
Ozone	0.16	0.03	-
Inorganic dust (containing silicon dioxide)[1]	0.3	0.1	-

1. Silicon dioxide content assumed to be 20-70%

INTERNATIONAL LENDER REQUIREMENTS

8.2.3. The World Bank Group (WGB) Environmental and Social Standards (ESS) applicable to air quality management include:

- WBG ESS1: Assessment and Management of Environmental and Social Risks and Impacts - with- with the objective to identify, evaluate and manage the environment and social risks and impacts of the project;
- WBG ESS2: Labor and Working Conditions – with the objective to promote safety and health at work;
- WBG ESS3: Resource Efficiency and Pollution Prevention – with the objective to avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities; and
- WBG ESS4: Community Health and Safety – with the objective to anticipate and avoid adverse impacts on the health and safety of project-affected communities during the project life cycle.

8.2.4. In addition to the above, examples of general and industry-specific Good International Industry Practice (GIIP) are provided in:

- WBG Environmental Health and Safety (EHS) Guidelines - General EHS Guidelines: Introduction (2007) – Section 1.1 provides guidance for management of emission limits and ambient air quality to ensure that relevant ambient quality guidelines and standards are not exceeded. This is done by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines or other internationally recognized sources.

WORLD HEALTH ORGANIZATION

8.2.5. The WBG General EHS Guidelines make specific reference to the World Health Organization (WHO) Air Quality Guidelines recommended levels and interim targets for common air pollutants in ambient air, namely: PM_{10} (particles less than 10 microns (µm) in diameter), $PM_{2.5}$ (particles less than 2.5 µm in diameter), O_3, CO, NO_2, and SO_2.

8.2.6. The WHO Guidelines aim to reduce health impacts of air pollution but are neither standards nor legally binding criteria. The provision of interim targets is intended for use in areas where pollution is high, providing targets for incremental reductions in air quality standards to meet the 2021 guidelines. Annual and peak season[2] averaging periods are applicable to the assessment of long-term exposure, whilst averaging periods of 24-hours and less including, 8-hour, 1-hour, 15-minutes and 10-minutes, are applicable to the assessment of short-term exposure and are applicable to both public and workers. The WHO interim targets and 2021 Guidelines are presented in **Table 8-2**.

8.2.7. The WHO Air Quality Guideline values presented in the WBG General EHS Guidelines are taken from the 2005 version of the WHO Air Quality Guidelines and although generally aligned, there are some discrepancies between the two data sources. These are noted in **Table 8-2** (see footnote to table), and the 2021 WHO Guideline values have been used in this assessment.

8.2.8. Air quality monitoring undertaken on site is done to monitor exposure of workers to particulates and exhaust emissions in indoor areas; and does not provide ambient baseline data. The airshed is considered non-degraded based on the surrounding land-use but it is not possible to distinguish the Project contribution from other sources of emissions to air, due to the absence of historic air quality monitoring data.

[2] The World Health Organization defines ‘peak season’ as the six consecutive months of the year with the highest six-month running-average Ozone concentration; usually over the warmer months

Table 8-2 – World Health Organization Ambient Air Quality Standards

Pollutant (unit)	Averaging Time	Interim Target				2021 AQ Guidelines
		1	2	3	4	
$PM_{2.5}$ (µg/m³)	Annual	35	25	15	10	5
	24-hour[(a)]	75	50	37.5	25	15
PM_{10} (µg/m³)	Annual	70	50	30	20	15
	24-hour[(a)]	150	100	75	50	45
O_3 (µg/m³)	Peak season[(b)]	100	70	-	-	60
	8-hour[(a)]	160	120	-	-	100
NO_2 (µg/m³)	Annual	40	30	20	-	10
	24-hour[(a)]	120	50	-	-	25
	1-hour	-	-	-	-	200[(c)]
	10-minute	-	-	-	-	500[(c)]
SO_2 (µg/m³)	24-hour[(a)]	125	50	-	-	40
	10-minute		-	-	-	500[(c)]
CO (mg/m³)	24-hour[(a)]	7	-	-	-	4
	8-hour	-	-	-	-	10[(c)]
	1-hour	-	-	-	-	35[(c)]
	15-minutes	-	-	-	-	100[(c)]

(a) – 99th percentile (i.e. 3-4 exceedance days per year)

(b) - Average of daily maximum 8-hour mean O_3 concentration in the six consecutive months with the highest six-month running- average O_3 concentration

(c) – Guideline values that were not updated in the WHO Air Quality Guidelines in 2021 and are still valid.

PROJECT AIR QUALITY STANDARDS

8.2.9. Ambient air quality monitoring is currently undertaken by contractors as part of their contractual obligations and monitoring is done at locations where activities result in airborne particulates, where fixed plant and equipment is operated and at quarries and borrow pits.

8.2.10. The current Project ambient air quality standards (AAQS) are detailed in the Air Quality and Dust Monitoring and Management Plan (AQDMMP) as shown in **Table 8-3**.

Table 8-3 – Current Project Ambient Air Quality Standards

Parameter	Unit	Adopted Project Standard
Temperature	ºC	N/A
Sulfur Dioxide (SO_2)	($\mu g/m^3$)	50
Carbon Monoxide (CO)	(mg/m^3)	3
Nitrogen Oxide (NO)	($\mu g/m^3$)	60
Nitrogen Dioxide (NO_2)	($\mu g/m^3$)	40
Particulate Matter – Dust (PM_{10})	($\mu g/m^3$)	150
Particulate Matter – Dust ($PM_{2.5}$)	($\mu g/m^3$)	15
Total Suspended Particulates (TSP)	$\mu g/m^3$	200 (1-hour for high receptor sensitivity) 250 (1-hour for moderate receptor sensitivity)

8.2.11. In addition to the Project AAQS, trigger values for dust require that the mean concentration of TSP does not exceed 6000 $\mu g/m^3$ (10-minute value) and 2000 $\mu g/m^3$ (8-hour value) at workplaces and work areas and 500 $\mu g/m^3$ at any sensitive receptor within 100 m of the site boundary.

8.2.12. The AQDMMP includes current Occupational Health and Safety standards (OHS) for dust levels at receptors based on Tajikistan national standards as shown in **Table 8-4**.

Table 8-4 – Project Occupational Health and Safety Standards

Receptors	Unit	Adopted Project Standard (averaging period)
Living Areas	mg/m^3	< 0.5 (10-minutes) < 0.15 (daily average)
Working Areas	mg/m^3	< 6.0 (10-minutes) < 2.0 (daily average)

8.2.13. The sample frequency stated in the current AQDMMP is:

- One air quality sample per month or frequently during periods of intensive machinery use or when responding to previous exceedance; and
- One dust concentration sample per week or frequently during times when there is no rainfall or upon visual observation results.

8.2.14. The averaging period is not stated in the AQDMMP and a review of the ambient air quality monitoring determined that measurement durations and frequencies undertaken by the contractor are not aligned with the averaging period required by the Project standards, and the data is not directly comparable.

8.2.15. Similarly, a review of the indoor air quality monitoring undertaken by the Republican Military Mine Rescue Service (RMMRS) determined that monitoring is done using hand-held devices on a

scheduled and unscheduled basis; however, measurement durations and frequencies are not aligned with the averaging period required by Project standards and the data is not directly comparable.

8.2.16. A review of the Tajik MAC and WHO AQ Guidelines was undertaken to compare with the existing AQ standards and identify the more stringent limit for a particular determinant as the long and short-term-term Project standards to ensure that air quality can be maintained during the construction and operational phases. The updated Project AQ standard is shown in **Table 8-5**.

Table 8-5 – Project Air Quality Standards

Pollutant	Unit	Averaging Period	Concentration	Source
$PM_{2.5}$	($\mu g/m^3$)	Annual	5	WHO AQG Level
		24-hour[a]	15[c]	WHO AQG Level
		One-time exceedance	160	Tajik Standard
PM_{10}	($\mu g/m^3$)	Annual	15[c]	WHO AQG Level
		24-hour	45[c]	WHO AQG Level
		One-time exceedance	300	Tajik Standard
O_3	($\mu g/m^3$)	peak season[b]	60[c]	WHO AQG Level
		24-hour	30	Tajik Standard
		8-hour	100	WHO AQG Level
		One-time exceedance	160	Tajik Standard
NO_2	($\mu g/m^3$)	Annual	10	WHO AQG Level
		24-hour[a]	25	WHO AQG Level
		1-hour	200[c]	WHO AQG Level
		One-time exceedance	85	Tajik Standard
SO_2	($\mu g/m^3$)	24-hour[a]	40	WHO AQG Level
		10-minute	500 [c]	WHO AQG Level
		One-time exceedance	500	Tajik Standard
CO	(mg/m^3)	24-hour[a]	3	Tajik Standard
		8-hour	10 [c]	WHO AQG Level
		1-hour	35[c]	WHO AQG Level
		15-minute	100	WHO AQG Level

Pollutant	Unit	Averaging Period	Concentration	Source
		One-time exceedance	5	Tajik Standard
Dust including silicon dioxide (SiO_2) ($20\%<SiO_2<70\%$)	(mg/m^3)	24-hour	100	Tajik Standard
		One-time exceedance	300	Tajik Standard

Notes:

a) 99th percentile (i.e. exceedance days per year)

b) Average of daily maximum 8-hour mean O_3 concentration in the six consecutive months with the highest six-month running-average O_3 concentration

c) Guideline values that were not updated in the WHO Air Quality Guidelines in 2021 and are still valid.

8.3 ASSESSMENT METHODOLOGY

8.3.1. The assessment methodology is described in **Volume 1, Chapter 5: ESIA Methodology** of this ESIA.

AREA OF INFLUENCE

8.3.2. The Area of Influence (AoI) for the air quality assessment has been informed by:

- Desk-based review of publicly available information;
- The location of the nearest residential areas, community and recreational facilities;
- Stakeholder engagement; and
- Site observations.

8.3.3. For the construction phase, the AoI comprises the entire construction site given the dispersed location and multiple working areas where activities generate sources of emissions to air which have the potential to cause air quality impacts. The AoI for the construction phase extends to 2 km from the location of the source given that large particles are deposited within a short time and distance; but finer particles remain suspended for longer and can be carried considerable distances before settling.

8.3.4. The AoI for the operational phase extends to the site, the Pasi Muhraho village and Rogun City but, following completion of the construction phase, vehicle movements will be limited and there are no other major sources of emissions to air.

8.3.5. No other village is located within the Project AoI. The village of Sidoni Nav, located on the left bank to the north of the construction site, is approximately 3 km from the crushing plant at the northern end of Quarry 17 and, with the distance and prevailing wind direction, it is unlikely that dust generated at the crusher would reach the village.

IMPACT MAGNITUDE

8.3.6. The assessment of magnitude is based on available data and consideration of the duration, extent, reversibility, and likelihood of the impact. The definitions of these key criteria and how they are considered to define magnitude are presented in **Volume 1, Chapter 5** of this ESIA.

8.3.7. The categories of impact magnitude are described in **Table 8-6**. Due to the absence of a baseline AQ data set, no data is available that would allow for a distinction between natural variability in AQ determinants and the Project contribution to ambient AQ.

8.3.8. To determine impact magnitude, activities undertaken during the construction and operational phases generate particulates and/or emissions that either meet or exceed the relevant Project ambient air quality standard for outdoor, and the air quality standard for indoor areas within the tunnels and caverns. Consequently, a limited number of categories are described relative to the number of categories identified in **Volume 1, Chapter 5: Methodology** of this ESIA.

Table 8-6 – Impact Magnitude Category

Magnitude Category	Description
Large	Particulate and other air quality determinants in outdoor and indoor areas exceed the Project AQ standard for relevant long-term and short-term averaging periods.
Very Small	Particulate and other air quality determinants in outdoor and indoor areas are within the Project AQ standard for relevant long-term and short-term averaging periods.
Beneficial	N/A

RECEPTOR SENSITIVITY

8.3.9. In the context of this Project, the identified receptors include:

- Workers on site in proximity to activities undertaken during the construction and operational phases. The sensitivity of the receptors is categorized as **high**.
- Residents of local communities are exposed to air quality, where the elderly, children, pregnant women and people with pre-existing health conditions are at heightened risk of adverse health effects. The sensitivity of residents of local communities is **high**.

8.3.10. However, the local community receptors identified in **Table 8-7** are at least 1 km from the nearest location on the construction site where emissions to air are generated; as such, mitigation measures to reduce the impact to workers will effectively reduce the impact on residents of local communities.

8.3.11. The location of areas where receptors applicable to the assessment are identified in **Table 8-7**.

Table 8-7 – Receptor Location

Receptor Name	Approximate Distance from Nearest Working Area (km)	Approximate Direction from Nearest Working Area	Applicable Phase
On-Site Workers (workers)	Adjacent	N/A	Construction and Operation
Rogun City (residential, school, hospital)	1.5	NW ((right-bank stabilization works)	Construction and Operation
Pasi Muhraho Village near Construction Site 2 (residential)	1.1	NW (right-bank stabilization works)	Construction and Operation
We-Build Worker Accommodation (residential and workers)	2.0	W (Quarry 17 crusher plant)	Construction
Other Worker Accommodation (residential and workers)	1.5	W (Quarry 17 crusher plant) NNW (left-bank stabilization works)	Construction

8.3.12. The village of Sidoni Nav located on the left bank to the north of the site has been scoped out of the assessment as the village is outside of the Project AoI.

8.3.13. During a typical construction 12-hour shift, workers in outdoor areas are exposed to pollutants resulting from activities such as blasting, crushing, mixing, vehicles moving materials along unsurfaced roads, dust blown from stockpiles and exhaust emissions from plant and equipment. Workers in indoor areas are exposed to pollutants resulting from the operation of plant and equipment in underground areas and vehicle movements through access tunnels.

8.3.14. During the operational phase, workers will spend limited time in outdoor areas such as the substation site and around the reservoir area, and most of the operational and maintenance (O&M) activities will occur within the turbine hall, powerhouse, workshops, offices and ancillary buildings.

EFFECT SIGNIFICANCE

8.3.15. The significance of each effect will be assessed based on a combination of the magnitude of impact due to the Project activities, and the sensitivity of the receptor to the impact. The Effect Significance Matrix is shown in **Table 8-8**.

Table 8-8 – Effect Significance Matrix

Impact Magnitude	Receptor Sensitivity		
	Low	Medium	High
Beneficial	Positive	Positive	Positive
Very Small	Negligible	Negligible	Minor
Small	Negligible	Minor	Moderate
Medium	Minor	Moderate	Major
Large	Moderate	Major	Major

8.4 POTENTIAL IMPACTS AND EFFECTS

8.4.1. The impact assessment is informed by an understanding of current site conditions based on site visits, visual observations of the working practices and monitoring data. The assessment determined where there is potential for adverse air quality impacts and to recommended mitigation measures to reduce the potential impact on the identified receptors. The assessment considers potential impacts on the receptors due to changes in ambient air quality (outdoor) and on the air quality within caverns and tunnels (indoor) for both the construction and operational phases.

8.4.2. Meteorological conditions on site are described in **Volume 2, Annex 7.1: Baseline Conditions Report** of this ESIA. In summary, in the Vakhsh Valley region, the prevailing wind direction is west to east, with peak recorded wind speeds of up to 10 m/s. Dust storms are common in lowland areas between April and November, due to the aridity of the region situated in the 'global dust belt' which extends from the Sahara to the Gobi.

8.4.3. The sources of emissions to air and the locations of the sources are indicated in **Table 8-9**.

Table 8-9 - Sources and Location of Air Emissions on Site

Emissions Source	Potential Emissions	Main Dam	Left Bank Upstream	Downstream	Area 5	Underground Work Areas	Road at Pasi Muhraho
Construction Phase							
Blasting, demolition, excavation, crushing, concrete batching, earth moving and dumping, material transfer, stockpiles and drilling activities	TSP (dust, PM_{10}, $PM_{2.5}$)	x	x	x	x	x	x
Combustion emissions from engine exhausts including vehicles, equipment and generators	NO_2, SO_2, PM_{10}, $PM_{2.5}$, CO	x	x	x	x	x	x
Suspended particles from vehicle and plant movements on road surfaces	TSP (dust, PM_{10}, $PM_{2.5}$)	x	x	x	x	x	x
Ozone emissions from the use of electrical equipment	O_3	-	-	-	-	x	-
Operation Phase							
Suspended particles from vehicle movements on roads (dust, PM_{10}, $PM_{2.5}$).	TSP (dust, PM_{10}, $PM_{2.5}$)	-	-	-	x	x	x
Combustion emissions from engine exhausts including vehicles and equipment used for operations and maintenance	NO_2, SO_2, PM_{10}, $PM_{2.5}$, CO	-	-	-	-	X	x
Ozone emissions from the operation of electrical equipment	O_3	-	-	-	-	X	-

8.5 SITE AIR QUALITY

8.5.1. Air quality conditions on site are detailed section 2 of **Volume 2, Annex 7.1: Baseline Conditions Report** of this ESIA.

8.5.2. Potential sources of emissions to air are shown in **Figure 8-1** and **Figure 8-2** for the upstream and downstream areas respectively.

Figure 8-1 - Upstream Area - Stockpiles, Plant, Conveyors and Transport Routes

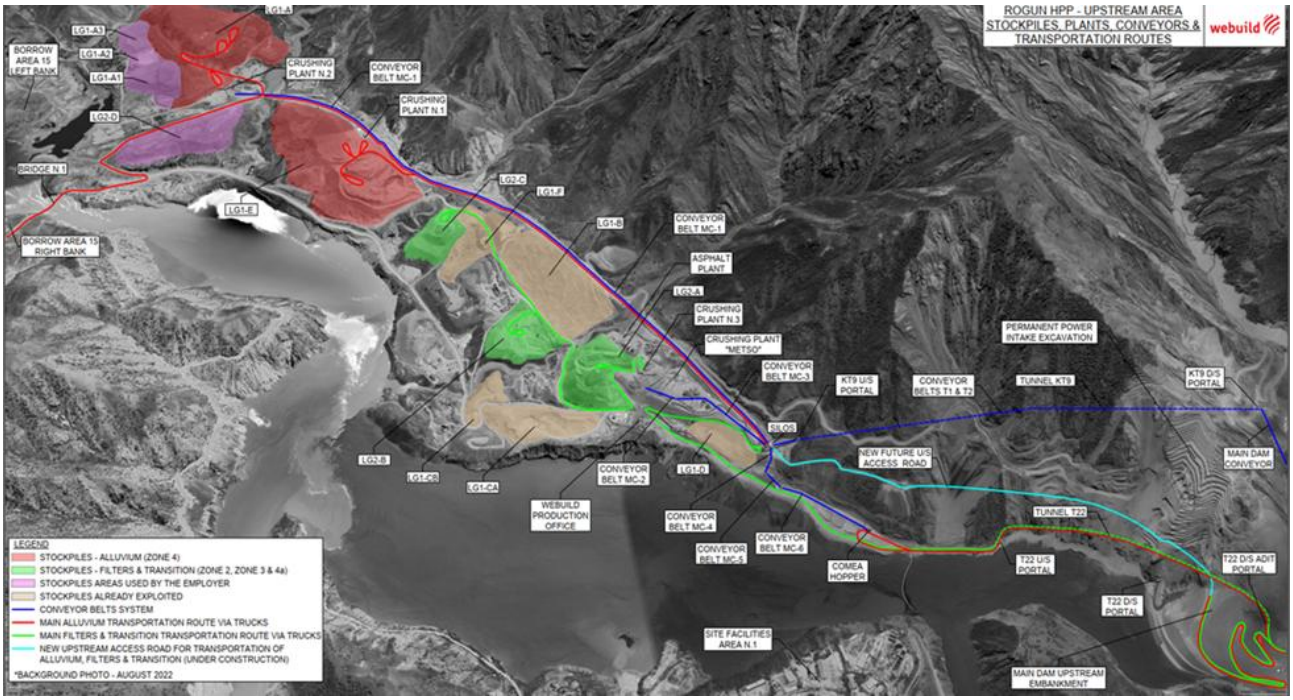
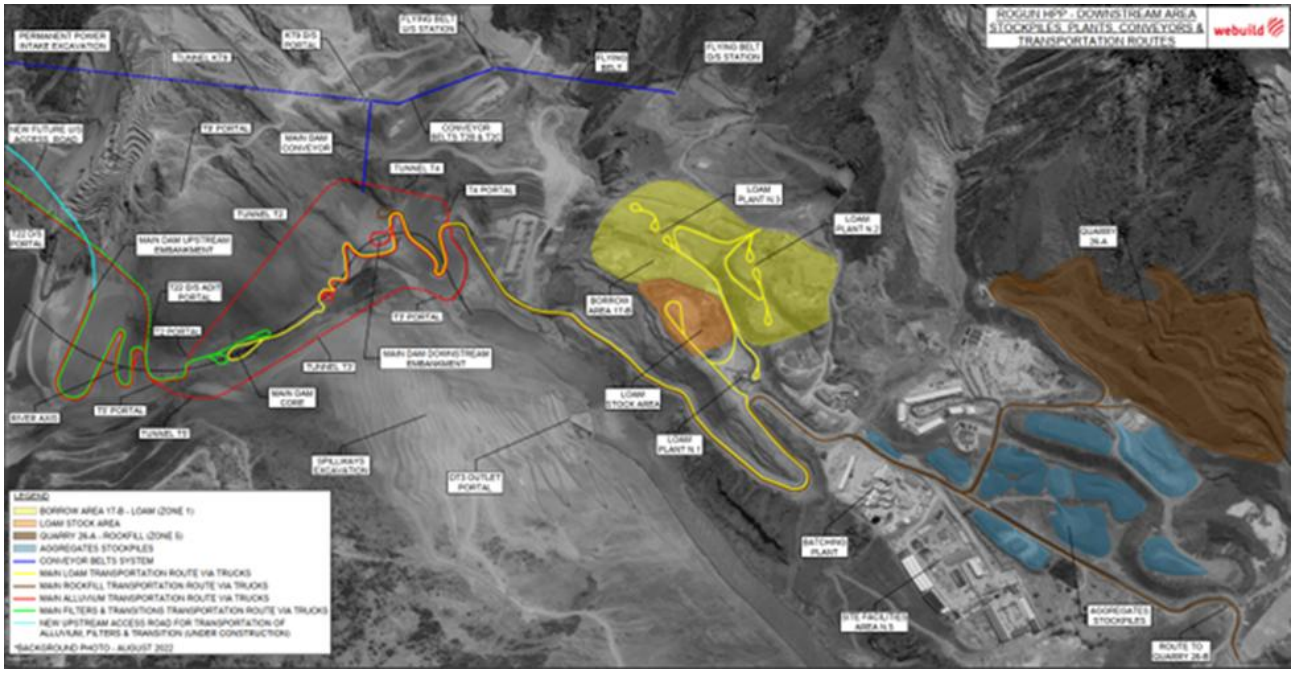


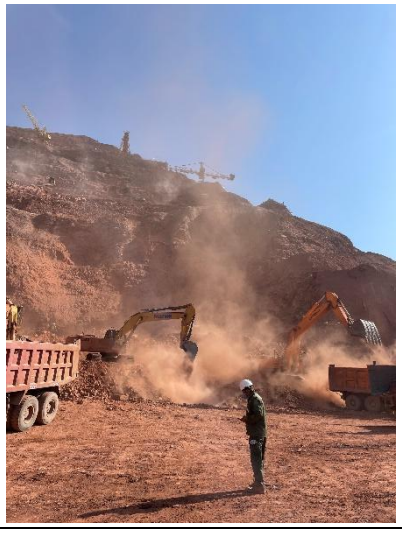
Figure 8-2 - Downstream Area – Stockpiles, Plant, Conveyors and Transport Routes



8.5.3. Site air quality conditions were observed during a site visit undertaken in May 2023 to verify the site monitoring program and concluded that:

- The construction area on the left bank generates significant dust, which is visible as a cloud above the site when viewed from a distance;
- A substantial amount of fugitive dust is generated due to the movement of construction traffic on dry and dusty haul roads within the site, primarily on the left bank—this would prevail in summer and early autumn dry conditions. Most above-ground roads are unpaved, and watering of road appears to be inconsistent across the site, with left bank roads better (but not adequately) watered, but the right bank access road to the site being extremely dusty and poorly watered, resulting in large fugitive dust emissions when used by vehicles;
- Fugitive dust is generated by handling of dusty materials, and evidently from trucks dumping materials down the side of embankments on a regular basis;
- Borrow pits, spoil storage areas and stockpiles are uncovered and observed as major sources of fugitive dust under windy conditions, although there are relatively few workers present to be exposed;
- Trucks carrying materials are not covered, but exposed materials nevertheless appear to be a relatively minor contributor to fugitive dust across the site.
- Fugitive dust and particulates are generated by underground vehicles, contributing to very poor air quality in the tunnels. In many locations, there is poor or no mechanical ventilation. In underground roads where daylight is not visible, and where no natural ventilation is possible, visible dust is present despite water ingress into tunnels from pipe work and other sources, which would be expected to have a mitigating effect;
- A high intensity of diesel-powered vehicle movement in the tunnels continue to emit $PM_{2.5}$, NO_2 and CO resulting in poor underground air quality. A deep haze in the air of many tunnels and in the powerhouse and other underground workplaces (especially where penstock and intake tunnels and shafts are being excavated) is likely to be a combination of humidity, diesel emissions, and fine particulates, which is considered almost certainly to present a significant health hazards to those who experience chronic exposure—this includes powerhouse staff and also construction staff since construction has been ongoing for nearly a decade and will continue until 2029; and
- Visible dust generation above ground and the deep haze underground demonstrate that more comprehensive management is required to improve current conditions at the site, and in particular to reduce risks for those working on site (particularly underground), those now residing in nearby Construction Camp 1, the settlement located in Construction Site 2, and future worker accommodation in Construction Site 2 and Area 5 downstream of the dam.
- General site air quality conditions are shown in **Figure 8-3**.

Figure 8-3 – General Site Air Quality Conditions

















CONSTRUCTION AIR QUALITY MONITORING

8.5.4. The monitoring of air quality is undertaken at several outdoor locations:

- Upstream cofferdam (dust, CO, NO_2, NO, SO_2, H_2S, CH_4, C_3H_8 and SiO_2);
- Downstream Coffer Dam (dust, CO, NO_2, NO, SO_2, H_2S, CH_4, C_3H_8 and SiO_2);
- Gas insulated substation (GIS) yard at T4 portal (dust);
- Main Dam Core (dust, CO, NO_2, NO, SO_2, H_2S, CH_4, C_3H_8 and SiO_2);
- Main Dam Core (middle) (dust);
- Main Dam Core (left side) (dust);
- Quarry No. 26 (CO, NO_2, NO, SO_2, H_2S, CH_4, C_3H_8 and SiO_2);
- GG2 (CO, NO_2, NO, SO_2, H_2S, CH_4, C_3H_8 and SiO_2);
- Asphalt Plant (CO, NO_2, NO, SO_2, H_2S, CH_4, C_3H_8 and SiO_2);
- CP-2 (CO, NO_2, NO, SO_2, H_2S, CH_4, C_3H_8 and SiO_2);
- CP-3 (CO, NO_2, NO, SO_2, H_2S, CH_4, C_3H_8 and SiO_2); and
- Quarry No. 17 (CO, NO_2, NO, SO_2, H_2S, CH_4, C_3H_8 and SiO_2).

8.5.5. The outdoor sample locations are shown in **Figure 2-3** of **Volume 2, Annex 7.1: Baseline Conditions Report** of this ESIA.

8.5.6. The monitoring of air quality is undertaken at several indoor locations:

- Tunnel 3A (CO, NO_2, NO, SO_2, H_2S, CH_4, C_3H_8 and SiO_2);
- Entrance of Tunnel 4 (CO, NO_2, NO, SO_2, H_2S, CH_4, C_3H_8 and SiO_2);
- Tunnel 22 (CO, NO_2, NO, SO_2, H_2S, CH_4, C_3H_8 and SiO_2); and
- Tunnel 5 (CO, NO_2, NO, SO_2, H_2S, CH_4, C_3H_8 and SiO_2).

8.5.7. The indoor sample locations are shown in **Figure 2-4** of **Volume 2, Annex 7.1: Baseline Conditions Report** of this ESIA.

8.5.8. An audit of the monitoring program undertaken in 2023 concluded that the sampling program is designed to indicate the presence of air pollutants and localized elevated concentrations and is fit for purpose. However, the monitoring program in its current form does not provide adequate data as:

- Spot samples do not represent air pollutant concentrations for the same exposure/ averaging periods as the Project Standards for both ambient and occupational exposure;
- The sampling period is not a full year and therefore may not represent pollutant concentration fluctuations caused by seasonality and all meteorological conditions; and
- The instrumentation used is not able to sample for the exposure periods required to assess against the Project standards.

8.5.9. The results of the outdoor and indoor monitoring indicate the presence of air pollutants and localized elevated concentrations. However, given the short-term nature of monitoring, the findings should be considered indictive only. The following indicative exceedances were recorded in the dataset, and these are further discussed in **Volume 2, Annex 7.1: Baseline Conditions Report**:

- SiO_2 at the Upstream Cofferdam in November and December 2023;
- SiO_2 at the Downstream Cofferdam in December 2023;
- SiO_2 at the Entrance of Tunnel 4 in December 2023; and
- CO at the Entrance of Tunnel 5 in January 2024.

8.5.10. A short sampling program was undertaken by WSP during the 2023 audit and all monitored pollutants were detected at the construction site, including plumes of visible dust observed at some of the areas visited. This monitoring program is summarized in **Volume 1, Chapter 7: Baseline** of this ESIA

8.6 IMPACT ASSESSMENT - CONSTRUCTION

8.6.1. The main construction site extends over an area of several square kilometers and, at the main dam, the left-bank, the right-bank and downstream of the main dam site the activities undertaken include blasting, demolition works, excavation works, crushing plants, concrete batching plants, earthmoving activities, material transfer including covered conveyors, open stockpiles and drilling.

TSP (DUST, PM_{10}, $PM_{2.5}$)

8.6.2. Activities that generate Total Suspended Particulates include:

- Blasting, demolition, excavation, crushing, concrete batching, earth moving and dumping, material transfer, stockpiles and drilling activities (main dam, left bank, right bank and Area 5).

- Vehicle and plant movements on roads (main dam, left bank, right bank, downstream, Area 5 and access tunnels).

8.6.3. Wind entrained dust (coarse particulates) from construction sources does not generally travel over distances greater than 250 m of the source. Fine particulates will be dispersed over greater distances particularly in the dry summer months. Dispersion is impacted by the topography within and surrounding the AoI as hilly and mountainous regions can lead to reduced wind speed or wake effects which may cause the particles to be deposited. In wet conditions in the winter months, particle mobilization by the wind is decreased.

8.6.4. Vehicles travelling along unpaved roads generate higher quantities of particulates than from paved roads. The speed of the vehicle and the moisture content of the surface material also affects the generation of dust. Dust entrained by vehicles is generally considered for receptors located within 50 m of roads[3]. The public and site roads are a combination of paved and unpaved surfaces.

8.6.5. Most roads within the tunnels are paved and water leaking from pipes in the tunnels has been observed to dampen the road surface with a resulting reduction in fugitive particulates and engine exhaust emissions as vehicles pass through the tunnels. In addition, the short tunnels have daylight at both ends within one km of the entrance or exit, providing natural ventilation with little visibility impairment.

8.6.6. During the 2023 site visit, poor visibility was noted in the tunnels, the impaired visibility indicating that the concentration of particulates and other pollutants likely exceed Project standards. Poor indoor air quality was cited in the 2014 ESIA with limited measures in place to manage the issue. Workers spend substantial amounts of time in underground spaces and tunnels, some workers are within tunnels for most of their 12-hour shift.

Impact Assessment

8.6.7. The receptors potentially impacted by this source are the site workers and residential receptors as defined in **Section 8.3**. The sensitivity of these receptors is **high**.

8.6.8. Air quality monitoring undertaken to date includes a trigger value for total suspended particulate matter (TSP) of 6 mg/m^3 (10-minute value) and 2mg/m^3 (8-hour value) at workplaces and work areas and 500 µg/m^3 at any sensitive receptor within 100m of the site boundary.

8.6.9. At the time of monitoring, localized concentrations of dust generated by construction activities were below the trigger value; however, SiO_2 concentrations exceed the Project standard for both outdoor and indoor areas, with indicative exceedances noted for one to two months at the end of 2023. Due to the proximity of the site workers to the emission sources, the magnitude of the potential impact is **large** as the 24-hour Project standard is exceeded, albeit that the workers will not be present for the full 24-hour period. The significance of the effect is **major**.

8.6.10. The village of Pasi Muhraho is located adjacent to the road used by heavy and light construction vehicles moving between Construction Site 1 or Rogun City to the site. In the absence of AQ monitoring data, the magnitude of the potential impact of suspended particulates on receptors within the village is **large** and the significance of the effect is **major**.

[3] IAQM Guidance on the Assessment of Dust from Demolition and Construction, 2024.

8.6.11. Site worker accommodation in Construction Site 1 and Rogun City is a minimum of 1 km from the nearest working area on the construction site. Given that larger suspended particles are known to settle within a short distance of the source and smaller suspended particles remain airborne depending on the wind speed and the presence of vegetation, it is unlikely that, due to the distance, AQ at these locations would be potentially impacted by suspended particulates generated on site. The magnitude of the impact is **very small**, the significance of the effect is **minor,** and no specific mitigation is proposed.

8.6.12. The demolition of structures on Construction Site 1 prior to inundation of the lower terrace will generate suspended particulates that may potentially impact on the WeBuild worker accommodation at Rogun City. An asbestos survey as described in **Volume 3, B14: Outline Demolition Management Plan** of this ESIA is required to protect worker health; however, most of the structures on site are prefabricated and the demolition process will be of short duration. The magnitude of the impact is **very small,** and the significance of the effect is **minor**.

Mitigation Measures

8.6.13. Mitigation measures to minimize the impact of particulates on workers and the village of Pasi Muhraho include:

- Undertake daily observations of visible dust at the Pasi Muhraho village and minimize dust on the paved road through the Pasi Muhraho village using water sprayers daily and more frequently during dry and windy periods;
- Fit watering system or dust extraction systems to crushing and mixing plant and consistently use systems to suppress airborne particulates;
- Use water cannons consistently in areas where spoil is dumped over the cliff and over large unpaved areas, especially during dry and windy periods;
- Use water sprayers consistently on roads on site and wet the load on open tip trucks prior to transport;
- Do not locate any activities that generate particulates adjacent to village community facilities or residential receptors;
- Ensure that workers wear appropriate PPE including face coverings during the shift if workers will be in areas that may exceed AQ standards for short periods of time. The face covering must show a NIOSH certification mark or the CE certification mark or equivalent;
- Ensure that roads within the tunnels are paved or kept sufficiently damp to minimize entrainment of particulates by vehicle movements; and
- If the mitigation measures are deemed to be insufficient, for example, dust levels are observed to be high, additional mitigation e.g. increased frequency of wetting of surfaces shall be undertaken.

Residual Effect Significance

8.6.14. With the implementation of the mitigation measures, the significance of the effect on the receptors, both workers and residents, can be reduced to **moderate**.

8.6.15. As **moderate** effects are considered significant, monitoring of AQ at sensitive receptor, including site locations where workers are undertaking activities and at Pasi Muhraro residences and at

Construction Site 1 worker accommodation, is required to ensure that the mitigation measures are sufficient to meet Project standards. The requirement for monitoring is described in **Section 8.8**.

EXHAUST EMISSIONS (NO_2, SO_2, PM_{10}, $PM_{2.5}$, CO)

8.6.16. Diesel, petrol and limited quantities of oil are used on site to power generators, plant and light and heavy vehicles both for site works and the transportation of workers. The major components of exhaust emissions include combustion products and fine particulates such as CO, NO_2, SO_2, PM_{10} and $PM_{2.5}$.

8.6.17. The receptors potentially impacted by this source are site workers and residents of local communities that have a **high** sensitivity.

Impact Assessment

8.6.18. On-site monitoring undertaken to date indicates that concentrations of these parameters are within the Project standard. The exception to this is CO, where an exceedance was recorded during a single month at one location. Particulate matter (PM_{10} and $PM_{2.5}$) from vehicle exhaust emissions is not monitored. However, given the lack of a robust AQ monitoring set to assess against the Project standards, the magnitude of the impact is considered **large**. The significance of the effect is **major**.

8.6.19. Several schemes have been implemented on site to reduce the combustion emissions. Most of the generator sets have been gradually replaced by generators powered by electricity received from the power line from Nurek HPP and in 2023 seven diesel-fueled generators remained on site. The covered conveyor belt transporting aggregate from Quarry 26a to the main dam site has considerably reduced vehicle exhaust emissions in recent years.

8.6.20. Within the short tunnels, natural ventilation provides limited fresh air at both ends of the tunnels. However, within the longer tunnels, the powerhouse and transformer caverns, there is no ducting to introduce clean air or to exhaust stale air that is recirculated by the fans that have been installed. The magnitude of the potential impact is **large,** and the significance of the effect is **major**.

8.6.21. The magnitude of the potential impact of exhaust emissions from vehicles on the road between the site and Construction Site 1 or Rogun City that pass the village of Pasi Muhraho is **large** given the number of vehicle movements and the significance of the effect is **major**.

Mitigation Measures

8.6.22. The following measures have been identified to further reduce the impact of exhaust emissions on indoor air quality:

- Ensure that generators, plant and vehicles are maintained in accordance with manufacturer's requirements to reduce excessive emissions. The maintenance of all vehicles and plant must be documented to ensure that it aligns with manufacturer instructions and GIIP supported by daily plant and vehicle inspections. This requirement should be included in the site vehicle and plant maintenance plans;
- Ensure that plant and equipment is not idled but switched off when not in use;
- Enforce the site vehicle speed limit of 20 km/hr in the tunnels to minimize exhaust emissions;
- Install mechanical ventilation of sufficient capacity to ensure sufficient delivery of fresh air to the working faces of the tunnels and removal of stale air;

- Ensure that roads within the tunnels are paved or kept sufficiently damp to minimize entrainment of particulates by vehicle movements;
- Where practicable, continue to replace fossil-fueled machinery with electrically operated plant and equipment; and
- Ensure that workers wear appropriate PPE including face coverings during the shift if workers will be in areas that may exceed AQ standards for short periods of time. The face covering must show a NIOSH certification mark or the CE certification mark or equivalent.

8.6.23. The following mitigations apply to outdoor areas:

- Ensure that generators, plant and vehicles are maintained in accordance with manufacturer's requirements to reduce excessive emissions. The maintenance of all vehicles and plant must be documented to ensure that it aligns with manufacturer instructions and GIIP supported by daily plant and vehicle inspections. This requirement should be included in the site vehicle and plant maintenance plans;
- Ensure that plant and equipment is not idled but switched off when not in use;
- Enforce the site vehicle speed limit of 40 km/hr above ground to minimize exhaust emissions;
- Ensure that workers wear appropriate PPE including face coverings during the shift if workers will be in areas that may exceed AQ standards for short periods of time. The face covering must show a NIOSH certification mark or the CE certification mark or equivalent; and
- Ensure that vehicles travelling between the site and Construction Site 1 or Rogun City adhere to the speed limit.

Residual Effect Significance

8.6.24. With the implementation of the mitigation measures, the significance of the effect on the receptors, both workers and residents, can be reduced to **moderate**.

8.6.25. As **moderate** effects are considered significant, monitoring of AQ at sensitive receptors, including site locations where workers are undertaking activities and at Pasi Muhraro residences and at Construction Site 1 worker accommodation, is required to ensure that the mitigation measures are sufficient to meet Project standards. The requirement for monitoring is described in **Section 8.8**.

OZONE EMISSIONS

8.6.26. There is potential for ozone (O_3) to be emitted from electrical equipment including the switchgear, cables, transformers and breakers, which may have implications for site workers. The sensitivity of the site workers is **high**.

Impact Assessment

8.6.27. There is temporary ventilation equipment in place in the powerhouse and transformer caverns, but this is considered inadequate. While the indoor ozone levels are unknown, the deep haze in many tunnels, the powerhouse and other underground workplaces strongly suggests that the magnitude of the potential impact is **large** and the significance of the effect is **major**.

8.6.28. Transformers will also contain sulfur hexafluoride (SF_6) as an insulating gas and the assessment of the potential impact of SF_6 on the atmosphere is described in **Volume 1, Chapter 9 Greenhouse Gases** of this ESIA.

Mitigation Measures

8.6.29. At present, there is insufficient information to comprehensively assess the risks and define a monitoring program for ozone. However, given the known health risks due to ozone, Rogun JSC and the relevant contractors must undertake a risk assessment to characterize the air quality within the turbine hall, powerhouse, tunnels and other interior workplaces for which they are responsible.

8.6.30. Mitigation measures to reduce the potential impact of ozone on workers in the underground work areas and tunnels can be categorized as conditional on the outcome of the risk assessment. Should the risk assessment indicate that the AQ within these areas does not comply with Project AQ standards, then a permanent ventilation system must be installed in the turbine hall, powerhouse, tunnels and other interior workplaces with sufficient capacity to ensure that the interior AQ meets Project AQ standards.

8.6.31. Mitigation measures that must be implemented as GIIP include:

- Ensure that generators, plant and vehicles are maintained in accordance with manufacturer's requirements to reduce excessive emissions. The maintenance of all vehicles and plant must be documented to ensure that it aligns with manufacturer instructions and GIIP supported by daily plant and vehicle inspections. This requirement should be included in the site vehicle and plant maintenance plans;
- Ensure that plant and equipment is not idled but switched off when not in use;
- Enforce the site vehicle speed limit of 20 km/hr in the tunnels to minimize exhaust emissions;
- Install mechanical ventilation of sufficient capacity to ensure sufficient delivery of fresh air to the working faces of the tunnels and removal of stale air;
- Ensure that roads within the tunnels are paved or kept sufficiently damp to minimize entrainment of particulates by vehicle movements;
- Where practicable, continue to replace fossil-fueled machinery with electrically operated plant and equipment; and
- Ensure that workers wear appropriate PPE including face coverings during the shift if workers will be in areas that may exceed AQ standards for short periods of time. The face covering must show a NIOSH certification mark or the CE certification mark or equivalent.

Residual Effect Significance

8.6.32. With implementation of GIIP, the significance of the effect can be reduced to **moderate**. However, as **moderate** effects are considered significant, monitoring of AQ at sensitive receptors is required to ensure that the mitigation measures are sufficient to meet Project standards. The requirement for monitoring is described in **Section 8.8**.

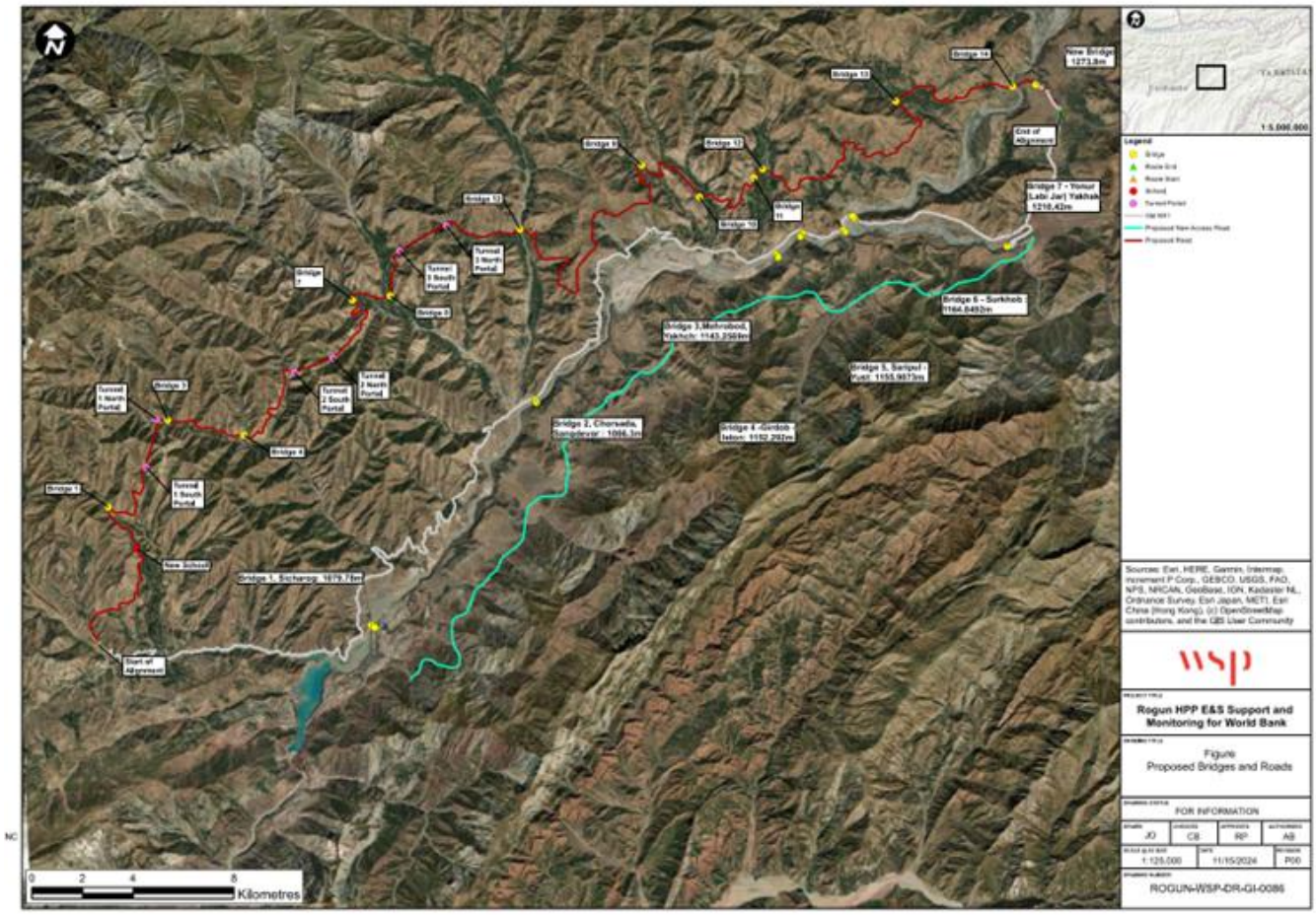
8.6.33. Pending the contractor assessments and implementation of the mitigation measures, the significance of the residual effects could be reduced to **minor**.

LEFT BANK ROAD

8.6.34. The progressive inundation of the reservoir will flood roads and bridges that connect the villages located on the left and right banks of the Vakhsh river; and villages located on the tributaries will also be affected. The timing of the inundation and the impact on roads and bridges is described in **Volume 1, Chapter 3: Project Description** of this ESIA.**The** The left bank road will be reinstated as

part of the reprovision of existing infrastructure as a bare ground road to prevent severance of communities, as detailed in **Volume 2, Annex 17-3: Severance Impacts** of this ESIA. The route of the left bank road is shown in **Figure 8-4** and the road alignment will pass close to or through several villages along the route. The distance of the road to the villages is unknown; however, village residents have been identified as receptors with a **high** sensitivity.

Figure 8-4 - Proposed Left Bank Road Alignment



8.6.35. The left bank road construction and rehabilitation activities that potentially impact on air quality include:

- Earth moving equipment and vehicle exhaust emissions.

Impact Assessment

8.6.36. The construction and rehabilitation activities will generate dust, finer particulate matter and exhaust emissions in the immediate vicinity of the works and, given the earth moving equipment and site vehicles operating at any one stretch of the road, the local air quality may be impacted.

8.6.37. Wind entrained dust (coarse particulates) from construction sources does not generally travel over distances greater than 250 m of the source. Fine particulates will be dispersed over greater distances particularly in the dry summer months and dispersion is also determined by the topography as hilly and mountainous regions can lead to reduced wind speed or wake effects which

may cause the particles to be deposited. Dust entrained by vehicles is generally considered for receptors located within 50 m of roads[4]. In wet conditions in the winter months, particle mobilization by the wind is decreased. Vehicles travelling along unpaved roads generate higher quantities of particulates than from paved roads. The speed of the vehicle and moisture content of the surface material also affects the generation of dust.

8.6.38. As the road is a bare ground road, it will follow the contours of the landscape and the requirement for road cuttings will be limited to maintain the road grade. Where the road intersects the Vakhsh river tributaries, five new bridges will be constructed.

8.6.39. During the construction phase, the potential for local AQ determinant concentrations to exceed Project standards and the magnitude of the potential impact is **very small** and the significance of the effect is **minor**.

Mitigation Measures

8.6.40. Although the significance of the effect is minor, mitigation measures to minimize the impact of the road construction activities are required as GIIP:

- Ensure that maintenance of all vehicles and plant aligns with manufacturer instructions and daily plant and vehicle inspections are undertaken. This requirement should be included in the site vehicle and plant maintenance plans;
- Ensure that the speed limit is limited to between 10 and 20 km/h in areas where construction works are taking place;
- Ensure that completed sections of the road are kept sufficiently damp to minimize entrainment of particulates by construction vehicle movements; and
- Ensure that workers wear appropriate PPE including face coverings during the shift if workers will be in areas that may exceed AQ standards for short periods of time. The face covering must show a NIOSH certification mark or the CE certification mark or equivalent.

Residual Effect Significance

8.6.41. With the implementation of the mitigation measures the significance of the residual effect is **negligible**.

8.6.42. Management of construction traffic should follow the measures identified in **Volume 3, A9a On-site Traffic Management Plan** of this ESIA.

8.7 IMPACT ASSESSMENT - OPERATIONS

8.7.1. As discussed in **Section 8.3**, the assessment for the operational phase includes potential impacts in indoor area where activities will include:

- Routine operation and maintenance (O&M) - activities within the turbine hall and powerhouse may include functional checks on the turbine, gearbox inspections and lubrication, hydraulic systems inspection and oil change and sensor checks and recalibration; and
- Reactive maintenance – activities may include repairs and replacement of mechanical and electrical parts undertaken on a scheduled basis or as necessary.

[4] IAQM Guidance on the Assessment of Dust from Demolition and Construction, 2024.

8.7.2. The potential impacts on receptors, including workers and residents of the Pasi Muhraho village and Rogun City are also considered.

8.7.3. During the operational phase, dust generated by O&M activities undertaken outdoors will be *de minimis* and are scoped out of the assessment.

TSP, EXHAUST EMISSIONS AND OZONE EMISSIONS

8.7.4. The primary changes from the construction to the operational phase include:

- A substantially smaller workforce of approximately 800 personnel is required to operate and maintain the HPP;
- A substantially smaller number of vehicles will be required, with mostly buses and light vehicles traversing the site; and
- Most energy demand can be met by renewable energy generated on site.

8.7.5. Workers will undertake O&M activities within indoor areas such as the turbine hall, powerhouse and access tunnels. The sensitivity of workers as a receptor is **high**. The sensitivity of workers in outdoor areas and the residents of the adjacent village of Pasi Muhraho and of Rogun City is **high**.

Impact Assessment

8.7.6. Although far fewer vehicles will utilize the access tunnels relative to the construction phase, suspended particulates, exhaust emissions and ozone emissions have the potential to exceed the Project standards and the magnitude of the potential impact on workers that may be in the tunnels is **large** and the significance of the effect is **major**.

8.7.7. Following completion of the construction phase, vehicle movements due to Project activities will be substantially reduced on roads passing the Pasi Muhraho village and within Rogun City, and the entrainment of particulate matter will be minimized due to the reduction in the number of vehicles and the roads being paved. The potential impact of suspended particulates and exhaust emissions on residents during the operational phase is scoped out of the assessment.

Mitigation Measures

8.7.8. The following mitigation measures have been identified to ensure that the air quality within indoor areas is maintained:

- Ensure that vehicles are maintained in accordance with manufacturer's requirements to reduce excessive emissions. The maintenance of all vehicles must be documented to ensure that it aligns with manufacturer instructions supported by daily vehicle inspections. This requirement should be included in the vehicle maintenance plans;
- The roads within the tunnels must be paved or kept sufficiently damp to minimize entrainment of particulates by vehicle movements;
- Ensure that workers wear appropriate PPE including face coverings during the shift if workers will be in areas that may exceed AQ standards for short periods of time. The face covering must show a NIOSH certification mark or the CE certification mark or equivalent; and
- Enforce the 20 km/h speed limit within the tunnels.

Residual Effect Significance

8.7.9. With the implementation of the mitigation for suspended particulates, exhaust emissions and ozone emissions, the significance of the effect can be reduced to **moderate**.

8.7.10. As **moderate** effects are considered significant, the OHS Plan must include an AQ monitoring program, implemented to assess the risk of air emissions on workers and identify the requirement for mitigation measures, including mechanical ventilation of the powerhouse and transformer room to maintain sufficient exchange of fresh air to comply with Project standards.

LEFT BANK ROAD

8.7.11. The alignment of the left bank road is not yet finalized, but where it passes close to villages, the residents of the villages have a **high** sensitivity.

8.7.12. Once completed, the unpaved road surface will be a source of dust and finer particulate matter due to passing vehicles, especially during the dry season and in windy conditions. Dust entrained by vehicles is generally considered for receptors located within 50 m of roads[5]. Finer particulate matter may be deposited further away depending on the wind speed and direction, vegetation and topography. Particulates generated by engine exhaust emissions tend to settle out of suspension within 250 m from the source.

Impact Assessment

8.7.13. The left bank road will be used by residents for access between villages and to travel to the larger centers located on the right bank. As an access road serving small villages and isolated dwellings, the road will not carry substantial volumes of traffic; however, the use of the road has the potential to impact on village residents depending on the final alignment.

8.7.14. Given the number of vehicles that will utilize the left bank road at any one time, it is unlikely that any of the Project standards for AQ determinants will be exceeded. The magnitude of the impact is **very small,** and the significance of the effect is **minor,** and no mitigation is proposed.

8.7.15. The left bank road will be the responsibility of the Jamoat and will be maintained in compliance with local requirements.

8.8 MONITORING AND ADAPTIVE MANAGEMENT

8.8.1. Site-wide E&S standards and guidelines will be established by Rogun JSC in **Volume 3, B6: Outline Air Quality Management Plan** of this ESIA. The document will specify the Project AQ standards for sensitive receptors, identify the overarching requirements for AQ management, alignment with other Project management plans, and the responsibilities and coordination required for implementation, monitoring and reporting to Rogun JSC.

8.8.2. For the construction phase, the EPC Contractor and all sub-contractors will each prepare a detailed AQ management plan that will be reviewed and approved by the Engineer's Representative and/or PMG. For the operational phase, the detailed management plan will be prepared and implemented by Rogun JSC as the operator of Rogun HPP.

8.8.3. The detailed management plans will include, but not be limited to, the mitigation measures identified in this chapter. In the absence of representative AQ measurements to quantify the AQ baseline,

[5] IAQM Guidance on the Assessment of Dust from Demolition and Construction, 2024.

mitigation measures identified in this ESIA may not be sufficient and residual effects may remain significant. This has been addressed by including a requirement for further measures to be implemented, specifically for AQ monitoring to be undertaken to check AQ relative to the Project standards.

8.8.4. The AQ monitoring to be undertaken requires a comprehensive and systematic monitoring program to be developed and implemented for the construction phase. The monitoring program should be developed by AQ specialists with expertise and experience of preparing monitoring plans for large construction sites having multiple types of activities that result in emissions to air.

8.8.5. Specific requirements for AQ monitoring include, but are not limited to:

- Use of diffusion tubes for sampling, where appropriate, to collect long-term data for Project AQ determinants at locations of sensitive receptors. Air quality monitoring must include all determinants in **Table 8-5**;
- Use of Type I or Type II hand-held air quality monitoring equipment that is maintained, serviced and calibrated according to manufacturer instructions;
- Use of an accredited laboratory for the analysis of AQ samples; a robust chain of custody procedure should be documented and tested;
- Ensure that the averaging period/s used for monitoring of AQ determinants align with the Project standard (short-term or long-term) to ensure that the monitoring data and Project standards are directly comparable; and
- Commission an annual review of the monitoring system by a suitable qualified and experienced specialist to ensure that the ambient and indoor AQ meets Project standards, and that either the Project standards and/or the monitoring done by contractors is amended, as necessary to continually improve the monitoring program.

8.8.6. PMG must instruct the contractor to stop work where monitoring indicates that Project standards are constantly exceeded for one or more AQ determinants. Work can restart when PMG or the representative is satisfied that AQ concentrations do not pose a hazard to workers; either through the ventilation of the workspace or workers using the specified PPE.

8.8.7. All contractors are required to monitor for AQ and implement measures to reduce emissions, including dust, when concentrations exceed Project standards.

8.8.8. If the monitoring indicates that Project standards for indoor AQ are exceeded, contractors will be required to install forced-air ventilation systems of sufficient capacity to maintain indoor AQ in compliance with Project standards.

8.9 SUMMARY

A summary of the construction and operational air quality impacts from the Project, pre- and post-mitigation, is presented in **Table 8-10** and **Table 8-11** respectively.

Table 8-10 - Summary of Air Quality Assessment (Construction)

Impact	TSP (DUST, PM_{10}, $PM_{2.5}$)			Exhaust Emissions (NO_2, SO_2, PM_{10}, $PM_{2.5}$, CO)			Ozone Emissions	Associated Facilities – Left Bank Road
Receptor	Workers	Pasi Muhraho village	Construction Site worker accommodation Rogun City worker accommodation and residential areas	Workers (indoors)	Pasi Muhraho village	Workers (outdoors) Construction Site worker accommodation Rogun City worker accommodation and residential areas	Workers	Residents of Villages adjacent to the road
Receptor Sensitivity	High	High	High	High	High	High	High	High
Frequency	Periodic	Periodic	Periodic	Periodic	Periodic	Periodic	Periodic	Periodic
Likelihood	Certain	Certain	Certain	Certain	Certain	Certain	Certain	Certain
Extent	Local	Local	Local	Local	Local	Local	Local	Local
Duration	Medium-term	Medium-term	Medium-term	Medium-term	Medium-term	Medium-term	Medium-term	Medium-term
Magnitude	Large	Large	Very Small	Large	Large	Very Small	Large	Large
Effect	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse
Direct / Indirect	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct
Significance of Effect	**Major**	**Major**	**Minor**	**Major**	**Major**	**Minor**	**Major**	**Major**
Mitigation (Y/N)	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Residual Significance	**Moderate**	**Moderate**	**Minor**	**Moderate**	**Moderate**	**Minor**	**Moderate**	**Moderate**

Table 8-11 - Summary of Air Quality Assessment (Operation)

Impact	TSP, Exhaust Emissions and Ozone Emissions	Associated Facilities – Left Bank Road
Receptor	Workers (indoors)	Residents of Villages adjacent to the road
Receptor Sensitivity	High	High
Frequency	Periodic	Periodic
Likelihood	Certain	Certain
Extent	Local	Local
Duration	Long-term	Long-term
Magnitude	Large	Very Small
Effect	Adverse	Adverse
Direct / Indirect	Direct	Direct
Significance of Effect	Major	Minor
Mitigation (Y/N)	Yes	No
Residual Significance	Moderate	Minor

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JSC “Rogun HPP” State Enterprise “Directorate for Flooding Zone of Rogun HPP” Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT – UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Volume 1, Chapter 9: Greenhouse Gases



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9 GREENHOUSE GASES

9.1.1. This chapter considers the impact of Greenhouse Gas (GHG) emissions during the Project construction and operation stages on global GHG.

9.1.2. The approach to carbon management within any ESIA is to provide a clear and proportional assessment of GHG emissions that includes practical mitigation measures. This is achieved by proposing for inclusion only those emission sources that are expected to be significant, that are within the Project's direct control or are expected to materially affect the assessment outcome.

9.1.3. A comprehensive description of GHG baseline conditions are presented in **Volume 2, Annex 7.1: Baseline Conditions Report** and a summary is provided in **Volume 1, Chapter 7: Environmental and Social Baseline** of this ESIA. An assessment of the potential impacts due to GHG emissions is presented in Section 9.8. Mitigation measures for the avoidance of impact, impact minimization and long-term management are included in Section 9.9.

9.1.4. Previous Project reports have not specifically considered the assessment of GHG emissions, and to date, the methane emissions produced by the reservoir have not been calculated, neither has any calculation of potential carbon savings from replacing fossil fuels with hydropower.

9.2 POYRY (2014) ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR ROGUN HYDOR POWER PLANT

9.2.1. The 2014 ESIA report touched on the issue of GHG emissions, stating that:

- Under conditions where large amounts of biomass are submerged or eutrophication occurs due to high trophic productivity or the stock of organic material in the reservoir, high oxygen consumption results due to the breakdown of the biomass and the deeper layers of the reservoir become anoxic. This can lead to an emission of methane from the reservoir, predominantly in large reservoirs in moist tropical areas; and
- Hydropower can reduce GHG emissions by reducing the amount of CO_2 emissions from the combustion of fossil fuels to produce electricity in thermal power plants.

9.2.2. No calculation of GHG emissions from the Project was undertaken as part of the 2014 ESIA report.

9.3 LEGISLATIVE FRAMEWORK, POLICY AND GUIDANCE

9.3.1. This section identifies the relevant legislation, policy and guidance for this GHG assessment.

THE LAW OF THE REPUBLIC OF TAJIKISTAN ON ENVIRONMENTAL PROTECTION

9.3.2. The Law does not refer to GHG emissions and GHG emissions are currently not controlled by legislation.

NATIONALLY DETERMINED CONTRIBUTION OF THE REPUBLIC OF TAJIKISTAN (FAO, 2022)

9.3.3. Tajikistan submitted its updated Nationally Determined Contribution (NDC) in June 2022, with input from various sectors that include revised unconditional and conditional emissions reduction targets for 2030 and increases the focus on adaptation. Tajikistan's updated NDC commits to a 50-60% reduction in emissions by 2030 compared to 1990 levels, conditional on international support. The country also set an unconditional emissions reduction target of 60-70% by 2030 compared to 1990 levels.

THE NATIONAL ACTION PLAN OF THE REPUBLIC OF TAJIKISTAN FOR CLIMATE CHANGE MITIGATION (FAO, 2003)

9.3.4. The National Action Plan (NAP) 2003 is a national-wide policy aiming at implementing the commitments of the Republic of Tajikistan concerning the UN Framework Convention on Climate Change (UNFCCC). Tajikistan's NAP includes the following measures on reduction of GHG emissions and enhancing of natural sinks of carbon:

- Enhancement of energy efficiency in relevant sectors of the national economy;
- Application of effective technologies and use of energy sources that promotes high rates of economic growth and reduce or limit GHG emissions;
- Protection and enhancement of natural sinks and reservoirs of GHG emissions;
- Promotion of sustainable forest management practices, afforestation and reforestation;
- Promotion of sustainable forms of agriculture;
- Research on promotion, development and use of new and renewable energies together with advanced and environmentally sound technologies; and
- Encouragement of appropriate reforms in relevant sectors to promote measures to limit or reduce GHG emissions.

9.4 GHG GUIDANCE

9.4.1. The approach to the calculation of GHG emissions is aligned with the guidance in:

- **Greenhouse Gases from Reservoirs Caused by Biogeochemical Processes** (World Bank, 2017): This document by the World Bank acts as a technical note to provide guidance on how to assess GHG emissions from reservoirs at an early stage of the preparation process. It recommends the use of GHG Reservoir tool (G Res tool) which has been developed by the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Hydropower Association (IHA).
- **GHG Protocol Corporate Standard** (Greenhouse Gas Protocol, 2015) **:** The GHG Protocol Corporate Accounting and Reporting Standard provides requirements and guidance for companies and other organizations preparing a corporate-level GHG emissions inventory. The standard covers the accounting and reporting of seven greenhouse gases covered by the Kyoto Protocol – carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3).

- **Guidelines for Estimating Greenhouse Gas Emissions of Asian Development Bank Projects** (ADB, 2017): The ADB guidance document puts forth general methodologies to estimate GHG emissions during project appraisal/development stage. The methodologies included are consistent with the approaches used by International Finance Institutions (IFI) and are based on the Clean Development Mechanism (CDM) methodologies and Japan Bank for International Cooperation's Guidelines for Measurement, Reporting and Verification of GHG Emission Reductions (Japan Bank for International Cooperation's J-MRV) (JBIC, 2018).

9.5 SCOPING

SCOPE OF THE GHG ASSESSMENT

9.5.1. The GHG assessment is not restricted by geographical area but instead includes "any increase or decrease in emissions as a result of the Project wherever they occur." This normally includes:

- Construction emissions from the Project, including the transport of materials to and from the site and their manufacture;
- Biogenic emissions - which originate from the decomposition of organic materials like plants and soil. Such emissions often arise from submerged vegetation in reservoirs, causing organic material underwater to decompose and release gases like methane (CH_4); and
- Decommissioning emissions.

9.5.2. **In accordance with the GHG Protocol**, the potential sources of emissions for each scope are set out as per Table 9-1, including justification of each being scoped in or out of the assessment.

Table 9-1 - Scope of the GHG Assessment

Scope	Potential Sources of Emissions	Scope In for Assessment	Justification
Scope 3 - Construction Emissions	GHG Emissions associated with the extraction and production of building materials by the manufacturer.	Yes	These activities are included as they have the potential to generate emissions and are material to the assessment.
	Emissions related to transporting the finished product to the construction site.	Yes	These activities are included as they have the potential to generate emissions and are material to the assessment.
	Construction site emissions from fuel and energy consumption	Yes	This completes the 'embodied carbon' assessment for the construction phase of works.
Scope 1 - Biogenic Emissions	Biogenic emissions from the reservoir	Yes	This is included as it has the potential to generate emissions material to the assessment.
Scope 2 – Consumer emissions	Emissions from the use of purchased energy by the consumer	Yes	This is likely one of the biggest sources / differences in emissions between the do minimum and do something scenarios.

Scope	Potential Sources of Emissions	Scope In for Assessment	Justification
Scope 2 – Operational Emissions	Operational Emissions due to heating, cooling and steam	No	Due to limited data on equipment data at this stage, operational emissions have been scoped out of the assessment.
Scope 3 - Decommissioning Emissions	Emissions from the decommissioning of plant and equipment and the deconstruction of the dam and ancillary infrastructure	No	Project lifespan is determined by the sedimentation rate, currently estimated at more than 100 years.

9.6 ASSESSMENT METHODOLOGY

GENERAL APPROACH

9.6.1. GHG emissions should be quantified following an internationally recognized methodology. The GHG Protocol: A Corporate Accounting and Reporting Standard (Greenhouse Gas Protocol, 2015) details the accounting and reporting of seven greenhouse gases covered by the Kyoto Protocol – carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PCFs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3).

9.6.2. For reporting purposes and to avoid double counting of emissions, the GHG Protocol divides GHG emissions into three separate 'scopes':

- **Scope 1 Direct GHG emissions -** from sources owned or controlled by the Project e.g. from a turbine;
- **Scope 2 Electricity indirect GHG emissions -** GHG emissions from generation of purchased electricity by the Project; and
- **Scope 3 Other indirect emissions -** emissions that result from Project activities but occur from sources not owned or controlled by the Project e.g. transport of fuels or materials. Scope 3 emissions are considered an optional reporting category and can often be difficult to quantify.

9.6.3. In accordance with the GHG Protocol, Scope 1, 2 and 3 emissions for the Project are quantified and reported in this ESIA.

9.6.4. To estimate GHG emissions, activity data (e.g. fuel consumption, electricity usage, transportation distances) should be multiplied by the corresponding emissions factors sourced from established databases, such as the UK Government GHG Conversion Factors for Company Reporting. The resulting emissions are converted into CO_2 equivalents (CO_2e) by applying the global warming potential (GWP) values as defined by the Intergovernmental Panel on Climate Change (IPCC).

9.6.5. Construction emissions have been calculated and aligned to the GHG Protocol's corporate reporting scopes, ensuring consistency with global reporting standards. Additionally, biogenic emissions have been assessed using the G-res tool, which is specifically designed to evaluate emissions associated with biogenic processes in hydropower reservoirs. Together, these methodologies offer a robust approach to capturing both construction and biogenic emissions accurately. Further detail of the approach to each aspect is given in the following sections.

Construction materials

9.6.6. Emissions from the manufacturing of construction materials used on site are one of the major contributors to the total GHG emissions. These emissions form part of the Scope 3 construction emissions.

9.6.7. The quantities of materials used in this assessment have been taken from Bill of Quantities (BOQs) for Lot 1, Lot 2, Lot 3 and Lot 4 and are summed to arrive at total quantity for each material type. Given the limited information in the BOQ for mechanical and electrical components, the assessment focusses primarily on civil infrastructure elements with appropriate uplift applied to account for other components. The assessment has been based on the following key elements that are the largest contributors of GHG emissions on civil infrastructure projects: excavation and embankment (dam construction), reinforced concrete and steel manufacturing.

9.6.8. Emissions Factors for Embankment Sand and Rocks were taken from the research paper (Cuihong Song et. al., 2018), highlighting the emissions of different components of the dam structure. Factors for all the remaining assets listed are taken from Bath Inventory of Carbon and Energy (ICE) V3.0 database (Bath ICE, 2019).

9.6.9. The corresponding assumptions while extracting relevant material quantities and choosing emission factors have been listed in the Assumptions and Limitations section of this chapter.

9.6.10. Construction materials have been assigned appropriate modelled materials using professional judgement and best practice. The emissions from the construction stage of the Project are assessed using the quantities and emission factors listed in **Table 9-2**.

Table 9-2 - Material Quantity from BOQs and Emission Factors

Asset Type	Material to be Modelled	Quantity	Unit	Emission Factor	Source
Excavation / Excavation common / Excavation and Support	Soil	7,344,436	m^3	0.0075 tCO_2e/t	Bath ICE V3.0 - Aggregate, General UK mixture
Excavation in Rock	Stone	733,969	m^3	0.079 tCO_2e/t	Bath ICE V3.0 -Stone general
Embankment / Embankment Alluvium shell / Embankment filter/ transition / drains	Sand	49,456,671	m^3	0.002 $kgCO_2e/kg$	Research Paper - Renewable and Sustainable Energy Reviews
Embankment Rockfill Shell / riprap	Stone	15,903,525.00	m^3		
Embankment Core	Concrete	6,992,491.00	m^3	0.1591 tCO_2e/t	Bath ICE V3.0 - Concrete C40/50
Rock mass	Stone	177,465	m^3	0.079 tCO_2e/t	Bath ICE V3.0 -Stone general
Shotcrete / Concrete and grouting / lean concrete	Concrete	1,363,319	m^3	0.1591 tCO_2e/t	Bath ICE V3.0 - Concrete C40/50

Asset Type	Material to be Modelled	Quantity	Unit	Emission Factor	Source
Slabs / civil works / Intake culvert	Reinforced Concrete	590,590	m^3	0.1908 tCO_2e/t	Bath ICE V3.0 - Concrete, Precast Concrete RC 40/50, CEM1 cement
Perforated drainage pipe / penstocks / hydraulic structure / anchor / metal cladding	Steel	49,548	tonnes	2.42 $kgCO_2e/kg$	Bath ICE V3.0 -Steel, pickled hot rolled steel

MATERIAL TRANSPORTATION

9.6.11. The GHG emissions associated with the transportation of construction materials to the Project Site should be quantified as part of the overall carbon assessment. This includes evaluating the distance materials are transported, the modes of transportation used (e.g., trucks, rail, shipping), and the specific materials being delivered. Emission Factors for each transportation mode should be applied to the relevant activity data (e.g., tonne-km travelled) to estimate total emissions. Identifying opportunities for reducing these emissions may involve optimizing logistics, consolidating deliveries, and selecting lower-carbon transport options.

9.6.12. The transport distances for Concrete and Steel have been assumed to be sourced from Primary Suppliers, as per Table 3-12 of **Volume 1, Chapter 3: Project Description**. The transport emissions have been assessed based on Average Laden load for journey to the Site, and Empty Laden load for journey away from the Site.

Table 9-3 - Transport Distances and Emission Factors

Asset Type	Source	Average Distance (in km)	Average Laden Emission Factor ($kgCO_2e/t.km$)	Empty 0% Laden Emission Factor ($kgCO_2e/t.km$)
Concrete	Dushanbe and Yavan	150	0.17819	0.65828
Steel	Russia/Iran	1500		

SITE EMISSIONS

9.6.13. Site activity data from 2023 has been used to quantify emissions from fuel used on site (diesel and gas) and electricity. The total litres of fuel and annual electricity consumption (kWh) have been multiplied by an appropriate emissions factor for fuel and electricity to give an estimated total carbon emissions per year. The annual emissions have then been scaled for the 10-year construction period.

9.6.14. Whilst the assessment outlined above focuses on civil infrastructure, it is important to account for emissions from other construction elements where data to assess was more limited. Based on previous life cycle assessments (EDP, n.d.)), it is estimated that approximately 70% of emissions are associated with civil assets. As such, an uplift has been included to account for emissions from mechanical and electrical components including turbines, transformers, pumps and cabling.

BIOGENIC EMISSIONS

9.6.15. Emissions originating from biological processes which include the release of carbon dioxide (CO_2) and methane (CH_4), and other gases from organic material decomposition, primarily from plant matter and soil organic carbon. In the context of this Project, biogenic emissions assessed include the carbon released from both the decaying vegetation that was cleared and submerged vegetation, as well as from the organic content in soils disturbed or flooded due to the vegetation clearance and loss of vegetation during the Project construction.

9.6.16. To assess GHG emissions from reservoirs at an early stage of the preparation process, it is recommended that the GHG Reservoir tool **(G-Res Tool)** (World Bank, n.d.) developed by the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Hydropower Association (IHA) is used to assess impact.

9.6.17. The G-res Tool is a specialized assessment tool designed to estimate carbon footprint of reservoirs, including emissions of CO_2 and CH_4 released from reservoirs, particularly those associated with hydropower projects.

9.6.18. Further information on the methodology for G-Res Tool, the required data inputs for the three categories and the data used to populate the G-res Tool is given in Appendix in Section 9.9.

ASSUMPTIONS AND LIMITATIONS

Construction materials and material transportation

9.6.19. Given the high-level nature of design information at this time, aligned to RICS (2023), an uplift of 6% has been made to the construction emissions to account for uncertainly to the assessment during design and construction.

9.6.20. The assessment has focused on civil infrastructure assets where more detailed information was available. To account for emissions from other areas (e.g. mechanical and electrical components) an uplift factor has been used based on previous studies which show civil infrastructure elements account for approximately 70% of construction emissions.

9.6.21. For civil elements, only those materials which were quantifiable in terms of volume/weight (e.g. concrete (m^3), steel (tonnes)), have been included in this assessment. Relevant density factors have been used to convert the quantities to arrive at final emission numbers.

9.6.22. Any material quantity provided in terms of length (e.g. drainage (m); filling grouting (m^2) etc.) or number of units (e.g. site investigations; stationery plant etc.) have been excluded from this assessment. The emissions from the excluded material items have the potential to increase emissions further, however it is not expected these elements to be significant and they are captured by the 6% uplift due to uncertainty.

9.6.23. The diameter for the perforated drainage pipe (500mm) is assumed to be internal diameter, with thickness as 15mm and material composition as steel.

9.6.24. Data for the dam structure has been taken from the BOQ and consists of the following materials, and the emission factors for these have been used in calculations:

- Sand for embankment, alluvium shell, filter and transition drains;
- Rock stones for rockfill shell and riprap; and
- Concrete core.

9.6.25. The embodied carbon does not account for emissions associated with on-site installation processes such as construction energy and fuel consumption, temporary works, and other on-site activities, are not calculated in this assessment. This exclusion is due to limited data on construction-phase installation activities and emissions specific to these.

9.6.26. In the absence of specific Environmental Product Declarations outlining materials, specifications, and transport categories, the emission factors chosen for construction emissions and transport distances are taken from internationally recognized databases and are appropriate for the stage of assessment in the absence of data from specific manufacturers.

9.6.27. The operational phase, which would include emissions from routine maintenance and repair activities, is scoped out from this assessment. Emissions from this category would be insignificant compared to those during the construction phase and it would be expected that with time, as the construction industry decarbonizes, that emissions from this phase would become less with time. Similarly, these impacts would be expected to be insignificant compared to the biogenic impacts, referenced below.

9.6.28. Emissions from the end-of-life stage, including decommissioning activities and any restoration of disturbed land, are also excluded from the current assessment. Given the long lifespan of the project, it is likely that any decommissioning activities would take place at time when construction impact has been decarbonized and thus the impact at this stage would be minimal.

9.6.29. This assessment serves as an indicative assessment due to limited data provided for materials and transport distances. All the data used in assessment is considered up to date and was provided by the Project site teams; however no independent verification of the raw data was done.

Biogenic Emissions

9.6.30. To obtain information on soil organic content, Geographical Information Systems (GIS) mapping was conducted using soil grid profiles from the International Soil Reference and Information Centre (ISRIC). ISRIC offers a high-resolution global dataset, SoilGrids, which provides predictive soil properties and classifications across multiple depths. This dataset enables detailed spatial analysis of soil organic carbon and other critical soil parameters, enhancing the accuracy and depth of environmental assessments.

9.6.31. It is assumed that the site area has undergone significant modification in the past due to activities such as grazing, agricultural practices, and urban development in the surrounding regions, leading to a reduction in soil organic matter compared to undisturbed conditions, as observed through GIS mapping and site observations, which also indicate a higher presence of minerals and bare rock, with soil mineral content calculated as the remainder after deducting estimated organic content, potentially not fully reflecting the site's soil diversity.

9.6.32. Organic soil carbon stock for the pre-impoundment land cover area is assessed up to a depth of 30 cm, which is where the highest concentration of carbon typically resides and limited data capability within the Soil Grid mapping.

9.6.33. At maximum inundation, the reservoir is assumed to reach a height of 1,290 meters above sea level (m asl) with the dam's base at 1,000 m asl obtained as detailed in **Volume 1, Chapter 3: Project Description** of this ESIA.

9.6.34. While the G-res tool estimates emissions based on average values derived from typical operational conditions, it assumes that real-world conditions will align with these parameters. The tool does not account for the potential impact of thermal stratification, which could influence water temperature layers in reservoirs and affect energy generation efficiency. This limitation means that variations in thermal stratification, which might occur due to seasonal changes or environmental factors, may not be reflected in the emissions estimate. However, the tool provides a reliable baseline estimate, with total emissions expected to remain close to the predicted value over the project lifecycle, assuming typical operational conditions and uniform thermal mixing.

9.7 BASELINE – CURRENT CONDITIONS

9.7.1. To assess the impact of the GHG emissions generated from the Project, a 'baseline' comparison of Tajikistan's national emissions has been selected to provide context to the impact of the Project. The total GHG emissions in the country was 13.974 million tCO_2e in 2016 (including land use, land use change and forestry) (Government of the Republic of Tajikistan, 2022). Tajikistan's major emission sources are from agriculture (50%), energy (47%), industrial process and product use (12%) in 2016. Waste and land use, land-use change and forestry make up the remaining emission contributions for the country.

9.7.2. Tajikistan's current grid average emissions factor per kilowatt-hour of electricity produced is 106 gCO_2e/kWh (UNFCCC, 2021). This will be used as a counterfactual to assess the impact of the proposed development against the equivalent power requirement being generated at Tajikistan current average.

9.7.3. For construction emissions, it has been assumed that there has been no construction previously and as such, any emissions from construction activities are an increase on a baseline of zero. While this is not an accurate assumption, it is a more conservative one.

9.7.4. With regards to the biogenic assessment, the 'do minimum' and 'do something' scenarios are described below:

'DO MINIMUM' SCENARIO

9.7.5. The 'Do Minimum' scenario comprises of "without project" baseline emissions associated with the current operations of 2x400MW units generating power.

Pre-impoundment soil organic carbon

9.7.6. Soil Organic Carbon (SOC) is the carbon stored within soil organic matter, which is composed of decomposing plant and animal materials, microorganisms, and stable organic compounds that resist further decomposition. SOC is a key indicator of soil health, as it helps improve soil structure, water retention, and nutrient availability, supporting plant growth and sustaining ecosystems (IPCC, 2016)

9.7.7. In the context of reservoir and land-use changes, assessing SOC is crucial for several reasons:

- **Carbon Emissions**: When land is flooded for reservoir creation, previously dry soils rich in organic carbon become submerged. This process can disrupt the natural carbon cycle, as anaerobic (oxygen-limited) conditions in submerged soils may trigger the decomposition of SOC, releasing greenhouse gases such as CH_4 and CO_2 into the atmosphere. Estimating SOC in the reservoir area helps predict potential emissions and understand the reservoir's impact on climate change.

- **Baseline for Carbon Stock Loss**: By assessing SOC levels in land destined for flooding, researchers establish a baseline for the amount of carbon that might be lost due to land-use change. This baseline aids in comparing pre- and post-impoundment conditions, helping measure how much organic carbon has shifted or emitted as greenhouse gases after the reservoir's creation.
- **Land-Use Change Impact**: SOC levels differ significantly across habitat types—forests, grasslands, and agricultural fields, for example, vary in their carbon densities. Understanding SOC by habitat type in a reservoir area helps anticipate and mitigate the environmental impacts of converting various landscapes to water bodies.

9.7.8. To assess SOC stock across the project area, we utilized soil data from the SoilGrids database, available on the ISRIC (International Soil Reference and Information Centre) website. This database provides SOC values and bulk density estimates for various land cover types up to a depth of 30 cm. The process involved the following steps:

- **Mapping SOC**: SOC values from SoilGrids were mapped across different land cover types in the project area, yielding average SOC stock estimates (t/ha) for each type.
- **Conversion to Soil Organic Matter (SOM):** Soil Organic Carbon (SOC) is key fraction of SOM, typically accounting for about 58% of total SOM content (E.V. Shamrikova et al., 2022). SOC stock was converted to soil organic matter by applying a standard conversion factor of 1.724. This conversion provided an estimate of SOM, which accounts for the total organic material within the soil.

Soil Organic Matter = Soil Organic Carbon * 1.724

- **Calculation of Bulk Mass**: The soil's bulk mass is calculated by multiplying bulk density by the specified depth (30 cm). This step provided the soil's total mass within the 30 cm depth profile, which is essential for estimating the overall SOM percentage in the soil.

Table 9-4 – Relative Landcover coverage based in the catchment area

Habitat Type	Relative Coverage (%)
Croplands	18.6%
Bare Areas	15.1%
Forest	3.8%
Grassland/Shrubland	29.9%
Permanent Snow / ice	32.2%
Settlements	0.2%
Water Bodies / Drained Peatlands	0.1%

- **Deriving SOC Percentage**: To determine the percentage of organic content in the soil, the SOM value has been divided by the calculated bulk mass. This resulted in the organic percentage for each land cover type, which helps evaluate soil carbon stocks across the reservoir's future inundation area.

Table 9-5 - Relative % distribution of Minerals and Organics based on different Habitat types

Habitat Type	% of Mineral Soil
Cropland/Agriculture	5.0%
Urban/Built-up	15%
Grassland/Pasture	49%
Wetland/Flooded Areas	0.4%
Forest/Woodland	1%
Water Bodies / Drained peatlands	30%

9.7.10. As seen in pictures and through site surveys, the percentage of organic content in the project area is relatively low across different habitat types. The site has been heavily modified since the 1960s due to agricultural activities and grazing practices, which have significantly altered the land cover. Further exploration of the site confirmed that extensive modifications were made for various purposes, contributing to the reduction in organic carbon levels in the soil.

9.7.11. For the purpose of this assessment, and in line with the G-Res Tool methodology, soils are categorized as either mineral soils or organic soils. While all soils contain some level of organic content, organic soils are specifically defined as those with a high carbon content. In the case of the Rogun reservoir catchment and analysis using Google Earth Engine confirms that the buffer area around the reservoir shows relatively low organic soil land cover present. Therefore, the percentage of organic soils in the different land cover types have been assumed to be zero for the purposes of this assessment.

'DO SOMETHING' SCENARIO

9.7.12. The 'Do something' scenario assesses the emissions from the whole project – both construction and biogenic emissions.

9.7.13. As part of Phase 2, the 2 x 400 MW ("without project") will be upgraded to 2 x 630 MW along with the additional 4 x 630MW units. Hence, the total power generated in the "with project" would be 3,780 MW (6 x 630 MW).

Soil Carbon Content under Impounded Area

9.7.14. Soil carbon content under the impounded area refers to the total amount of organic carbon stored in the soil layers (typically the top 30 cm) of land that will be submerged by a reservoir once it's filled. When land is inundated, the submerged soil becomes anaerobic (lacking oxygen), which slows down the decomposition of organic material but can still result in emissions over time. For reservoirs, calculating the SOC within the impounded area helps estimate potential greenhouse gas emissions due to the new water coverage. It also serves as a baseline for carbon stock loss in areas previously used for agriculture, forestry, or natural vegetation.

9.7.15. The G-res Tool, developed for assessing GHG emissions from reservoirs, requires SOC values (in kgC/m²) to estimate these emissions based on the amount of carbon stored in the soil and the anticipated anaerobic conditions after impoundment.

9.7.16. To calculate SOC for the impounded area, data from the SoilGrids database (ISRIC) can be used to estimate SOC concentration, bulk density, and soil depth. The methodology involves converting SOC concentration (usually in %) into SOC stock (kgC/m²) with the following steps:

Calculate SOC Stock: Using the formula

(SOC) Stock (kgC/m^2) = Bulk Density (g/cm^3) * depth (cm) * SOC % * 1/10000

9.7.17. This approach provides SOC in kg of carbon per m² for the top 30 cm of soil.

- **Summing SOC across Land Types**: Aggregate SOC values across habitat types in the impounded area to provide the total SOC stock. This approach, based on methods detailed by ISRIC, helps estimate carbon stocks accurately, especially for assessing land inundation impacts in reservoirs (ISRIC, 2024; G-res Tool Methodology).

9.7.18. The calculation will involve assessing soil samples collected to a depth of 30 cm- where majority of SOC is typically found. The formula used for this calculation will incorporate the bulk density of the soil, which is necessary to convert the SOC concentration (kgC/m^3) to a stock value across the specific depth (IPCC, 2006). This approach ensures a comprehensive evaluation of the impacts of reservoir inundation on SOC and overall soil health, supporting effective land management and climate resilience strategies.

Total Soil carbon content under Impounded area (kgC/m^2) = 7.746 kgC/m^2

9.8 ASSESSING SIGNIFICANCE

9.8.1. The Project impacts have been assessed against baseline conditions that include embedded mitigation (i.e. mitigation that is an inherent component of the Project design). The significance of the effect indicates the requirement for additional mitigation. The post-mitigation outcome has also been assessed to determine the significance of the residual effect.

Sensitive Receptors

9.8.2. The impact of GHG emissions relate to their contribution to global warming and climate change. These impacts are global and cumulative in nature, with every tonne of GHG contributing to impacts on natural and human systems. The receptor is therefore the global atmosphere. As there is only one receptor 'the climate', it has a consistent sensitivity **(high)** no matter the location of the emissions source.

Significance Criteria

9.8.3. There are currently no agreed thresholds for what level of GHG emissions generated in new development is considered to be 'significant' for ESIA. The significance of GHG emissions is assigned with reference to the magnitude of emissions, their context, guidance (such as the Institute of Environmental Management and Assessment (IEMA, 2022)), and the use of experience and professional judgement. As climate change impacts are global in nature, it is not possible to link an overall global effect with a specific project and determine the specific environmental-climate impact.

9.8.4. Although the IEMA Guidance is specific to UK, it is considered as a **best practice** approach to assess GHG emissions and significance of projects, **irrespective of their geographical location**. It provides a scale of significance by which to assess the current Project. A development's emissions should be based on its net impact over its lifetime, which may be beneficial, adverse, or negligible. The evaluation of significance should not just focus on GHG emissions, or the magnitude of those emissions, but whether the Project contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050. Significance of GHG impacts for the Proposed Scheme is assessed in line with IEMA Guidance as set out in **Table 9-6** -

9.8.5. Whilst there is no scale for 'receptor sensitivity' or 'impact magnitude' for GHG emissions following those described in **Table 5-2 Impact Significance Table** in **Chapter 5** of this ESIA, the level of impact (e.g. major, moderate, minor, negligible, positive) is aligned between this and IEMA and experience and professional judgement has been used to determine the overall impact of significance.

Table 9-6 - Significance of GHG Impacts

Level of Effect	Significance Criteria	Significance
Major adverse	The GHG impacts are not mitigated or are only compliant with do-minimum standards set through regulation, and do not provide further reductions required by existing local and national policy nor make a meaningful contribution to the country's trajectory towards net zero.	Significant
Moderate adverse	The GHG impacts are partially mitigated and may partially meet the applicable existing and emerging policy requirements but would not fully contribute to decarbonisation in line with local and national policy goals, falling short of fully contributing to the country's trajectory towards net zero.	Significant
Minor adverse	The GHG impacts are fully consistent with applicable existing and emerging policy requirements and good practice design standards; they are fully in line with measures necessary to achieve the country's trajectory towards net zero.	Not significant

Level of Effect	Significance Criteria	Significance
Negligible	The GHG impacts are reduced through measures that go well beyond existing and emerging policy and design standards for projects of this type, such that radical decarbonisation or net zero is achieved well before 2050.	Not significant
Beneficial	The net GHG impacts are below zero, causing a reduction in atmospheric GHG concentration, whether directly or indirectly, compared to the without-project baseline, substantially exceeding net zero requirements with a positive climate impact.	Significant

9.9 POTENTIAL IMPACTS

9.9.1. The GHG emissions from the Project have been calculated and contextualized with various other power generating sources and against Tajikistan's annual carbon emissions and NDC. The resultant construction and biogenic emissions are discussed in this section.

CONSTRUCTION (SCOPE 3)

9.9.2. The construction emissions from material extraction, manufacturing and production and transportation together account for 6.60 $MtCO_2e$.

Table 9-7 - Scope 3 Project Lifespan Emissions ($MtCO_2e$)

Emissions Source	tCO_2e	$MtCO_2e$
Construction Materials	5,819,221	5.82
Material Transportation	197,979	0.20
Construction (Fuels and Electricity)	208,185	0.21
Total - Construction emissions (Scope 3)	6,225,375	6.23
Total Emissions with 6% Contingency Factor (*Section 4.10.1 of RICS 2023*)	6,598,897	6.60

9.9.3. The majority of emissions generated in the construction phase are from the embankment which represented approximately 3 $MtCO_2e$. This is expected as the total volume of sand, stone and concrete needed for the shell and core of the embankment equated to over 72 million m^3 of material.

BIOGENIC EMISSIONS (SCOPE 1)

9.9.4. The project's biogenic emissions calculated from the G-res Tool are listed in **Table 9-8**. It is recognized that metrics such as emissions/m^2/year simplify complex dynamics, including depth variation, stratification, and year-to-year changes, for practical purposes. However, this metric represents the average conditions and provides an accessible means of assessing the reservoir's overall GHG footprint.

Table 9-8 - Biogenic Emissions over 100-year project lifespan (tCO_2e)

	Post-Impoundment	Pre-Impoundment	Unrelated Anthropogenic sources	Net GHG Footprint
Emissions per m^2 of Reservoir ($gCO_2e/m^2/yr$)	64	0	-	64
Total Reservoir Emissions per Year (tCO_2e/yr)	10,908	-30	-	10,938
Total Lifetime Emission (tCO_2e)	1,090, 788	-3,040	-	1,093,828

9.9.5. This analysis evaluates the GHG emissions associated with reservoir impoundment by comparing pre- and post-impoundment emission metrics. The assessment focuses on three key indicators:

- Emissions per square meter of reservoir area;
- Total annual reservoir emissions; and
- Cumulative lifetime emissions.

9.9.6. Understanding these metrics provides insights into how the reservoir's creation affects GHG emissions on both an immediate and long-term basis.

EMISSIONS PER M² OF RESERVOIR ($GCO_2E/M^2/YR$)

9.9.7. The emissions intensity per square meter is estimated at 64 $gCO_2e/m^2/yr$ under post-impoundment conditions, compared to negligible pre-impoundment emissions (0 $gCO_2e/m^2/yr$). This indicates that the net GHG footprint of the Rogun reservoir can be fully attributed to the creation and operation of the impoundment. The pre-impoundment baseline contributes only a minor negative offset (–30 tCO_2e/yr), reflecting the already modified state of the land.

TOTAL BIOGENIC RESERVOIR EMISSIONS

9.9.8. Post-impoundment, the project is expected to generate approximately 10,908 tCO_2e/yr of biogenic emissions. Over a 100-year project lifetime, this equates to a cumulative total of about 1.09 $MtCO_2e$. The pre-impoundment baseline is negligible (–30 tCO_2e/yr, or –3,040 tCO_2e over the lifetime), meaning that the reservoir contributes a net increase of roughly 10,938 tCO_2e/yr, or 1.09 $MtCO_2e$ over 100 years. While this represents a substantial quantity of carbon released, the net footprint is considered modest relative to the project's renewable electricity generation potential (17,000 GWh/yr), equivalent to about 0.64 gCO_2e/kWh.

9.9.9. As noted earlier, the post-impoundment emissions are estimated at 64 $gCO_2e/m^2/yr$. This trend is consistent with many reservoir projects, where the inundation of soils and biomass creates anaerobic conditions that enhance methane (CH_4) and carbon dioxide (CO_2) production. In contrast, the pre-impoundment land within the reservoir footprint was already heavily modified, primarily used for grazing, with much of the natural vegetation removed and soils disturbed. As a result, baseline emissions were minimal, with the small negative value suggesting a minor sink or offset under certain land cover conditions. While limited, some emissions during land clearing may still result

from the release of soil organic carbon previously stored underground, which becomes oxidized when exposed (Fearnside, P.M., 2004) and (Amin, M.A.., et al., 2021).

9.9.10. Once the reservoir is filled during the post-impoundment phase, emissions from land clearing and biomass removal cease. At this stage, the primary source of emissions is the anaerobic decomposition of submerged soils and organic material, which produces methane (CH_4) and, to a lesser extent, carbon dioxide (CO_2). While the initial release of carbon from inundated biomass can be significant, the rate of soil carbon release gradually stabilizes over time. A portion of the organic carbon transported into the reservoir becomes buried in sediments, leading to long-term carbon sequestration, which partially offsets decomposition-related emissions (McGuire, K.J., et al., 2013) and (Fearnside, P.M., 2006). For the Rogun project, post-impoundment emissions are estimated at approximately **10,908 tCO_2e/yr**, which corresponds to the **net biogenic footprint** of the reservoir after accounting for pre-impoundment baseline conditions.

9.9.11. Over the 100-year lifetime of the project, the reservoir is projected to generate cumulative biogenic emissions of approximately 1,093,828 tCO_2e under post-impoundment conditions. By comparison, the pre-impoundment baseline represents a negligible contribution of about -3,040 tCO_2e, which reflects the limited emissions potential of the previously disturbed, grazing-dominated land. The higher post-impoundment emissions are primarily linked to the long-term anaerobic decomposition of flooded soils and organic matter, whereas the small pre-impoundment value reflects the land's already modified state. Importantly, a portion of organic carbon transported into the reservoir is buried in sediments, contributing to long-term sequestration that partially offsets ongoing emissions (McGuire, K.J., et al., 2013) and (Fearnside, P.M., 2006). In summary, while the transition from pre- to post-impoundment results in a net increase in emissions attributable to the reservoir, the overall footprint remains relative lower when compared to its electricity generation potential. (McGuire et al., 2013; Fearnside, 2006).

9.9.12. The breakdown of carbon dioxide and methane emissions by Project phase is presented in **Table 9-9**.

Table 9-9 - Emissions Breakdown (CO_2 and CH_4)

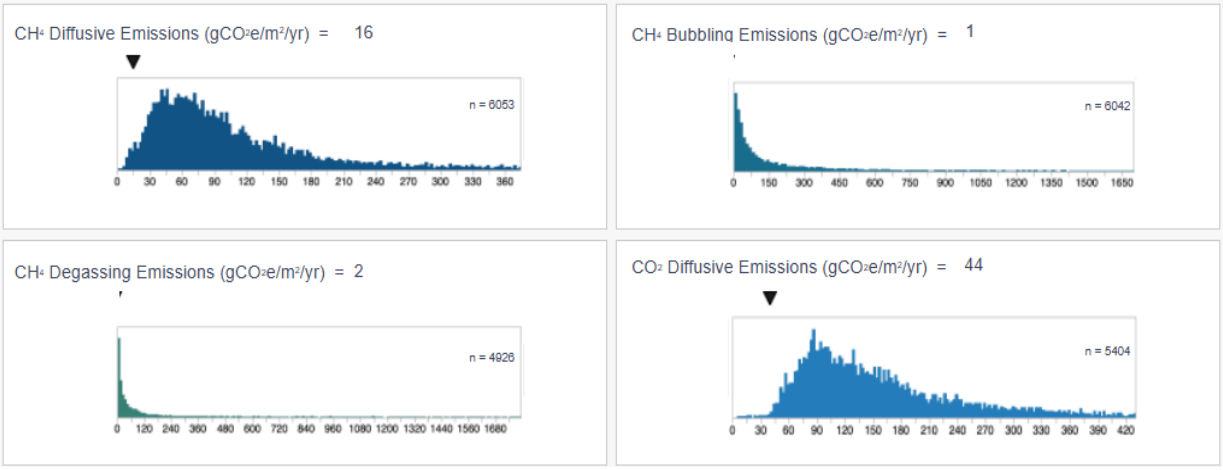
	Post-Impoundment	Pre-Impoundment	Unrelated Anthropogenic sources	Net GHG Footprint
Emissions rate (tCO_2e/yr)	10,908	-30	--	10,938
Of which CO_2	7,551	-561	-	8,112
Of which CH_4	3,356	531	-	2,825
Emissions rate ($gCO_2e/m_2/yr$)	64	0	-	64
Of which CO_2	44	-3	-	47
Of which CH_4	20	3	-	17

* Using GWP100 of 34 to obtain CH_4 emissions as CO_2e (IPCC 2013).

9.9.13. The assessment of GHG emissions focuses on the overall emissions rate, the breakdown of emissions by gas type (CO_2 and CH_4), and the emissions per unit area. Each metric provides insight into how the impoundment influences the reservoir's GHG footprint, particularly examining the contributions of CH_4, which can significantly impact the climate due to its higher global warming potential compared to CO_2.

9.9.14. The reservoir's CH_4 and CO_2 emissions are relatively low compared to global benchmarks across different pathways as shown in **Figure 9-1**. The assessment of greenhouse gas (GHG) emissions from the Rogun reservoir considers overall emissions rates, the breakdown between carbon dioxide (CO_2) and methane (CH_4), and emissions per unit area. While CO_2 is the dominant gas emitted, CH_4 remains important due to its significantly higher global warming potential. Compared with global benchmarks, the Rogun reservoir's emissions are relatively low. CH_4 diffusive emissions are estimated at **16 $gCO_2e/m^2/yr$**, placing the project near the lower quartile of global distributions and indicating limited methane production or effective diffusion mitigation. CH_4 bubbling emissions are minimal at about **1 $gCO_2e/m^2/yr$**, suggesting that sediment conditions and low organic inputs restrict bubble formation and release. CH_4 degassing emissions are reported as **zero**, although this reflects a lack of data on water column stratification and discharge rather than a confirmed absence, highlighting the need for additional monitoring. CO_2 diffusive emissions are estimated at **44 $gCO_2e/m^2/yr$**, positioning the reservoir near the median of global benchmarks and reflecting the continued decomposition of organic matter within the flooded area. Taken together, these results suggest that the Rogun reservoir has a relatively low climate impact compared to global averages, though further monitoring particularly of potential degassing pathways is recommended to fully characterize its GHG profile.

Figure 9-1 - CH_4 and CO_2 emissions compared to worldwide reservoirs

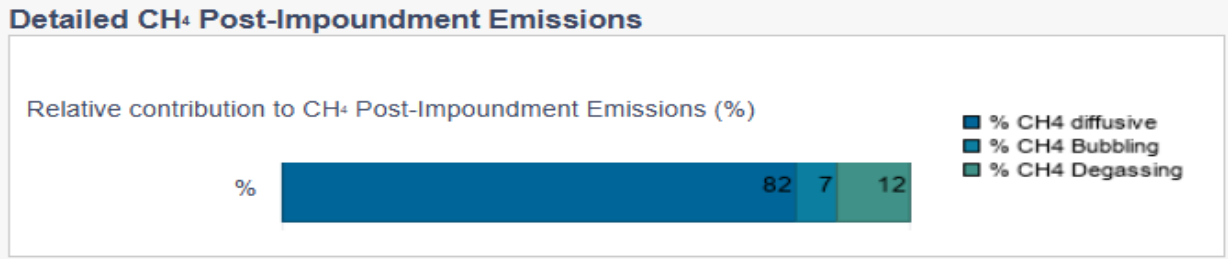


9.9.15. Whilst CO_2 emissions fall by approximately 58% a year, CH_4 emission increase by approximately 116%. Although CO_2 emissions are higher, the potency of CH_4 (25-28 times that of CO_2 over 100 years) elevates the climate impact due to this increase in global warming potential. The overall reduction is a positive shift, lowering the CO_2-specific footprint of the reservoir. The substantial rise in CH_4 is a result of organic material submerged by the impoundment. Underwater, organic matter decomposes anaerobically, leading to CH_4 production—a potent greenhouse gas. This effect is typical in reservoirs but can vary depending on factors like organic load, depth, and water temperature. This increase offsets the benefits gained from CO_2 reduction and adds significant climate impact due to methane's higher global warming potential. Despite the small overall change

per area, CH_4 emissions per area rise significantly post-impoundment. This finding aligns with the overall CH_4 increase, reinforcing that CH_4 production has become a dominant contributor to emissions following impoundment. Post-impoundment dynamics significantly influence CH_4 emissions due to changes in environmental conditions. The flooding of organic matter, such as vegetation and soil, creates a rich carbon source that decomposes under anaerobic conditions, producing methane. Impoundment often leads to stratification, where warmer, oxygen-rich surface waters are separated from cooler, methane-rich bottom layers by a thermocline. Seasonal variations further impact these dynamics; for example, strong summer stratification can lead to methane buildup, while mixing during cooler seasons or events like water release can result in sudden, significant methane emissions. These processes highlight the need for a comprehensive understanding of post-impoundment conditions to accurately quantify CH_4 emissions.

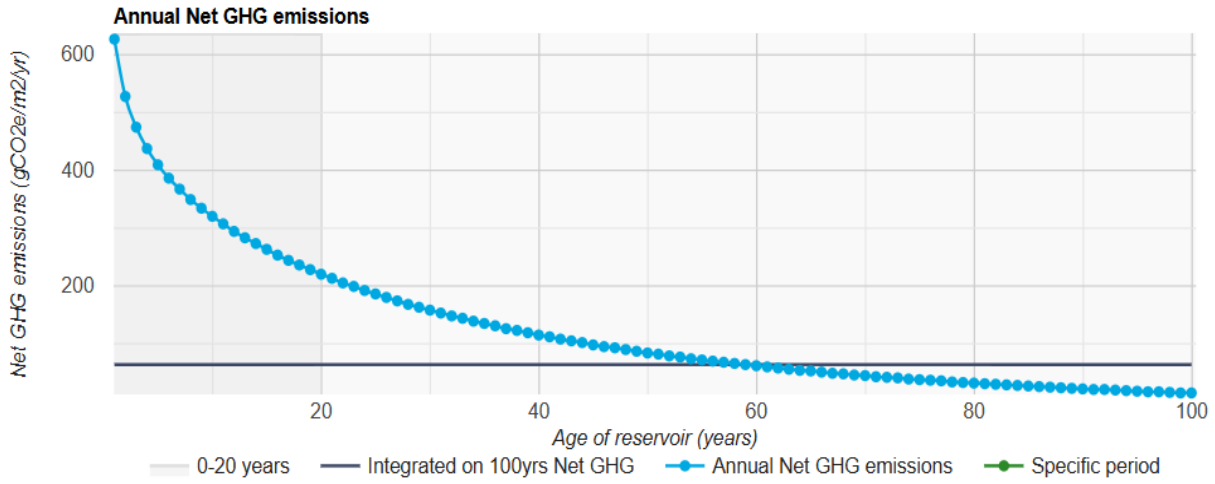
9.9.16. As shown in **Figure 9-2**, 82% of post-impoundment CH_4 emissions arise from diffusion, indicating surface-driven release likely influenced by temperature, wind, and organic matter. Degassing contributes 12%, suggesting some CH_4 is released through deeper water discharges, potentially from stratified layers. Bubbling accounts for 7%, indicating limited CH_4 escape from sediments. Overall, diffusive emissions dominate, while degassing and bubbling play smaller but notable roles.

Figure 9-2 - Post-impoundment CH_4 emissions



9.9.17. **Figure 9-3** shows the graph illustrating the annual net GHG emissions per square meter over the lifespan of a reservoir, showing a steep decline in emissions in the initial years post-impoundment.

Figure 9-3 - Annual net GHG emissions trajectory through the lifecycle of the reservoir

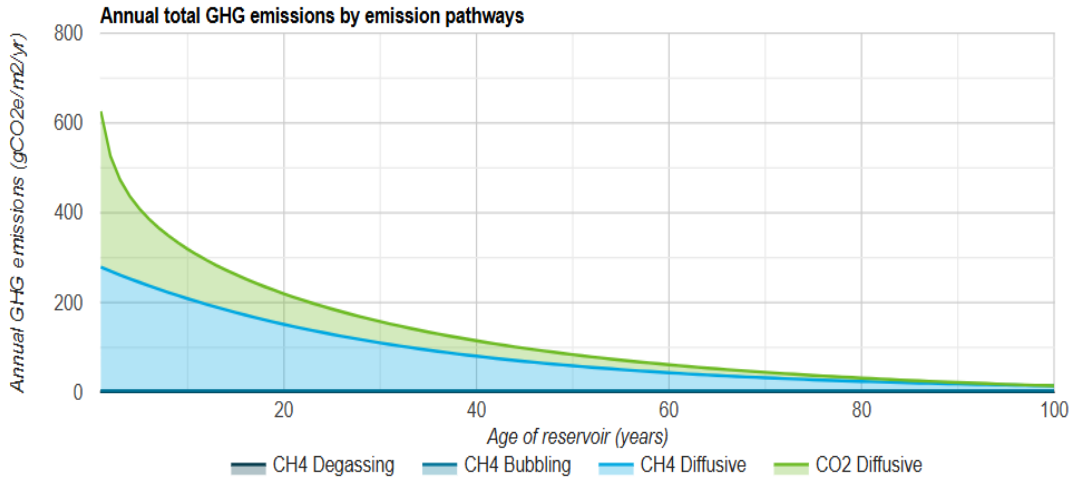


9.9.18. Emissions start high, above 600 $gCO_2e/m^2/yr$, likely due to rapid CH_4 release from the anaerobic decomposition of submerged organic material, but they decrease sharply within the first 20 years

and gradually stabilize below zero over time. This trend suggests that while reservoirs have a significant GHG impact in the early years, their long-term emissions footprint is much lower thus giving a carbon reduction over the Project's lifespan.

9.9.19. The black line in **Figure 9-3**, representing the 100-year integrated net GHG level, provides a baseline that balances this initial surge with the subsequent decline, giving a more comprehensive view of the reservoir's climate impact over a century. This pattern emphasizes the potential effectiveness of early-stage mitigation strategies, such as pre-impoundment vegetation removal, to reduce the high initial emissions and lower the reservoir's cumulative GHG impact in the long run.

Figure 9-4 - Annual Total GHG emissions by emission pathways



9.9.20. **Figure 9-4** illustrates the annual total GHG emissions ($gCO_2e/m^2/yr$) from the reservoir over a 100-year period, disaggregated by key emission pathways: CH_4 degassing, CH_4 bubbling, CH_4 diffusive, and CO_2 diffusive emissions. The graph demonstrates that GHG emissions are highest immediately following impoundment, primarily driven by the rapid decomposition of submerged biomass and organic matter. During this initial stage, CH_4 degassing and CO_2 diffusive emissions are the dominant contributors, reflecting intense microbial activity and the release of gases from deeper, anoxic layers of the water column and from the decomposition of organic carbon. As the reservoir ages, total emissions decline significantly, stabilizing after approximately 60 to 80 years. CH_4 degassing shows the steepest decline within the first two decades, likely due to the depletion of easily degradable organic material and reduced methane production in deeper waters as thermal stratification becomes less pronounced or as management strategies mitigate its formation. In contrast, CH_4 bubbling and diffusive emissions persist at lower rates over a longer period, indicating a gradual release of methane from sediments where decomposition continues at a slower rate. CO_2 diffusive emissions also decline sharply after the first few years, suggesting that carbon mineralisation and microbial respiration in the surface waters diminish as organic inputs decrease over time. By the later decades of the reservoir's life (post-60 years), total GHG emissions stabilise at significantly lower levels, with residual contributions mainly from CH_4 bubbling and diffusion. This long-term emission profile underscores the importance of early-stage management to limit peak emissions, particularly by minimising the amount of organic material inundated during reservoir filling and addressing thermal stratification that drives CH_4 degassing. These mitigation strategies can substantially reduce the reservoir's climate impact in its most emission-intensive years.

Summary of Impacts

9.9.21. As a final step, to help better understand the summary of impacts related to the hydropower generation capacity of the reservoir, the results of the construction assessment were added with the biogenic emissions in the G-res tool to help identify an emissions intensity over the project life cycle.

9.9.22. The combination of the construction emissions and biogenic emissions give an estimated emissions intensity of approximately **4.5 gCO_2e/kWh** for the proposed scheme. This is substantially lower than the current grid average emission factor for Tajikistan of 106 gCO2e/kWh.

9.10 MITIGATION MEASURES

9.10.1. GHG mitigation for the Project are discussed for the project construction and operational phases.

CONSTRUCTION PHASE

9.10.2. To reduce the carbon footprint of the Project, the following mitigation measures for the construction phase have already been implemented:

- Green air ventilation system installed - an automated ventilation system capable of optimizing jet fan speed based on real-time pollutants measurements to provide continuous monitoring of pollutants (CO_2, NO_2) and ventilation speed adaptation to reduce energy consumption by 6,023 kWh/day; and emissions by 337.28 kg CO_2e/day (123 tCO_2e/annum).
- Installation of the remaining 6.02 km of the electrically controlled conveyor belt system to transfer crushed materials from crusher plants to silos near the dam area. The system is expected to result in annual energy savings of 9 million kWh and annual CO_2e savings of 13,500 tonnes. (1 Ton = 0.99 tonnes; values in tons have been converted to tonnes in order to maintain uniformity throughout the assessment.)
- Connection of a direct power source was already solicited from the Nurek Power Station. The external power feeds into a 16,000kVA transformer substation which subsequently phases down the infeed power into usable electricity power source. In this way, the direct power feed effectively replaces the use of 12 generator sets of 1,200kVA. This is expected to result in 101 million kWh energy savings and 71,600 tCO_2e savings annually.
- Energy efficient lighting has been installed at various locations of the site. LED lighting is expected to result in annual energy savings of 239,919 kWh for the main offices and camp area and 460,776 kWh for the workshop area.
- The installation of energy efficient water hoses, energy and water efficient water guns significantly reduces consumption of on-site water resources for dust suppression. Energy savings also result from reduced water truck mileage. These measures are expected to lead to annual energy savings of 76,000 kWh and annual savings of 69 tCO_2e.
- Transportation emissions have been reduced and are expected to result in energy savings of 6 million kWh per year and CO_2e savings of 904 tonnes per year by:
  - Deploying only vehicles that will get better fuel mileage;
  - Ensuring regular and proper vehicles' technical inspection and maintenance;
  - Re-siting expat camps next to Main Office to cut down travelling; and
  - Using multiple-passenger vans or bus to transport staff.

9.10.3. To reduce these emissions further, it is recommended that all engines are turned off when not in use to be implemented through the CEMP.

BIOGENIC EMISSIONS

9.10.4. The recommended GIIP measures to reduce the generation and release of methane and other GHGs to the atmosphere include:

- Hydropower projects like this Project, must consider alternative project design configurations to minimize emissions wherever possible:
  - Forestry Agency, under the guidance and supervision of the Directorate for Flooding Zone (DFZ), is obliged to clear of vegetation all the areas to be flooded before each inundation stage.
  - Implement mechanical mixing systems, air bubble plumes, or controlled water flow management to disrupt thermal stratification and maintain oxygen levels throughout the water column. This prevents anaerobic conditions in deeper layers, reducing methane emissions. Regular monitoring of water temperature, dissolved oxygen, and methane concentrations should guide mixing operations to target hotspots effectively. Where feasible, utilize renewable energy sources to power mixing systems and ensure long-term sustainability.
  - This involves carefully controlling how water is released from the reservoir to avoid the build-up of methane in the deeper layers. By releasing water from the surface, where there are fewer greenhouse gases, and occasionally lowering the water level, it helps mix the water and adds oxygen. This process reduces the chance of organic material breaking down in low-oxygen areas, which would release methane. By preventing the formation of anaerobic (low oxygen) zones where methane is produced, optimized flow management helps reduce biogenic emissions, particularly methane, from the reservoir.
  - The permanent water intakes under construction will be located at quite higher level. This is considered as design factor for GHG emissions and climate change.

9.10.5. EIB requires that all hydropower projects considered as large hydropower projects, undertake direct and continuous monitoring of CO_2e emissions during operation. The assessment is based on available Scope 1-3 data. To manage these emissions, it is recommended that an ongoing monitoring and mitigation plan (GHG Reduction Plan) of operational GHG sources is put in place. Whilst the mitigation measures listed above help to mitigate emissions, there is always more that can be undertaken to reduce GHG emissions further. **Table 9-10** provides further opportunities which exist and could be included in the GHG Reduction Plan.

Table 9-10 - Mitigation measures for identified Scope 1,2 and 3 Emissions.

Monitor	Manage and Mitigate
Scope 1 Emissions:	
Are there any processes that release emissions during operations? For example: Are any fuel powered machinery used to remove plant matter from the dam?	Measure, monitor and switch to low carbon or no carbon plant machinery instead.

Monitor	Manage and Mitigate
What fuel is combusted on site, per annum for the Project operations? For example: How much diesel, petrol, gas is used in operations per annum?	Measure, monitor and switch to low carbon or no carbon vehicles or generators, where possible.
Reservoir Emissions – where appropriate	The Project is likely to have a relatively small amount of biomass to be submerged. A thorough pre-impoundment reservoir clearing, should decrease the amount of methane released during the reservoir operations. The reservoir will be filled in stages. The pre-impoundment clearing will have to be in coordination with this staged filling, with the aim of clearing areas as shortly before impoundment as possible, in order to prevent regrowth. In the last stage, care will have to be taken not to cut any trees, and not to burn any vegetation above this level. Watershed management (will be required as part of the Watershed Management Plan) will help reduce the contribution of organic matter from the catchment area to the reservoir and the removal of decomposable vegetative matter from the inundation area before flooding. Thermocline: a temperature gradient in a reservoir, can trap methane by limiting vertical water mixing. Methane, produced in deeper, cooler layers, stays dissolved due to this barrier. However, effectiveness depends on factors like thermocline strength and reservoir dynamics. This should be monitored as water temperature may change as a result of climatic variables.
Scope 2 Emissions:	
Is there any electricity, heating, cooling and/or steam procured from off site for operations per annum?	Energy efficiency measures and switching to renewable electricity will reduce Scope 2 emissions.
Scope 3 Emissions:	
Has use of low carbon alternative materials been considered to reduce construction emissions	Use of alternative low-carbon materials like low-carbon concrete. Choose materials with a longer lifespan ensuring durability and lower emissions from replacement. Use aluminum and steel with higher recycled content. Use low carbon concrete alternatives for foundations and related structures. Integrate smart design options to efficiently use materials. Prioritize suppliers with certified low-carbon manufacturing processes and environmental management systems aligned to ISO 14001.
What has been considered to reduce transportation emissions?	Avoid environmentally sensitive areas and select shortest, most direct route for transportation. Utilizing locally sourced materials when feasible to minimize transportation distances and associated carbon emissions.

9.11 SUMMARY OF IMPACTS

9.11.1. **Table 9-11** presents a summary of the annual emissions for the "do minimum" baseline scenario. This is based on biogenic emissions from the site pre-impoundment (Scope 3). It also presents the grid equivalent consumption for 17,000 GWh per year using Tajikistan's average grid emissions factor.

Table 9-11 - Summary of annual emissions (tCO_2e/yr) for Baseline (do minimum) Scenario

Source/Scope	Scope 1	Scope 2	Scope 3	Total
Construction	-	-	-	-
Biogenic	-30	-	-	-30
Grid Equivalent Consumption) *	-	1,802,000	-	1,802,000
Total (tCO_2e/yr)	-30	1,802,000	-	**1,801,970**

*based on 17,000 GWh of electricity produced each year using the grid average emissions factor of Tajikistan of 106 gCO_2e/kWh.

9.11.2. **Table 9-12** presents a summary of the annual emissions for the "do something" scenario which includes the construction emissions (split evenly over 100 years), biogenic emissions post-impoundment and the consumption of 17,000 GWh per year based on the emissions factor of 2.4 gCO2e/kWh from the proposed scheme.

Table 9-12 - Summary of annual emissions (tCO_2e/yr) for the do something Scenario

Source/Scope	Scope 1	Scope 2	Scope 3	Total
Construction	-	-	65,989	65,989
Biogenic	10,908	-	-	10,908
Consumption of electricity based on scheme emissions factor	-	40,800	-	40,800
Total (tCO2e/yr)	10,908	40,800	65,989	**117,697**

9.11.3.

9.11.4. **Table** 9-13 presents the annual change between the “do minimum” and “do something” scenarios. This shows that overall emissions are significantly lower in the do something scenario versus the do minimum scenario.

Table 9-13 - Summary of annual emissions (tCO_2e/yr) for the do something Scenario

Source/Scope	Scope 1	Scope 2	Scope 3	Total
Total DM (tCO_2e/yr)	-30	1,802,000	-	1,801,970
Total DS (tCO2e/yr)	10,908	40,800	65,989	117,697
Change (tCO_2e/yr)	10,938	-1,761,200	65,989	-1,684,273

9.11.5. A summary of the direct GHG emissions over the Project's construction and operation are presented in **Table 9-14**. The total emissions over the assumed 100-year lifespan is 7.69 $MtCO_2e$.

Table 9-14 - Total GHG emissions over the Project's lifetime

Emissions Source	$MtCO_2e$
Total Construction Materials (Scope 3)	6.60
Biogenic Emissions (Scope 1)	- 1.09
Total Emissions	7.69

9.11.6. Phase 2 of construction will finish in 2032. Assuming an even split of emissions each year of construction (assuming 10 years), the annual impact of the construction equates to 0.660 $MtCO_2e$. This represents approximately 4.7% of Tajikistan's annual emissions (based on the 2016 baseline). This is a substantial impact for one project and provides a risk of Tajikistan not meeting is short-term NDC carbon targets. As such, the impact of the scheme aligned to IEMA's criteria, before mitigation, is **Moderate Adverse** for construction emissions.

9.11.7. The assessment of Biogenic Emissions shows overall emissions of approximately 1.09 $MtCO_2e$ over the 100-year project lifespan. However, compared to the pre-impoundment scenario (-3,040 tCO_2e over the 100years), this represents a net increase of about 1.09 $MtCO_2e$.. Whilst this indicates as overall increase in emissions over the project lifetime, as discussed in Sections 9.8.8 – 9.8.21, there is a net increase in emissions initially and it will be approximately 30-40 years before the net benefit of this improvement is seen. As such, this will also put pressure on short-term NDC targets; however, over the long-term, it is well positioned to contribute positively to the transition toward a net-zero future, resulting in a classification of **Minor Adverse** impact.

9.11.8. Whilst the summary above is based on the construction impact, and changes to biogenic emissions, it is widely recognized that hydropower dams, over their entire project lifecycle, emit significantly less carbon compared to other electricity sources like coal and gas. Although hydropower projects can have initial emissions associated with construction and reservoir creation, their operational phase typically has minimal emissions due to the renewable nature of water flow as an energy source.

9.11.9. To demonstrate this, the assessment has shown how the proposed scheme compares against the current grid average emissions factor for Tajikistan. With an intensity of approximately 4.5 gCO_2e/kWh, the scheme is substantially better than the current grid average of 106 gCO_2e/kWh.

This equates to an annual difference – based on the projected generation of 17,000 GWh per year – of 1.76 MtCO2e per year.

9.11.10. Table 9-15 shows how the proposed scheme compares to gas (CCGT) at 348 gCO_2e/kWh and Coal (IGCC) at 760 gCO_2e/kWh (International Finance Corporation, 2008). This also is much lower than Tajikistan's current grid average at 106 gCO_2e/kWh (UNFCCC, 2021).

Table 9-15 - Indicative emissions intensities of various generation sources

Energy Generated	Emissions Intensity (gCO_2e/kWh)
The Proposed Scheme	4.5
Tajikistan Grid Mix (2021)	106
Coal (IGCC)	760
Gas (CCGT)	348

9.11.11. However, although this is significantly better than the baseline, it is acknowledged that that this scheme is to enhance grid capacity rather than replacing less clean forms of energy generation. As such, although the scheme is much better than alternatives, there will still be a net increase in emissions over the lifetime of the project. As such, an overall impact of **Minor Adverse** has been given.

9.11.12. A full summary of the GHG Impact Assessment is provided in **Table 9-16**.

RESIDUAL EFFECTS

9.11.13. The **construction phase** of hydropower projects will always lead to an increase in emissions. Whilst there is a substantial amount of emissions from the construction phase – primarily associated with the construction of the embankment – mitigation measures, those both implemented already and proposed, will help to reduce this impact over the 10-year construction period.

9.11.14. Regarding **biogenic emissions**, as with most hydropower dams, the project is anticipated to contain biomass which will be submerged. Although it is shown that there will be a negative impact at first, over the 110-year lifespan of the project, there will be a net benefit to biogenic emissions over the do-minimum baseline. The project will work to reduce any residual emissions. Where practicable, monitoring of methane emissions can be undertaken to understand the long-term effects on carbon and carbon equivalent emissions.

9.11.15. Implementation of these mitigation measures will aid the reduction of emissions. Whilst the impact during construction is likely to remain Moderate for that stage of the project, through the remaining lifespan of the project, recognizing that the alternative of using coal or gas for electricity generation, the overall impact of the project is expected to be **Minor Adverse**.

Table 9-16 - Greenhouse Gases Impact Assessment Summary

Impact Factor	Impact Factor 1 - What is the Impact of Reservoir Emissions on Climate Change?
Sensitivity	**High**
	Any increase in GHG emissions from human activity is said to impact Climate Change, and therefore the sensitivity is high.
Type	**Negative**
	The proposed project will lead to an increase in GHG emissions from the baseline existing project. This will have a negative effect on climate change, but it will have less of a negative effect if the proposed project output of electricity was met with coal or gas power stations instead.
Extent	**Global**
	Increasing GHG emissions into the atmosphere has a global impact, as it affects the global climate.
Duration	**Long-term**
	Releasing GHG emissions into the atmosphere has a long-term impact on the climate. Each GHG has a different average lifetime in the atmosphere i.e. CO_2 = 100's to 1,000's of years, CH_4 = about a decade, SF_6 = 3,200 years.
Frequency	**Constant**
	The GHG emissions presented in this Carbon footprint represent the 10 year Phase 2 of construction and annual biogenic emissions.
Likelihood	**Likely**
	It is likely that the reservoir will emit GHG emissions into the atmosphere. It is also likely that there will be other emissions from the Projects Scope 1 & 2 emissions emitted, although compared to the reservoir emissions the remaining emissions are of lesser significance.
Reversibility	**Irreversible**

Impact Factor	Impact Factor 1 - What is the Impact of Reservoir Emissions on Climate Change?
	Many of the impacts of climate change are now irreversible according to the UN's latest IPCC assessment.
Magnitude	**Medium**
	The reservoir will emit GHG emissions into the atmosphere but compared to the number of emissions released from an alternative coal of gas fired power station the impacts will be a lot less.
Significance	**Moderate Adverse**
	Compared to the of various Power Generation types, Hydropower comes in at Moderate significance, Coal and Gas are Major significance, with Wind On-shore and Nuclear are Minor significance, based on median lifecycle carbon emissions (gCO_2/kWh).
Additional Mitigation?	**Yes**
	Included as AM2-1 & AM2-2 Section 9.7 – Management and Mitigation
Residual Significance	**Minor Adverse**

9.12 APPENDIX

G-RES TOOL METHODOLOGY

9.12.1. The G-res Tool follows methodologies aligned with the Intergovernmental Panel on Climate Change (IPCC) Guidelines for national Greenhouse Gas Inventories (IPCC, 2019). To produce accurate estimates, the G-res tool requires comprehensive data inputs, categorized into three main groups:

- Landscape data – provides a baseline of the natural conditions before the area was flooded to create the reservoir. The input includes data on prior land use, vegetation types, soil carbon content, and the total carbon stored in biomass.
- Reservoir data – encompasses the characteristics of the reservoir post-construction, such as its area, depth, water quality, sediment accumulation, and fluctuations in water levels.
- Reservoir Services Data – captures operational aspects, focusing on how the reservoir is used and managed for functions like hydropower, irrigation, or flood control.

9.12.2. The following section outlines the methodology used by the G-Res tool and provides a description of the data needed for input within the tool.

Table 9-17 - Landscape Data Description for G-Res Tool

Landscape Data	Description
Catchment Area (km^2)	The catchment area upstream of the reservoir, measured in (km^2). This area analysis is crucial to understand upstream impacts on hydrology, nutrient flow, and organic matter input, which influence reservoir emissions and water quality.
Population in the Catchment (persons)	The population within the catchment area upstream of the dam. This provides an estimate on the total number of individuals residing in the catchment area for understanding the potential social impacts and the demand for resources in the affected communities.
Land cover of the Catchment area	Represents percentage of the land cover within the catchment area upstream of the dam. The first step involves identifying and categorizing based on the land cover types: 1. Bare Areas 2. Croplands 3. Forest 4. Grassland/Shrubland 5. Permanent Snow/Ice 6. Settlements 7. Water Bodies 8. Wetlands 9. Drained Peatland For each identified category, the percentage of the total catchment area (in km^2) is calculated and entered into the assessment. Additionally, for certain land cover categories, it is essential to specify the Land Use intensity, indicating whether the land is 'unmanaged' (low intensity, natural land

<table>
<tr><th>Landscape Data</th><th>Description</th></tr>
<tr><td></td><td>cover) or heavily managed’ (high intensity land cover with significant human influence).
For the purposes of categorizing and maintaining symmetry across the chapters, classification has been streamlined:
<table>
<tr><th>Original Habitat Type</th><th>G-res Land cover classification</th></tr>
<tr><td>Pasture</td><td>Grassland/Pasture</td></tr>
<tr><td>Agriculture</td><td>Cropland/Agriculture</td></tr>
<tr><td>River/Floodplain</td><td>Wetland/Flooded Areas</td></tr>
<tr><td>Settlements</td><td>Urban/Built-up</td></tr>
<tr><td>Woodland</td><td>Forest/Woodland</td></tr>
</table></td></tr>
<tr><td>Pre-impoundment land cover in the reservoir area (% of mineral and organic soils)</td><td>Pre-impoundment land cover refers to the land cover characteristics and types present in an area before the construction of a dam and subsequent flooding that creates a reservoir. This includes all natural and human-altered landscapes, such as forests, grasslands, croplands, wetlands, urban areas, and water bodies prior to the alteration of the landscape caused by impoundment. For each land cover category, the corresponding percentage of mineral and organic soils within the impounded area, as well as the percentage of organic soil that is drained.
Furthermore, for certain land cover categories, the Land Use Intensity should be indicated on a similar scale ranging from ‘unmanaged to heavily managed’ land.</td></tr>
</table>

Table 9-18 - Reservoir Data Description for G-Res Tool

Reservoir Data	Description
Country	Specifies the location of the reservoir (or for cross-border schemes, the country from which the reservoir is managed).
Longitude and Latitude of dam	Longitude and Latitude of point location of dam in decimal degrees (DD).
Climate zone (reservoir area)	Defines the appropriate climate category for the reservoir area. The climate should be assessed based on the Koppen-Geiger climate classification system, which categorizes climates based on temperature and precipitation patterns into four categories: 1. Tropical 2. Subtropical 3. Temperate 4. Boreal If the reservoir spans multiple climate zones, the category representing the largest proportion of the area should be chosen.

Reservoir Data	Description
Impoundment year	The impoundment year refers to the specific year in which the flooding of land to create the reservoir was completed. This year marks the transition from a pre-impoundment landscape, with it's associated land cover and ecological characteristics, to a post-impoundment environment dominated by water.
Reservoir Area (km2)	The reservoir area refers to the total surface area occupied by the reservoir, in km^2. For a more conservative estimate of emissions associated with the reservoir, it is recommended to use the surface area at full supply water level (which is 1,290 m). This represents the maximum area of the reservoir when it is at its designed capacity, providing a comprehensive view of potential emissions under the highest water level conditions. **Note**: *Reservoir area, Reservoir mean depth, maximum depth, volume, discharge, have all been assumed at the same chosen water level (full supply water level of 1,290 m).*
Reservoir Volume (km3)	Represents the total volume of water in the reservoir at the full water supply level in cubic kilometers.
Water Level (m above sea level)	Refers to the full water supply or mean operating level of the reservoir in meters above sea level, depending on the reservoir area.
Maximum and Mean depth (m)	Specifies to the Maximum and Mean depth of the reservoir relative to water level of the reservoir (at full water supply level)
Soil Carbon Content Under Impounded Area (kgC/m^2)	Soil carbon content under the impounded area refers to the amount of carbon stored in the soils that are submerged beneath the flooded region of the reservoir. This measurement is typically taken from the top 0-30 centimeters of soil which is where most of the carbon is stored. This is assessed using the carbon stocks that may be released into the atmosphere due to the flooding and subsequent decomposition of organic matter in the submerged soils. It is usually expressed in kilograms of carbon per square meter (kgC/m^2).
Annual Wind speed (m/s)	The average wind speed above the reservoir surface in meters per second.
Wind value from Earth Engine	Clarifies whether the annual wind speed value is coming from Earth Engine or a different source.
Wind measurements height (m)	Represents the height above the reservoir surface at which the wind speed measurements were taken.
Water Residence time (years)	The water residence time represents the average amount of time that a molecule of water spends in the reservoir in years.
Annual Discharge from Main Intake (m^3/s)	Represents the annual average rate of discharge from the main dam outlet for the chosen water level of the reservoir.
Water Intake Depth	The depth from the surface of the reservoir to the level of the dam intake.
Water intake elevation	Elevation of the water intake of the reservoir in meters above sea level.

Reservoir Data	Description
Annual discharge from secondary intake	Annual average rate of discharge from the secondary dam outlet for chosen water level of the reservoir (full water supply or mean operating level) in cubic metres per second.
Secondary Water intake depth	The depth from the surface of the reservoir to the level of any secondary dam intake.
Phosphorous concentration	Mean phosphorous concentration within the reservoir
Trophic level	The tropic state of the reservoir in four different categories: ▪ Oligotrophic = Less than 10 ▪ Mesotrophic = Between 10 and 30 ▪ Eutrophic = between 30 and 100 ▪ Hyper-eutrophic = More than 100
Reservoir Mean Global Horizontal Radiance (kWh/m^2/d)	It is the annual or ice-free average amount of total solar radiation that is incident on the horizontal surface at the surface of the Earth, measured in (kWh/m^2/d).
Mean Temperature per Month (degree C)	Refers to the average air temperature recorded for each month over multiple years at the specific location of the reservoir or from a nearby weather station.

Table 9-19 - Reservoir Services Data Description for G-Res Tool

Reservoir Services Data	Description
Allocation of Reservoir Purposes (e.g. Flood Control, Fisheries, Water Supply, Hydroelectricity).	Helps allocate proportionate use for which the reservoir is going to be used. It can be ranked as Primary, Secondary, and Tertiary. **Note: Information on hydropower system** Installed Capacity – The maximum capacity that the hydropower system is designed to run at (sum of all turbines). Total Annual Generation – The intensity of power production generated per year in gigawatt hours per year (5-year avg. recommended).

G-RES TOOL – INPUT DATA

9.12.3. The following section provides a summary of the data input within the G-Res tool. This is broken down in three areas: Landscape Data, Reservoir Data, and Reservoir Service Data.

Landscape Data

Table 9-20 - Landscape data for G-Res Tool assessment

<table>
<tr><th>Landscape Data</th><th>Value</th></tr>
<tr><td>Catchment Area (km^2)</td><td>30,390 km^2</td></tr>
<tr><td>Population in the Catchment (persons)</td><td>304,338 persons</td></tr>
<tr><td>Land cover of the Catchment area

% Land Use Intensity</td><td>
<table>
<tr><th>Habitat Type</th><th>Relative Coverage (%)</th></tr>
<tr><td>Croplands</td><td>18.6%</td></tr>
<tr><td>Bare Areas</td><td>15.1%</td></tr>
<tr><td>Forest</td><td>3.8%</td></tr>
<tr><td>Grassland/Shrubland</td><td>29.9%</td></tr>
<tr><td>Permanent Snow/Ice</td><td>32.2%</td></tr>
<tr><td>Settlements</td><td>0.2%</td></tr>
<tr><td>Water Bodies / Drained Peatlands</td><td>0.1%</td></tr>
</table>
<table>
<tr><th></th><th>Past</th><th>Current</th></tr>
<tr><td>Croplands</td><td>75%</td><td>75%</td></tr>
<tr><td>Forest</td><td>75%</td><td>75%</td></tr>
<tr><td>Grassland/Shrubland</td><td>75%</td><td>75%</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Landscape Data</th><th>Value</th></tr>
<tr><td>Pre-impoundment land cover in the reservoir area (% of mineral and organic soils)</td><td>
<table>
<tr><th>Habitat type</th><th>% Mineral Soil</th></tr>
<tr><td>Croplands</td><td>5%</td></tr>
<tr><td>Forest</td><td>1%</td></tr>
<tr><td>Grassland/Shrubland</td><td>49%</td></tr>
<tr><td>Settlements</td><td>15%</td></tr>
<tr><td>Water Bodies / Drained Peatlands</td><td>30%</td></tr>
<tr><td>Wetlands</td><td>0.4%</td></tr>
</table>
</td></tr>
<tr><td>% past land use Intensity</td><td>
<table>
<tr><th></th><th>Past</th></tr>
<tr><td>Croplands</td><td>75%</td></tr>
<tr><td>Forest</td><td>75%</td></tr>
<tr><td>Grassland/Shrubland</td><td>75%</td></tr>
</table>
</td></tr>
</table>

9.12.4. The catchment area (km^2) represents the total defined as the total area of land that contributes surface water flow to the reservoir. At the proposed Rogun dam site the Vakhsh drains a catchment area of approximately 30,390 km² and at this location the river flows through a narrow, 400 to 500 m deep V-shaped gorge with gradients of the valley sides up to 50° (Pöyry, 2014).

9.12.5. **Population within the Catchment Area** - This indicator represents the population residing within the catchment area upstream of the dam providing an estimate of the total number of individuals living in the area, which is important for understanding potential social impacts as well as the demand for resources in affected communities. The estimated population within the catchment area is 304,338 persons.

9.12.6. **Land Cover of the Catchment Area -** The land cover within the catchment area upstream of the reservoir was assessed to provide an overview of habitat types, land use intensity, and their relevance to greenhouse gas (GHG) emissions. Understanding this distribution is critical for evaluating potential carbon fluxes under the G-Res Tool framework, as different habitat types have varying emission or sequestration potentials.

The analysis indicates the following land cover distribution:

- **Permanent Snow/Ice (32.2%)** – These areas are largely inert with respect to GHG fluxes, contributing minimally to biogenic emissions. However, glacier retreat could expose new surfaces that may gradually increase organic matter inputs downstream.
- **Grassland/Shrubland (29.9%)** – These ecosystems can serve as moderate carbon sinks but may release emissions when inundated, particularly from soil organic matter decomposition.

- **Croplands (18.6%)** – Agricultural land use is associated with relatively higher GHG emissions, especially due to organic matter inputs, soil disturbance, and potential nutrient runoff that can drive methane and nitrous oxide production in the reservoir.
- **Bare Areas (15.1%)** – With limited vegetation or soil organic matter, these contribute minimally to direct GHG emissions, although erosion from these areas may supply particulate matter to the reservoir.
- **Forest (3.8%)** – While forests are generally strong carbon sinks, inundation of forested areas during reservoir filling can lead to significant decomposition of biomass and elevated methane emissions in the short to medium term.
- **Settlements (0.2%)** – Although limited in area, settlements may contribute local sources of organic waste and nutrients, indirectly affecting reservoir emissions.
- **Water Bodies and Drained Peatlands (0.1%)** – Peatlands, even in small areas, can be important hotspots for methane and carbon dioxide emissions when disturbed or inundated.

9.12.7. **Soil Classification within the Catchment** - For the purposes of this assessment, and in line with the G-Res Tool methodology, soils are categorized as either mineral soils or organic soils. While all soils contain some level of organic content as noted in Table 9-5, organic soils are specifically defined as those with a high carbon content. In the case of the Rogun reservoir catchment and analysis using Google Earth Engine confirms that the buffer area around the reservoir shows relatively low organic soil land cover present. Accordingly, for the G-Res Tool assessment, % organic soils in the different land cover types have been assumed to be zero for the purposes of this assessment.

9.12.8. A remote sensing exercise was undertaken using readily available mapping data, to accurately map/classify habitat polygons across the Project and for a buffer distance of 2km using the industry leading ESRI GIS software. This process underwent ongoing iteration following site visits and review of satellite imagery to assist with defining the boundaries of the various habitat types; in particular those of greatest sensitivity.

9.12.9. As mentioned earlier in the do something scenario (Section 9.4) and as visible upon site surveys, the site seems to be heavily modified for agriculture, grazing and other purposes. To reflect this, the land use intensity % across Cropland, Forest, and Settlement has been taken as 75%.

9.12.10. **River length before impoundment (m)** - This value represents the length of the river channel between the upstream river inlet and the dam site before the reservoir was impounded (i.e., before the dam was built and the area was flooded). This has been assumed as 70,000 m.

Reservoir Data

Table 9-21 - Reservoir data for G-Res Tool assessment

Reservoir Data	Value
Country	Tajikistan
Longitude and Latitude of dam	38.681320, 69.771522
Climate zone (reservoir area)	Temperate
Impoundment year	2038

Reservoir Data	Value
Reservoir Area (km^2)	170
Reservoir Volume (km^3)	13.3
Water Level (m above sea level)	1,290
Maximum depth (m)	290
Mean Depth (m)*	78.235
Littoral Area (%)*	2.775
Thermocline Depth (m)*	9.4
Soil Carbon Content Under Impounded Area (kgC/m^2)	7.746
Annual Wind speed (m/s)	3.07
Wind value from Earth Engine	No
Wind measurements height (m)	1,251 m above sea level
Water Residence time (years)*	0.3002
Annual Discharge from Main Intake (m^3/s)	1,405
Water Intake Depth	110
Water intake elevation	1,180
Annual discharge from secondary intake	
Secondary Water intake depth	
Phosphorous concentration*	9.8
Trophic level*	Mesotrophic
Reservoir Mean Global Horizontal Radiance (kWh/m2/d)	4.2
Mean Temperature per Month (degree C)	3.5

* - Mean Depth, Litoral Area, Thermocline Depth, Water Residence time, Phosphorus concentration, and Trophic level were calculated from the G-res tool based through the mandatory inputs inserted in the tool.

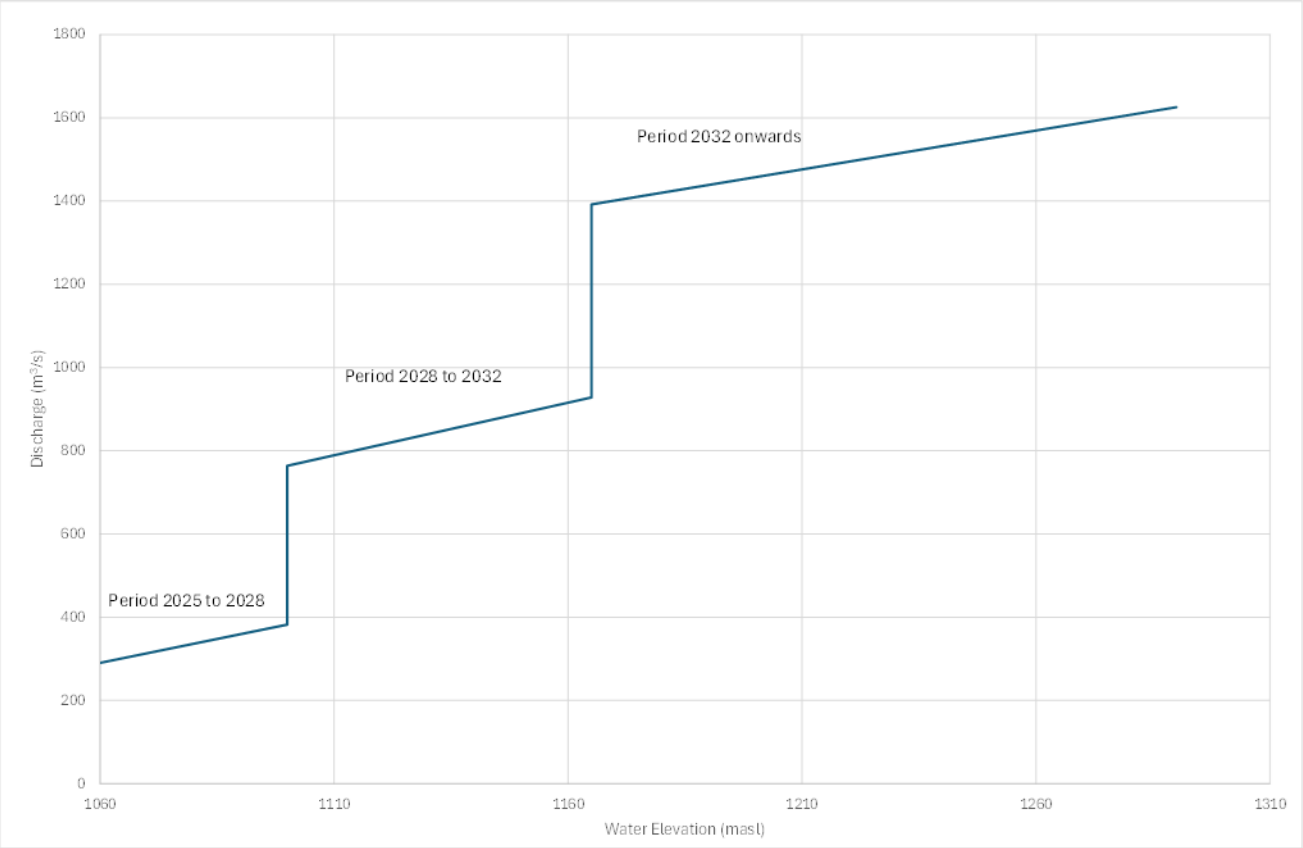
9.12.11. The location and region-specific characteristics of the project such as latitude and longitude have been obtained from a review of the Google Earth engine to accurately reflect the properties.

9.12.12. Tajikistan, including the Rogun area, generally falls within a continental climatic zone. The climate is characterized by significant variations in temperature across seasons, with cold winters and hot, dry summers. Precipitation levels vary across different regions but are generally low, with most areas experiencing limited rainfall, mainly during the winter and early spring months. As per the Koppen-

Gieger Climate Classification referenced in the G-res tool, the climatic zone in Tajikistan has been assumed to be temperate with cold summers and dry winters.

9.12.13. The annual discharge from main intake value represents the total volume of water withdrawn from the reservoir through its main intake. This value expressed in (m^3 /sec) reflecting the typical flow released through the intake. For G-res tool input, we have assumed a long-term average discharge rate through the intake/outlet accounting for season variations and operational constraints and typically required by the tool for estimating methane degassing calculations. The annual discharge values have been referenced from the doc. Ref. No. 41106439-REP-00001 *Rogun Hydropower Project – Updated Environmental and Social Impact Assessment Vol. 2, Annex 13-3 Water Resource Modelling*.

Figure 9-5 - Maximum flow through turbines as Rogun reservoir is constructed and number of turbines increase



9.12.14. **Figure 9-5** represents the maximum flow through the turbine for the 100-year operational lifecycle of the reservoir. To help calculate the long-term average, we have used weighted average method from the start of the first turbine. The below periods and durations have been calculated based on the graph provided above.

Table 9-22 - Average discharge over the lifetime of Rogun HPP based on turbine flow

Time Period	Duration (in years)	Average discharge over the time period (m^3/s)
2025-2028	4	340
2029-2032	4	850
2032-2124	92	1475

9.12.15. To estimate the long-term average annual discharge from the main intake over the reservoir's 100-year operational life, a weighted average approach was applied. This method accounts for changes in flow capacity over time as additional turbines become operational. Based on defined operational periods and corresponding discharge rates, the calculation ensures a representative average value that reflects both early-stage and full-capacity operations.

Weighted average formula

Weighted average = Summation of (annual discharge * no. of years) / Total no. of years

Weighted average = (340 * 4) + (850*4) + (1475 * 92) / 100

Weighted average = (1360 + 3400 + 135700) / 100 = 1405 m^3/s (approx.)

As per calculations above, we have assumed the annual discharge from main intake as 1405 m^3/sec.

9.12.16. The "impoundment year" refers to the specific year when the flooding of land, creating the reservoir, was completed. It is assumed that the reservoir will be fully completed at its operating level by 2038.

9.12.17. The Project has been in construction for many years, most recently since 2018 with work currently ongoing. The current status of the Project (as of September 2024) includes: A reservoir at elevation 1,065 m asl with a surface area of 12 square kilometers (km^2). The reservoir will be raised to 1,110 m asl by 2027 and progressively raised to 1,290 by 2039.

9.12.18. A reservoir with a full supply level (FSL) at 1,290 m above sea level (asl), a total surface area of 170 km^2, an overall length of approximately 70 km and capacity of approximately 13.3 cubic kilometers (km^3).

9.12.19. **Water Intake Elevation (m a.s.l.) –** This input refers to the elevation above sea level (in meters) at which water is withdrawn from the reservoir through the main intake structure. This is calculated by the difference between the maximum water level and the water intake depth. The maximum water level is 1,290 m and the water intake depth of 110 m.

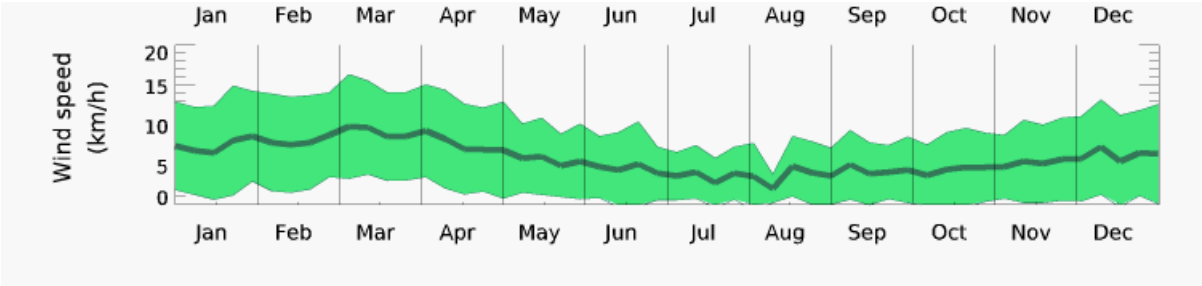
Water Intake Elevation = Water Level – Water Intake Depth

Water Intake Elevation = 1290 – 110 = 1180 m a.s.l.

9.12.20. **Water Intake Depth (m)** - This input refers to the vertical distance between the reservoir surface (at the chosen operating level—either full supply or mean level) and the intake point where water is withdrawn. This has been taken as 110 m.

9.12.21. Wind speed data is not available from the World Bank Climate Change Knowledge Portal. However, Meteoblue presents observed climate data for the DRS (Meteoblue, 2022) with data obtained from a weather station approximately 72km away (at 1251 m asl) from Project site shown in **Figure 9-6**. This data is provided as an indication of the wind speeds at the Project site. Wind speeds are typically lowest in July and August, and highest in March.

Figure 9-6 - Wind speed data for Dehauz, 72km far from the Rogun Project site



9.12.22. At the time of writing this report no direct flow measurement downstream of Rogun is available to WSP. However, the data used in Coyne et Bellier et al. (2014) and the World Bank (2023) can be considered a good approximation to the flow conditions downstream of Rogun before the construction of the dam. The data sources available are:

- Rogun dam inflows for the period from 1932 to 2008 (Coyne et Bellier et al., 2014); and
- Nurek HPP inflows for the period from 2009 to 2019 (World Bank, 2023).

9.12.23. Mean Global Horizontal Radiance (GHR) refers to the average amount of total solar radiation received per unit area by a horizontal surface at the Earth's surface, typically measured in kilowatt-hours per square meter per day (kWh/m²/day). It represents the total solar energy that strikes a horizontal plane and accounts for direct sunlight as well as diffused radiation scattered through the atmosphere. The Mean Global Horizontal Radiance (kWh/m2/d) though not available on the Global Solar Atlas website, has information on Global Horizontal Irradiance (GHI) used similarly can be used for reservoir modelling and greenhouse gas emissions (Solargis, 2023).

9.12.24. The temperatures experienced across Tajikistan are moderated by the mountainous terrain. Average monthly temperatures are slightly warmer in comparison to the rest of Tajikistan as presented in

9.12.25. **Figure** 9-7.

Figure 9-7 - Average monthly temperatures



9.12.26. Seasonal temperatures range from an average of -6.9°C in winter (December, January, February) and 15.9°C in the summer (June, July, August). The average minimum temperature in winter is -11.0°C and average maximum summer temperature is 23.1°C.

Reservoir Services data

Table 9-23 - Reservoir Services data for G-Res Tool assessment

Allocation of Reservoir Services Data	Value
Hydroelectricity	Primary – 80% allocation Installed Capacity – 3,780 MW Total Annual Generation – 17,000 GWh
Environmental Flow	Secondary Allocation – 15%
Flood Control	Tertiary Allocation – 5%

9.12.27. To assess the distribution of services provided by the reservoir, the G-Res Tool methodology applies proportional allocation based on the primary intended use and associated benefits. For Rogun HPP, three main services were identified: hydroelectricity generation, environmental flow provision, and flood control.

- Hydroelectricity was determined to be the primary service, representing 80% of the total allocation. This is supported by the reservoir's substantial installed capacity of 3,780 MW and an average annual generation of 17,000 GWh. The dominance of hydroelectricity reflects the project's design objective and the significant role it plays in meeting regional energy demands.

- Environmental flows were categorized as a secondary service, with an allocation of 15%. This recognizes the operational measures in place to maintain downstream ecological integrity, including sustaining aquatic habitats and ensuring minimum flow requirements.
- Flood control was identified as a tertiary service, receiving 5% allocation. While not the primary driver of reservoir construction, flood attenuation remains an important co-benefit, providing protection to downstream communities and infrastructure.

9.12.28. Currently, there is an underground powerhouse on the site with two operating turbines (Units 5 and 6) with a combined generation capacity of 400 MW. These will be upgraded in 2024 / early 2025, bringing their capacity to 630MW each. Turbine Units 1 to 4 will be progressively installed from 2025 to 2029, at which point the full generation capacity will reach 3,780 MW.

9.13 REFERENCES

E.V. Shamrikova et al. (2022). Transferability between soil organic matter measurement methods for database harmonization. *Elsevier*.

ADB. (2017, April). *Guidelines for Estimating Greenhouse Gas Emissions of ADB Projects.* Retrieved from https://www.adb.org/documents/guidelines-estimating-ghg-energy-projects

Amin, M.A.., et al. (2021). Land use changes and carbon dynamics in the tropical forests.

Bath ICE. (2019, November). *Circular Ecology.* Retrieved from https://circularecology.com/embodied-carbon-footprint-database.html

BSI. (2023). *Carbon Management in Infrastructure and Built Environment - PAS 2080.* Retrieved from https://www.bsigroup.com/en-GB/insights-and-media/insights/brochures/pas-2080-carbon-management-in-infrastructure-and-built-environment/

Cuihong Song et. al. (2018). Cradle-to-grave greenhouse gas emissions from dams in the United States of America. *Renewable and Sustainable Energy Reviews*.

EDP. (n.d.). *LIfe Cycle Assessment of a Hydroelectric Plant*. Retrieved from https://www.edp.com/en/life-cycle-assessment-lca-a-hydroelectric-plant

EIB. (2019). Retrieved from https://www.eib.org/en/press/all/2019-313-eu-bank-launches-ambitious-new-climate-strategy-and-energy-lending-policy

EIB. (2019, Ocotber). *Environmental, Climate and Social Guidelines on Hydropower Development.* Retrieved from https://www.eib.org/en/publications/environmental-climate-and-social-guidelines-on-hydropower-development

EIB. (2022, February). *European Investment Bank Environmental and Social Standards.* Retrieved from https://www.eib.org/en/publications/eib-environmental-and-social-standards

EIB. (2023, January). *EIB Project Carbon Footprint Methodologies.* Retrieved from https://www.eib.org/en/publications/20220215-eib-project-carbon-footprint-methodologies

FAO. (2003, June). *National Action Plan of the Republic of Tajikistan for Climate Change Mitigation.* Retrieved from https://leap.unep.org/en/countries/tj/national-legislation/national-action-plan-republic-tajikistan-climate-change

FAO. (2022, June). *UPDATED VERSION OF THE NATIONAL DETERMINED CONTRIBUTION OF THE REPUBLIC OF TAJIKISTAN.* Retrieved from

https://leap.unep.org/en/countries/tj/national-legislation/updated-version-national-determined-contribution-republic

Fearnside, P.M. (2004). The impacts of deforestation on the carbon balance of the Amazon Basin.

Fearnside, P.M. (2006). Hydroelectric dams in the Brazilian Amazon as source of greenhouse gases.

Government of the Republic of Tajikistan. (2022, December). *FOURTH NATIONAL COMMUNICATION OF THE REPUBLIC OF TAJIKISTAN UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE.* Retrieved from UNFCCC: https://unfccc.int/sites/default/files/resource/4NC_TJK_eng_0.pdf

Greenhouse Gas Protocol. (2015). *GHG protocol corporate Standard.* Retrieved from https://ghgprotocol.org/corporate-standard

IEMA. (2022, February). *Assessing Greenhouse Gas .* Retrieved from https://www.iema.net/media/xmgpoopk/2022_iema_greenhouse_gas_guidance_eia.pdf

International Finance Corporation. (2008, December). *Environmental, Health, and Safety Guidelines for Thermal Power Plants.* Retrieved from https://www.ifc.org/content/dam/ifc/doc/2000/2008-thermal-power-ehs-guidelines-en.pdf

International Hydropower Association. (2021). *Hydropower's carbon footprint*. Retrieved from https://www.hydropower.org/factsheets/greenhouse-gas-emissions#:~:text=The%20IPCC%20states%20that%20hydropower,490%20gCO%E2%82%82-eq%2FkWh.

IPCC. (2006). *2006 IPCC Guidelines for National Greenhouse Gas Inventories.* Retrieved from https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_02_Ch2_Generic.pdf

IPCC. (2016). Special Report: Special Report on Climate Change and Land. (pp. Chapter 04, Land Degradation). IPCC.

IPCC. (2019). *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.* Retrieved from https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/

JBIC. (2018, July). *Guidelines for Measurement, Reporting and Verification of GHG Emission Reductions in JBIC's GREEN (the "J-MRV Guidelines").* Retrieved from https://www.jbic.go.jp/en/business-areas/sectors/environment/j-mrv.html

McGuire, K.J., et al. (2013). Carbon sequestration in reservoir sediments.

Meteoblue. (2022). *Observed historical climate & weather data for Roghun.* Retrieved from https://www.meteoblue.com/en/weather/historyclimate/climateobserved/roghun_tajikistan_1220701

RICS. (2023, September). *Whole life carbon assessment (WLCA) for the built environment.* Retrieved from https://www.rics.org/content/dam/ricsglobal/documents/standards/Whole_life_carbon_assessment_PS_Sept23.pdf

Solargis. (2023). *Global Solar Atlas*. Retrieved from https://globalsolaratlas.info/download/tajikistan

UNFCCC. (2021). *IFI Default Grid Factors 2021 v3.1.* Retrieved from https://unfccc.int/documents/437880

World Bank. (2017, December). *Publication: Greenhouse Gases from Reservoirs Caused by Biogeochemical Processes.* Retrieved from https://openknowledge.worldbank.org/entities/publication/1f93db13-7752-50a6-8be3-cd90fda632bd

World Bank. (n.d.). *G Res tool*. Retrieved from https://www.grestool.org/

PUBLIC

JSC “Rogun HPP”

State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT – UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Volume 1, Chapter 10: Climate Change



MAY 2025

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PROJECT REF

DATE: MAY 2025

QUALITY CONTROL

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10 CLIMATE CHANGE

10.1.1. This chapter assesses climate change from a dual perspective, considering the vulnerability of the Project to current and future climate risks; and the potential for transition risks to affect the Project, specifically those of policy and regulatory changes. The climate risk and vulnerability assessment is presented from Section 2 to Section 10.9 and considers how future climate change may impact the physical assets and operations of the Project. Unlike other ESIA topic assessments, it does not consider the impact of the Project on the environment. The assessment of transition risks is presented from **Section 10.10** and considers risks or opportunities related to a transition to a low-carbon economy.

10.1.2. A description of baseline climate change conditions is presented in **Volume 2, Annex 7.1: Baseline Conditions Report** and a summary is provided in **Volume 1, Chapter 7: Baseline** of this ESIA. The assessment is in line with the requirements of WB ESS3: Resource Efficiency and Pollution Prevention and Management.

10.2 CLIMATE RISK AND VULNERABILITY ASSESSMENT

10.2.1. The Climate Risk and Vulnerability Assessment (CRVA) is an assessment of the potential impacts which may occur to the Project due to climate change variables. This considers how future climate trends may adversely impact the construction and operation of the Project components (the 'receptors') which are yet to be constructed. The scope of the CRVA does not extend to the consideration of impacts outside of the immediate HPP infrastructure. Any impacts such as those to downstream riparian countries will be considered within **Volume 1, Chapter 13: Water** and / or **Volume 1, Chapter 24: Summary of Transboundary Cumulative Impact Assessment**. The CRVA is presented in Section 10.7 and utilizes future climate trend analysis (Section 10.6) as well as project specific risk mitigation measures to determine the risk rating. Where necessary, additional mitigation measures for the avoidance of impact, impact minimization and long-term management are included in **Section 10.8**.

10.2.2. The approach to the CRVA is to consider climate change risks through an assessment of the climate hazards and provides a high-level overview as to how the Project may be at risk from future climate change; and through an assessment of the risks to the Project due to the transition to a lower-carbon economy.

10.2.3. The assessment of the climate-related risks which may impact the Project is based on forecast climate data for relevant climate variables, and the exposure and vulnerability of the Project to these climate variables. The assessment considers the Project specific design and mitigation measures that improve the Project resilience.

10.2.4. The hydrology and climate change study is underway. A hydrological geodatabase has been developed and thematic maps were produced. The flood hydrographs, previously evaluated as part of the TEAS studies, have been reevaluated for return periods up to 10,000 years, revealing slightly lower results. The risks of glacial lake (GLOF) and landslide dam outburst floods (LDOF) have been assessed, showing that GLOF events are not considered critical for Rogun dam and flood safety and that there is a potential for large LDOF events in the Vakhsh catchment, but not significant enough to be the critical flood type. A catchment model is being developed, which will be used to evaluate the impact of climate change on the key hydrologic process drivers for mid- and end-of-

century horizons. The sediment yield under current conditions and climate change scenarios is still under evaluation, and will be an input for a comprehensive sedimentation study.

10.3 CRVA LEGISLATIVE FRAMEWORK, POLICY AND GUIDANCE

NATIONAL STRATEGY

10.3.1. The National Climate Change Adaptation Strategy of the Republic of Tajikistan for the period up to 2030 outlines the country's commitment to the Paris Agreement (Government of Tajikistan, 2019). The Strategy notes that Tajikistan is one of the most vulnerable countries to the impacts of climate change due to its geographical location, diversity of climatic conditions, economic structure and demographic interests. Priority sectors for development in Tajikistan include energy and the Strategy notes that the country has a strong dependence on hydroelectric power.

10.3.2. Climate change risks may impact hydropower performance though changes in water availability affecting hydropower production.

10.3.3. Prioritized adaptation options that are relevant to hydropower in the Strategy include:

- Investing in climate-resilient infrastructure to enhance hydropower resilience and productivity; and
- Strengthening adaptation and planning tools for long-term hydropower generation, addressing changes in water and energy availability.

INTERNATIONAL STANDARDS

10.3.4. The CRVA aligns with the World Bank Environmental and Social Standards (ESS) including:

- ESS1, paragraph 35 which requires an ESIA to consider potentially significant project related risks associate with climate change adaptation and resilience issues; (World Bank, 2018)
- ESS3, paragraph 13 where impacts of climate change should be assessed; (World Bank, 2018) and
- ESS4, paragraph 2 where the considerations relating to climate change should be considered. (World Bank, 2018)

10.3.5. The CRVA aligns with European Investment Bank (EIB) Environmental and Social Standard 5: Climate Change (EIB, 2022). The objective of Standard 5 is to promote *"the alignment of projects supported by the EIB with the goals and principles of: (i) the Paris Agreement and (ii) the Sustainable Finance Action Plan".* Standard 5 notes that climate change mitigation and adaptation must be considered and addressed in the decision-making process of the Project. In relation to physical climate risk, a Project should be assessed to consider its *"alignment with climate-resilient development pathways,*[1] *and identify options to reduce physical climate risks to the project, its natural environment and the people that may be affected by it"* and identify *"options to reduce transition risks".*

10.3.6. Standard 5 outlines the approach for CRVA to align with the EIB Group Climate Bank Roadmap (EIB Group, 2020) and have consistency with the EU Taxonomy 'Do No Significant Harm' (DNSH)

[1] Climate-resilience development pathways are defined as: *"Trajectories that strengthen sustainable development and efforts to eradicate poverty and reduce inequalities while promoting fair and cross-scalar adaptation to and resilience in a changing climate"* (IPCC, 2018)

principle (Official Journal of the European Union, 2023). The EIB Group Climate Bank Roadmap is based on:

- Promoting green finance through investing in projects which accelerate low carbon transition;
- Investing in projects that simultaneously support the transition and improve socio-economic development;
- Supporting Paris-aligned projections, considering both low carbon and climate resilience; and
- Ensuring projects align with finance and socially sustainable policies, and that their success can be monitored and reported for accountability.

10.3.7. The criteria for EU Taxonomy DNSH to climate change adaptation include:

- Screening of the activity to identify the physical climate risks that may affect the performance of the economic activity during its expected lifetime;
- A CRVA to assess the materiality of the physical climate risks on the economic activity; and
- An assessment of adaptation solutions that can reduce the identified physical climate risk.

10.3.8. The International Hydropower Association (IHA) has produced a Climate Resilience Guide for the Hydropower Sector (IHA, 2019) which has informed the identification and assessment of climate change risks and, where required, suggest additional mitigation measures for the Project.

10.4 CRVA ASSESSMENT METHODOLOGY

10.4.1. The CRVA is aligned with EU Taxonomy 'DNSH' criteria (Official Journal of the European Union, 2023).

10.4.2. An initial screening of climate hazards (such as changing temperature, heavy precipitation, glacial lake outburst) was undertaken to identify the climate-related hazards which are relevant to the Project and its geographical location. The chronic (long-term) and acute (event-driven) hazards identified in the DNSH criteria have been used to inform the screening process.

10.4.3. The climate projection data contained in this Chapter has been obtained from the World Bank Climate Change Knowledge Portal (World Bank Group, 2021) to inform the CRVA. Climate projections have been presented for the Districts of Republican Subordination (DRS) in Tajikistan.

10.4.4. Projections are provided for Shared Socioeconomic Pathways (SSP) 2-4.5, as the middle-of-the-road scenario, equivalent to 2-degree warming; and SSP5-8.5, as the fossil fuel development scenario, equivalent to 4-degree warming. The use of two climate projection scenarios provides context for the uncertainties inherent in climate science and projection modelling. SSP5-8.5 has been used to assess the risk to the Project as a conservative, precautionary approach. A precautionary approach is used in CRVAs to identify potential risks where there is scientific uncertainty. Climate projections have been provided for 20-year incremental periods, including the 2030s, 2050s and 2090s, using global climate data. The current global climate model is known as Coupled Model Intercomparison Project (CMIP6).

10.4.5. The CRVA considers hazard, exposure and vulnerability to determine the overall risk rating. These have five levels, namely very low, low, moderate, high and very high which correspond to the terminology detailed in **Table 10-1**.

Table 10-1 – Risk Assessment Terminology

Rating	Hazard	Exposure	Vulnerability
	Likelihood		Sensitivity and adaptive capacity
1	Very Low	Very Low	Very Low
	The climate hazard may occur once during the lifetime of the Project, or is a long-term chronic hazard.	The climate hazard occurs in the region, but the receptor can tolerate the climate impact with no adverse effects.	The probability the Project will be affected by the climate hazard is minimal. Risk mitigation measures are in place, proposed or very easily implemented and effective.
2	Low	Low	Low
	The climate hazard occurs occasionally during the lifetime of the Project; e.g. once in 60 years.	The climate hazard occurs in the region, but the receptor can tolerate the climate impact with minimal adverse effects.	The probability that the main components of the Project will be affected by the climate hazard is minimal. There is a small chance that secondary components will be affected by the climate hazard. Risk mitigation measures are in place, proposed or easily implemented and effective.
3	Moderate	Moderate	Moderate
	The event occurs limited times during the lifetime of the Project; e.g. approximately once every 30 years.	The climate hazard occurs in the region and the receptor is somewhat affected by the climate impact.	There is a low probability that the main components will be affected by the climate hazard. There is a good chance that the secondary components will be affected by the climate hazard. Risk mitigation measure (or proposed measures) may not be sufficient or effective.
4	High	High	High
	The event occurs several times during the lifetime of the Project; e.g. approximately once every 10 years.	The receptor is able to tolerate a range of climate conditions but is adversely affected by the climatic impact.	There is a high probability that the Project will be directly affected by the climate hazard. Risk mitigation measures (or proposed measures) are unlikely to be sufficient or effective.
5	Very High	Very High	Very High

Rating	Hazard	Exposure	Vulnerability
	Likelihood		Sensitivity and adaptive capacity
	The event occurs multiple times during the lifetime of the Project; e.g. approximately annually.	The receptor is highly affected by the climate impact and is not able to tolerate any variation in climate conditions.	There is a very high probability that the Project will be directly affected by the climate hazard. Risk mitigation measures are non-existent.

10.4.6. Climate-related hazards which are screened out will not be assessed further. Those that are screened in will be considered in the risk assessment.

10.4.7. Firstly, the risk rating is obtained by assessing the 'magnitude of impact' which is determined by assessing the hazard likelihood and the exposure, as presented in **Table 10-2**. The rating for the hazard likelihood is determined using future climate projection data and professional judgement to assign a rating to the receptor (the Project component at risk). The exposure rating is determined through literature review and professional judgement.

Table 10-2 - Matrix for Impact Magnitude

Magnitude of impact		Exposure				
		Very Low (1)	**Low (2)**	**Moderate (3)**	**High (4)**	**Very High (5)**
Hazard (Likelihood of event)	**Very High (5)**	Low (5)	Moderate (10)	High (15)	Very High (20)	Very High (25)
	High (4)	Low (4)	Moderate (8)	High (12)	High (16)	Very High (20)
	Moderate (3)	Low (3)	Low (6)	Moderate (9)	High (12)	High (15)
	Low (2)	Very Low (2)	Low (4)	Low (6)	Moderate (8)	Moderate (10)
	Very Low (1)	Very Low (1)	Very Low (2)	Low (3)	Low (4)	Low (5)

10.4.8. Secondly, the overall risk rating is determined, where the magnitude of impact (described above) and the vulnerability is assessed. The risk rating matrix is presented in **Table 10-3**. The vulnerability rating considers the probability of the receptor being impacted by the climate hazard and any known embedded or committed risk mitigation measures that have been incorporated into the design to incorporate resilience to climate change.

10.4.9. Mitigation measures may include technological and engineering solutions (termed 'grey' measures), nature-based solutions ('green' measures) or soft measures which include policy, legal, social, management and financial measures.

Table 10-3 - Risk Rating Matrix

Risk Rating		Vulnerability				
		Very Low (1)	Low (2)	Moderate (3)	High (4)	Very High (5)
Magnitude of impact	Very High (5)	Low (5)	Moderate (10)	High (15)	Very High (20)	Very High (25)
	High (4)	Low (4)	Moderate (8)	High (12)	High (16)	Very High (20)
	Moderate (3)	Low (3)	Low (6)	Moderate (9)	High (12)	High (15)
	Low (2)	Very Low (2)	Low (4)	Low (6)	Moderate (8)	Moderate (10)
	Very Low (1)	Very Low (1)	Very Low (2)	Low (3)	Low (4)	Low (5)

10.4.10. Where the overall risk rating is categorized as very low or low, it is considered that the receptor is not materially affected by the climate hazard and no additional mitigation measures are required.

10.4.11. Where the overall risk rating is categorized as moderate, high or very high, it is considered that there is a potential for a material effect to the Project and additional mitigation measures may be required. Additional mitigation measures are detailed in **Section 10.8**.

10.4.12. Supporting information used to undertake the CRVA is provided in **Volume 2, Annex 10-1: Climate Change** of this ESIA This includes a summary of previous reports made available to inform the CRVA and a hydropower literature review to inform the sensitivity of Project receptors.

ASSUMPTIONS AND LIMITATIONS

10.4.13. The World Bank Knowledge Portal climate projections have been used to infer future changes in a range of climate variables that may pose a risk to the Project from climate change. At the time of writing, these represent the most up-to-date representation of future climate.

10.4.14. There are inherent uncertainties associated with climate projections and they are not predictions of the future. It is possible that future climate will differ from the future climate against which the Project has been assessed, depending on global emissions over the next century. The use of two climate projection scenarios (SSP2-4.5 and SSP5-8.5) across short-, medium- and long-term time frames have been used to develop a baseline against which climate change risk has been assessed.

10.4.15. Any further research, analysis or decision-making should take account of the uncertainties associated with climate projections. It is also important to note that the analysis is based on selected observational data, the results of climate model ensembles and a selected range of existing climate change research and literature available at the time of assessment. Any future decision-making based on this analysis should consider the range of literature, evidence and research available at that time and any changes to this.

10.4.16. The CRVA considers the risk posed to the Project receptors from projected changes in climate. The scope of the CRVA does not extend to modelling or calculations to inform design specifications or inputs.

10.4.17. Identification of the embedded and committed mitigation measures for the Project is informed by review of the design, previous studies, committed future studies and available management plans. It is assumed that the recommendations of previous studies and management plans will be implemented and updated during the construction and operation of the Project. Whilst the outcomes of future studies are unknown, the assumption has been made that the studies will be undertaken by competent experts and the recommended design specifications and construction and operational processes will be incorporated into the Project. The CRVA should be reviewed and updated as the outcomes of future studies are embedded into the Project.

10.4.18. Provision of detailed design measures and the implementation of measures is outside of the scope of the CRVA.

10.4.19. The CVRA is a qualitative assessment, with the risk grading based on analysis of the climate hazards (climate projection data), understanding of the Project and literature review. Professional judgement is used to apply risk ratings to the assessment categories.

10.4.20. The CRVA should be considered an iterative tool which will require review and update as the Project design develops, as further studies are completed and as additional mitigation measures are identified and implemented.

10.5 CRVA SCREENING OF CLIMATE-RELATED HAZARDS

10.5.1. **Table 10-4** identifies the climate hazards as detailed in the DNSH criteria and provides justification where climate hazards have been screened out.

Table 10-4 – Screening of DNSH climate hazards

Climate Hazard			Screened in	Screened out	Justification (where screened out)
Chronic	Temperature related	Changing temperature (air, freshwater, marine water)	✓		
		Heat stress	✓		Heat stress impacts human receptors and is considered only for human health receptors.
		Temperature variability	✓		
		Permafrost thawing		✓	Permafrost is not present in the location of the Project.
	Wind related	Changing wind patterns	✓		
	Water related	Changing precipitation patterns and types (rain, hail, snow/ice)	✓		
		Precipitation or hydrological variability	✓		
		Ocean acidification		✓	The Project is located approximately 1000km from the Arabian Sea at an elevation of approximately 1000m. Climate risks associated with oceanographic conditions will not impact the Project.
		Saline intrusion		✓	
		Sea level rise		✓	
		Water stress	✓		

Climate Hazard			Screened in	Screened out	Justification (where screened out)
	Solid mass related	Coastal erosion		✓	The Project is located approximately 1000km from the Arabian Sea at an elevation of approximately 1000m. Climate risks associated with coastal conditions will not impact the Project.
		Soil degradation		✓	The Project does not rely on the quality of the soil for any purpose (as may be required for agriculture for example).
		Soil erosion	✓		
		Solifluction	✓		
Acute	Temperature related	Heat wave	✓		
		Cold wave / frost	✓		
		Wildfire	✓		
	Wind related	Cyclone, hurricane, typhoon		✓	Cyclone, hurricanes and typhoons form over oceans, and although they do make landfall, they are not typical in central Asia and therefore the risk associated with them is not considered further.
		Storm (including blizzards, dust and sandstorms)	✓		
		Tornado		✓	Tornados are not typical in central Asia and therefore the risk associated with tornadoes is not considered further.
	Water related	Drought	✓		
		Heavy precipitation (rain, hail, snow/ice)	✓		

Climate Hazard			Screened in	Screened out	Justification (where screened out)
		Flood (coastal, fluvial, pluvial, ground water)	✓		
		Glacial lake outburst	✓		
	Solid mass related	Avalanche	✓		
		Landslide	✓		
		Subsidence	✓		

10.6 CRVA CLIMATE PROJECTIONS

10.6.1. Climate projections have been derived from the World Bank Climate Change Knowledge Portal for the Project area (World Bank, 2020). Projections have been presented for the DRS, using CMIP6 data for SSP2-4.5 (representing a middle-of-the-road scenario, equivalent to 2-degree warming) and SSP5-8.5 (representing a fossil fuel development scenario, equivalent to a 4-degree warming) over the 20-year intervals covering the 2030s (2020 to 2039), 2050s (2040 to 2059) and 2090s (2080 to 2099).

10.6.2. The climate projection data shows the 50th percentile, with the 10th and 90th percentiles in brackets to demonstrate the range in the modeled data. Seasonal data has been used for each of the time periods, with the summer season covering the months of June, July and August; and the winter season covering December, January and February.

Temperature

10.6.3. Compared to the baseline of 1995-2014, the projected change in seasonal temperature for the DRS for the 2030s, 2050s and 2090s time periods under SSP2-4.5 and SSP5-8.5 scenarios shows an increase in temperature. Under the SSP2-4.5 scenario the temperature increase ranges from 1.09°C (2030s winter) to 3.21°C (2090s summer) for the 50% percentile 'central estimate' (taken as the median value of predicted change). Under the SSP5-8.5 scenario there is an increase in temperature in the range of 1.15°C (2030s winter) to 6.27°C (2090s summer).

10.6.4. For both scenarios, the projected air temperature increases are greatest for the summer months. During the winter months, air temperatures are also expected to increase, albeit to a lesser extent. Data are presented in **Table 10-5**.

Table 10-5 - DRS Projected Change in Average Seasonal Temperature (°C) under SSP2 and SSP5 for the 2030s, 2050s and 2090s (baseline period 1995-2014)

Year		SSP2-4.5	SSP5-8.5
2030s	Summer	+1.21 (+0.58 to +2.08)	+1.51 (+0.51 to +2.39)
	Winter	+1.09 (+0.11 to +1.95)	+1.15 (+0.36 to +2.01)
2050s	Summer	+2.01 (+1.09 to +3.25)	+2.65 (+1.74 to +4.02)
	Winter	+1.87 (+0.72 to +2.89)	+2.30 (+1.19 to +3.62)
2090s	Summer	+3.21 (+1.93 to +4.63)	+6.27 (+4.49 to +8.64)
	Winter	+2.97 (+1.57 to +4.40)	+5.49 (+3.69 to +8.41)

10.6.5. As well as an increase in average temperatures, projections indicate an increase in extreme temperatures (i.e. the temperature experienced during heatwaves). **Table 10-6** shows the projected change in maximum daily maximum temperature for summer in each of future time slices relative to the reference period (1995-2014) for the DRS. **Table 10-6** shows that the by the 2090s daily maximum temperature in summer may be 3.03°C hotter under SSP2-4.2, and potentially 6.38°C hotter under SSP5-8.5.

Table 10-6 - DRS Projected Change in Maximum of Daily Max-Temperature (°C) during Summer under SSP2 and SSP5 for the 2030s, 2050s and 2090s (baseline period 1995-2014)

Year		SSP2-4.5	SSP5-8.5
2030s	Summer	+1.10°C (-0.68 to +2.66)	+1.34 (-0.10 to +3.05)
2050s	Summer	+2.12 (+0.33 to +3.66)	+2.59 (+1.17 to +4.38)
2090s	Summer	+3.03 (+1.49 to +4.40)	+6.38 (+4.06 to +8.55)

10.6.6. Periods of extreme temperature can increase the risk of fire outbreak, with high temperatures, low humidity and dry conditions conducive to fire weather (Jones et al., 2020). Projection data for Tajikistan suggest that by the 2030s, there will be minimal increase in the land fraction exposed to wildfire (0.1%). By the 2050s and 2075 (the furthest extent of the projection data) this will increase slightly to 0.2% (Climate Analytics , 2023).

Precipitation

10.6.7. Projection data shows that summer precipitation rates will decrease (under the 50th percentile in both SSP2-4.5 and SSP5-8.5), but winter precipitation rates will increase. Under the SSP2-4.5 scenario precipitation decreases from -2.38mm (2030s summer) to -17.5mm (2090s summer) for the 50% percentile. Under the SSP5-8.5 scenario the decrease in precipitation is projected to be from -11.5mm (2030s summer) to -34.5mm (2090s summer).

10.6.8. Winter increases in precipitation under SSP2-4.5 range from 13.6mm in the 2030s to 30.9mm in the 2090s (50th percentile); and from 8.5mm to 72.7mm by the 2090s.

10.6.9. Annually, there is an increase in the DRS due to winter precipitation increases far outweighing summer precipitation decreases.

Table 10-7 - DRS Projected Change in Summer, Winter and Annual Precipitation (mm) under SSP2 and SSP5 for the 2030s, 2050s and 2090s (baseline period 1995-2014)

Year		SSP2-4.5	SSP5-8.5
2030s	Summer	-2.38 (-43.70 to +27.98)	-11.51 (-45.55 to +31.07)

Year		SSP2-4.5	SSP5-8.5
	Winter	+13.66 (-35.54 to +54.02)	+8.58 (-52.95 to +65.12)
	Annual	+17.11 (-188.01 to +186.26)	-6.43 (-203.62 to +199.77)
2050s	Summer	-10.20 (-49.97 to +34.70)	-12.30 (-51.52 to +29.97)
	Winter	+24.33 (-31.66 to +81.37)	+30.92 (-28.65 to +97.13)
	Annual	+26.85 (-188.95 to +238.29)	+37.18 (-181.11 to +252.99)
2090s	Summer	-17.50 (-65.73 to +32.61)	-34.52 (-90.65 to +23.22)
	Winter	+30.94 (-46.09 to +91.01)	+72.75 (-26.62 to +153.8)
	Annual	+32.34 (-224.9 to +271.52)	+42.70 (-277.45 to +342.30)

10.6.10. Water stress in the Project area is projected to remain low in the future (data available for the 2080s under a the SSP5-8.5 scenario). Projected drought data is not available, however, the Project is in an area of low water depletion with low to medium variability of water supply (World Resources Institute, 2024).

10.6.11. Given the projection data showing increasing temperatures, it is anticipated that there will be seasonal changes as more precipitation will fall as rain and less as snow. This has the potential to increase annual and inter-annual variability, leading to greater average flow volumes and greater variability.

10.6.12. As the country's mountain glaciers melt at increasing rates due to higher temperatures, in the short to medium term this could lead to excess waterflows and cause severe flooding and associated hazards such as landslides and mudslides. This will occur for several decades whilst the glaciers deplete. In the longer term, reduced glaciers are likely to reduce the regularity of waterflows, where annual flow volumes will decrease due to extensive glacier recession and may result in the drying of some watersheds.

Wind

10.6.13. Due to the complexities of modelling global changes in wind, there is low confidence in the accuracy of the results from existing models of future wind conditions under climate change. The site of the Project is identified as having a 'very low' storm hazard risk (Swiss Re, 2020). Changes in summer

and winter wind speeds in the vicinity of the Project are projected to increase by two to four meters per second, however the granularity of the data is low (Copernicus , 2024).

10.6.14. The retreat of glaciers can increase the incidence of dust storms however these are concentrated within the lowland areas.

10.6.15. Wind can generate wave action on reservoirs which increase with wind strength.

Solid Mass

10.6.16. Climate projection data is not available for solid mass variables, although change in precipitation and temperature have a direct relationship to avalanche, mudflows and landslides. Projected increases in extreme precipitation events combined with warm spells could increase avalanching and landslides with climate change.

FUTURE CLIMATE TRENDS

10.6.17. Using the climate projection data, the climate trends taken forward to inform the CRVA are described in **Table 10-8**. The increasing or decreasing direction of the climate trend has been derived from the climate projection data.

Table 10-8 – Climate hazards and direction of trend.

Climate variable	Climate hazard	Climate trend
Temperature-related (Chronic)	Changing temperature and temperature variability	↑
Temperature-related (Acute)	Heatwave	↑
	Cold wave / frost	↓
	Wildfire	↑
Wind-related (Chronic)	Changing wind patterns	Uncertain
Wind-related (Acute)	Increase in storm conditions	Uncertain
Water-related (Chronic)	Changing precipitation patterns, types (rain, hail, snow/ice)	↑
	Water stress	No significant change
	Precipitation or hydrological variability due to changes in glacial melt and snowmelt patterns	↑
Water-related (Acute)	Drought	Uncertain
	Heavy precipitation events and an increase in extreme precipitation events and flooding	↑
	Glacial Lake Outburst Floods (GLOF)	↑
Solid-mass related (Chronic)	Soil erosion and solifluction	↑

Climate variable	Climate hazard	Climate trend
Solid-mass related (Acute)	Landslide and avalanche.	↑

10.7 RISK ASSESSMENT

10.7.1. The CRVA utilizes the climate projection data to assess the change in climate trends across the time periods relevant to the Project.

10.7.2. An assessment of risk, considering the climate hazard, exposure of the Project and vulnerability of the Project, is undertaken using the methodology described in Section 10.4, and terminology detailed in **Table 10-1**. The components of the Project (receptors) are assessed against each of the screened-in climate hazards. The Project receptors align with the descriptions provided in **Volume 1, Chapter 3: Project Description** of this ESIA, and comprise:

- Construction Assets and Temporary Works,
- Energy Generation,
- Dam (Stage 2) and Reservoir,
- Powerhouse, transformers, turbines,
- Spillway (High level outlets and Remote tunnel) and Headrace Tunnel,
- Access roads and replacement bridges,
- Permanent offices and maintenance facilities,
- Transmission lines, and
- Human health.

10.7.3. The CRVA describes potential impacts associated with the climate hazards and Project receptors ('Potential Impact(s)' column). Existing, or committed mitigation measures are known through documentation review and engagement with DSPOE and are listed in the 'Embedded and Committed Mitigation Measures' column.

10.7.4. Where the overall risk rating is very low or low, it is considered that no additional mitigation measures are required beyond those stated in the 'Embedded and Committed Mitigation Measures' column of the CRVA. Where moderate-, high- or very high-risk ratings are identified, then additional mitigation recommendations are provided in Section 10.8.

10.7.5. The CRVA presented in **Table 10-9** is for the construction phase. This considers the climate projections for the 2030s in line with the anticipated completion of the construction phase by 2032.

10.7.6. **Table 10-10** presents the CRVA for the operation phase. This assessment is based on the 2090s climate projections in line with a precautionary approach.

Table 10-9 – Construction phase CRVA

Receptor	Climate Variable	Climate Hazard	Climate Trend	Hazard	Potential Impact(s)	Exposure	Magnitude of Impact	Embedded and Committed Mitigation Measures	Vulnerability	Risk Rating	Additional Mitigation Required
Construction Assets and Temporary Works	Temperature-related (Chronic)	Changing temperature and temperature variability	↑	Very low (1)	Overheating of construction equipment and construction workers. Curing times for construction materials impacting quality. Delays to construction program. Damage to or loss of construction equipment (wildfire). H&S impact to construction workers (wildfire). Access/egress to site for materials and employees restricted due to wildfire	Very low (1)	Very low (1)	Construction due to be completed by 2032. Short term impacts from climate change are not anticipated to substantially exceed current climatic conditions. Climate hazards less likely and impactful in the short term. Construction emergency preparedness plan includes for erosion, landslides, snowfalls, frosts, heavy rain, floods, high temperatures and drought. Potential impacts easily managed with legislative requirements (Law on the Safety of Hydraulic Structures (2010 as amended in 2018) which governs safety during design, construction, commissioning, operation, maintenance, reconstruction, and decommissioning of hydraulic engineering structures), good practice and industry standard construction processes, techniques, management plans and risk assessments.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Temperature-related (Chronic)	Heat Stress	↑	Very low (1)		Low (2)	Very low (1)		Very low (1)	**Very Low (1)**	
	Temperature-related (Acute)	Heatwave	↑	Low (2)		Low (2)	Low (2)		Very low (1)	**Very Low (2)**	
	Temperature-related (Acute)	Cold wave / frost	↓	Low (2)		Low (2)	Low (2)		Very low (1)	**Very Low (2)**	
	Temperature-related (Acute)	Wildfire	↑	Very low (1)		High (4)	Low (2)		Low (2)	**Low (4)**	
	Wind-related (Chronic)	Changing wind patterns	Uncertain	Very low (1)	Damage to construction equipment and H&S impact to construction workers. Delays to construction program.	Very low (1)	Very low (1)		Very low (1)	**Very Low (1)**	
	Wind-related (Acute)	Increase in storm conditions	Uncertain	Low (2)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Water-related (Chronic)	Changing precipitation patterns, types (rain, hail, snow/ice)	↑	Very low (1)	Delays to construction program. Damage or loss of stockpiled construction materials from heavy precipitation or flood. Access/egress to site for materials and employees restricted from flooding. Lack of water resources impacting construction work and program (water stress and drought).	Very low (1)	Very low (1)		Very low (1)	**Very Low (1)**	
	Water-related (Chronic)	Water stress	No significant change	Very low (1)		Very low (1)	Very low (1)		Very low (1)	**Very Low (1)**	
	Water-related (Chronic)	Precipitation or hydrological variability due to changes in glacial melt and snowmelt patterns	↑	Very low (1)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Water-related (Acute)	Drought	Uncertain	Low (2)		Very low (1)	Low (2)		Very low (1)	**Very Low (2)**	
	Water-related (Acute)	Heavy precipitation events and an increase in extreme precipitation events and flooding	↑	Moderate (3)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Water-related (Acute)	Glacial Lake Outburst Floods (GLOF)	↑	Moderate (3)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Solid-mass related (Chronic)	Soil erosion and solifluction	↑	High (4)	Failure of constructed components. Delays to construction program. H&S risks to construction workers.	High (4)	High (4)	No existing mitigation measures identified	Moderate (3)	**High (12)**	Develop and implement measures to manage the risks posed by potential mudflows which may adversely impact on the construction phase works.
	Solid-mass related (Acute)	Landslide, avalanche and subsidence.	↑	High (4)		High (4)	High (4)		Moderate (3)	**High (12)**	
Energy Generation	Temperature-related (Chronic)	Changing temperature and temperature variability	↑	Very low (1)	Change in demand levels as temperatures increase. Damage to critical Project infrastructure from wildfire preventing energy generation.	Very low (1)	Very low (1)	Phased and incremental turbine installation Turbines operating at reduced capacity using temporary impellers Optimization studies for energy generation to be undertaken. Built infrastructure (such as roadways) will act as fire breaks. Powerhouse is underground.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Temperature-related (Acute)	Heatwave	↑	Low (2)		Moderate (3)	Low (2)		Very low (1)	**Very Low (2)**	
	Temperature-related (Acute)	Cold wave / frost	↓	Low (2)		Low (2)	Low (2)		Very low (1)	**Very Low (2)**	

Receptor	Climate Variable	Climate Hazard	Climate Trend	Hazard	Potential Impact(s)	Exposure	Magnitude of Impact	Embedded and Committed Mitigation Measures	Vulnerability	Risk Rating	Additional Mitigation Required
	Temperature-related (Acute)	Wildfire	↑	Very low (1)		Moderate (3)	Low (2)	The Project area has minimal vegetation cover	Very low (1)	**Very Low (2)**	
	Wind-related (Chronic)	Changing wind patterns	Uncertain	Very low (1)	Damage to critical Project infrastructure from storms, high winds or lightning strike preventing energy generation.	Very low (1)	Very low (1)	Project location at low risk of storm hazards. Lightning protection on assets vulnerable to lightning strikes	Very low (1)	**Very Low (1)**	
	Wind-related (Acute)	Increase in storm conditions	Uncertain	Low (2)		Moderate (3)	Low (2)		Very low (1)	**Very Low (2)**	
	Water-related (Chronic)	Changing precipitation patterns, types (rain, hail, snow/ice)	↑	Very low (1)	Changes in energy generation and shift in seasonal peak and load factors due to changes in water flow and water levels. Loss in power generation as a result of variability in flow, particularly when associated with increased reservoir sedimentation (storage loss). Average losses may range from 10% without sedimentation to up to 45%. Damage to critical Project infrastructure from flooding or GLOF events.	Very low (1)	Very low (1)	Phased and incremental turbine installation Turbines operating at reduced capacity using temporary impellers Optimization studies for energy generation to be undertaken. Hydrology estimates updated regularly using latest climate change data and projections. GLOF events taken into account in design and emergency preparedness plan. Further detailed hydrology, GLOF, landslide-dam-break, sedimentation and climate change studies have been commissioned under RFP NO. RHPP/CS/QCBS/05.	Very low (1)	**Very Low (1)**	
	Water-related (Chronic)	Water stress	No significant change	Very low (1)		Very low (1)	Very low (1)		Very low (1)	**Very Low (1)**	
	Water-related (Chronic)	Precipitation or hydrological variability due to changes in glacial melt and snowmelt patterns	↑	Very low (1)		High (4)	Low (2)		Low (2)	**Low (4)**	
	Water-related (Acute)	Drought	Uncertain	Low (2)		High (4)	Moderate (3)		Very low (1)	**Low (3)**	
	Water-related (Acute)	Heavy precipitation events and an increase in extreme precipitation events and flooding	↑	Moderate (3)		Moderate (3)	Low (2)		Low (2)	**Low (6)**	
	Water-related (Acute)	Glacial Lake Outburst Floods (GLOF)	↑	Moderate (3)		Moderate (3)	Moderate (3)		Low (2)	**Low (6)**	
	Solid-mass related (Chronic)	Soil erosion and solifluction	↑	High (4)	Damage to critical Project infrastructure from landslides, debris flows, avalanche or subsidence disrupting power generation. Increased sediment load and deposition resulting in loss of storage/depleted peaking energy leading to decreased capacity.	High (4)	High (4)	Buildings constructed on site will be constructed to international standards. The design of the PPI is intended to keep sediment out of the powerhouse and turbines, but is relatively untested as it is a first of a kind. Reduction in power output accepted in the event of heavy sedimentation	Low (2)	**Moderate (8)**	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. The studies include the estimation of impact of climate change on sediment yield. A second study will model the deposition patterns within the reservoir and include density current venting. Ensure management and monitoring plans clearly detail the measure required to manage sedimentation and landslide impacts.
	Solid-mass related (Acute)	Landslide, avalanche and subsidence.	↑	High (4)		High (4)	High (4)		Low (2)	**Moderate (8)**	

10.7.7. During the construction phase, the risks to the Project from climate change are generally considered to be very low or low based on the change in climate hazards in the short-term (2030s) and the embedded and committed mitigation measures currently in place. The exception to this relates to solid mass climate related variables. Recommendations for additional risk mitigation measures are detailed in **Section** 10.8.

10.7.8. The CRVA presented in **Table 10-10** is for the Operation phase.

Table 10-10 – Operation phase CRVA

Receptor	Climate Variable	Climate Hazard	Climate Trend	Hazard	Potential Impact(s)	Exposure	Magnitude of Impact	Embedded and Committed mitigation Measures	Vulnerability	Risk Rating	Additional Mitigation Required
Energy Generation	Temperature-related (Chronic)	Changing temperature and temperature variability	↑	Very low (1)	Change in demand levels as temperatures increase. Damage to critical Project	Very low (1)	Very low (1)	Phased turbine installation - six turbines in place by 2032. At Full Supply Level (FSL) from 2038. The	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required

Receptor	Climate Variable	Climate Hazard	Climate Trend	Hazard	Potential Impact(s)	Exposure	Magnitude of Impact	Embedded and Committed mitigation Measures	Vulnerability	Risk Rating	Additional Mitigation Required
	Temperature-related (Acute)	Heatwave	↑	Moderate (3)	infrastructure from wildfire preventing energy generation.	Moderate (3)	Moderate (3)	Project is expected to average electricity generation in excess of 17 billion kWh per year. Optimization studies for energy generation to be undertaken. Built infrastructure (such as roadways) will act as fire breaks. Powerhouse is underground. The Project area has minimal vegetation cover	Very low (1)	**Low (3)**	
	Temperature-related (Acute)	Cold wave / frost	↓	Low (2)		Low (2)	Low (2)		Very low (1)	**Very Low (2)**	
	Temperature-related (Acute)	Wildfire	↑	Low (2)		High (4)	Moderate (3)		Very low (1)	**Low (3)**	
	Wind-related (Chronic)	Changing wind patterns	Uncertain	Very low (1)	Damage to critical Project infrastructure from storms, high winds or lightning strike preventing energy generation.	Very low (1)	Very low (1)	Project location at low risk of storm hazards. Lightning protection on assets vulnerable to lightning strikes	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Wind-related (Acute)	Increase in storm conditions	Uncertain	Low (2)		Moderate (3)	Low (2)		Low (2)	**Low (4)**	
	Water-related (Chronic)	Changing precipitation patterns, types (rain, hail, snow/ice)	↑	Very low (1)	Changes in energy generation and shift in seasonal peak and load factors due to changes in water flow and water levels. Loss in power generation as a result of variability in flow, particularly when associated with increased reservoir sedimentation (storage loss). Average losses may range from 10% without sedimentation to up to 45%. Damage to critical Project infrastructure from flooding or GLOF events.	Very low (1)	Very low (1)	Optimization studies for energy generation to be undertaken. Hydrology estimates updated regularly using latest climate change data and projections. GLOF events taken into account in design and emergency preparedness plan. Further detailed hydrology, GLOF, landslide-dam-break, sedimentation and climate change studies have been commissioned under RFP NO. RHPP/CS/QCBS/05.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Water-related (Chronic)	Water stress	No significant change	Very low (1)		Very low (1)	Very low (1)		Very low (1)	**Very Low (1)**	
	Water-related (Chronic)	Precipitation or hydrological variability due to changes in glacial melt and snowmelt patterns	↑	High (4)		High (4)	High (4)		High (4)	**High (16)**	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. Monitor sedimentation rates and how severe weather events exacerbate sedimentation to undertaken when additional clearance or maintenance is required on key components. Record weather patterns to increase understanding of when GLOF events are more likely to plan for the potential occurrence of such events and minimize impacts. Incorporate short and medium weather forecast monitoring into daily operational procedures to allow for preparedness planning and control measure to be implemented. Acceptance of reduced power generation over time due to sedimentation and increased hydrologic variability.
	Water-related (Acute)	Drought	Uncertain	High (4)		High (4)	High (4)		High (4)	**High (16)**	
	Water-related (Acute)	Heavy precipitation events and an increase in extreme precipitation events and flooding	↑	Moderate (3)		Moderate (3)	Moderate (3)		High (4)	**High (12)**	
	Water-related (Acute)	Glacial Lake Outburst Floods (GLOF)	↑	High (4)		High (4)	High (4)		Moderate (3)	**High (12)**	
	Solid-mass related (Chronic)	Soil erosion and solifluction	↑	High (4)	Damage to critical Project infrastructure from landslides, debris flows, avalanche or subsidence disrupting power generation. Increased sediment load and deposition resulting in loss of storage/depleted peaking energy leading to decreased capacity.	High (4)	High (4)	Buildings constructed on site will be constructed to international standards. The design of the PPI is intended to keep sediment out of the powerhouse and turbines, but is relatively untested as it is a first of a kind.	High (4)	**High (16)**	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. The studies include the estimation of impact of climate change on sediment yield. A second study will model the deposition patterns within the reservoir and include density current venting. Ensure management and monitoring plans clearly detail the measure required to manage sedimentation and landslide
	Solid-mass related (Acute)	Landslide, avalanche and subsidence.	↑	High (4)		High (4)	High (4)		High (4)	**High (16)**	

Receptor	Climate Variable	Climate Hazard	Climate Trend	Hazard	Potential Impact(s)	Exposure	Magnitude of Impact	Embedded and Committed mitigation Measures	Vulnerability	Risk Rating	Additional Mitigation Required
											impacts. Monitor sedimentation rates and how severe weather events exacerbate sedimentation to undertaken when additional clearance or maintenance is required on key components.
Dam (Stage 1)	Temperature-related (Chronic)	Changing temperature and temperature variability	↑	Very low (1)	Material degradation and reduced durability (above ground assets) from expansion or contraction. Increased damage and/or instability. Increased maintenance requirements.	Very low (1)	Very low (1)	Materials selected according to strength and durability characteristics. Dam design reviewed by Dam Safety PoE (DSPoE) and risk management plan in place and being implemented. Inspection and maintenance procedure and program in place. Built infrastructure (such as roadways) will act as fire breaks. The Project area has minimal vegetation cover.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Temperature-related (Acute)	Heatwave	↑	Moderate (3)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Temperature-related (Acute)	Cold wave / frost	↓	Low (2)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Temperature-related (Acute)	Wildfire	↑	Low (2)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Wind-related (Chronic)	Changing wind patterns	Uncertain	Very low (1)	Overtopping of dam from increased wave height during strong winds.	Very low (1)	Very low (1)	Dry freeboard includes for the allowance for permanent settlement, wave run up and GLOF.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Wind-related (Acute)	Increase in storm conditions	Uncertain	Low (2)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Water-related (Chronic)	Changing precipitation patterns, types (rain, hail, snow/ice)	↑	Very low (1)	Heavy precipitation, flooding, GLOF events and glacial melt /or exceeding of flood design levels. Drainage systems, culverts and crossings overwhelmed and become damage or result in overtopping of the dam. Potential safety issues. Flooding causing erosion of dam and damage to spillways. Seasonal fluctuations in water levels.	Very low (1)	Very low (1)	Staged construction to allow for increasing dam crest height Additional design measures incorporated in Stage 2 Dam development Designed for the 1 in 10,000 year flood event and the PMF level. Dry freeboard includes for the allowance for permanent settlement, wave run up and GLOF. Additional freeboard has been taken into consideration for the risk of GLOFs. Rapid drawdown able to be undertaken without affecting the safety of the dam. The Emergency Preparedness Plan includes a GLOF monitoring program in the catchment to complement any flood forecasting system. The Emergency Preparedness Plan requires that GLOFs or PMF changes in peak flows will be regularly updated using the latest climate change data and projections for the region. Designed and built in such a way that erosion damage caused by sediments running along it can be easily repaired by isolating part of the spillway. Steel lining or other anti-erosion materials in place. The Emergency Preparedness Plan requires scouring impacts to be verified during operation and stabilize or infill where necessary if there are changes to original design assumptions. Further detailed hydrology, GLOF, landslide-dam-break, sedimentation and climate change studies have been commissioned under RFP NO. RHPP/CS/QCBS/05.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Water-related (Chronic)	Water stress	No significant change	Very low (1)		Low (2)	Very low (1)		Moderate (3)	**Low (3)**	
	Water-related (Chronic)	Precipitation or hydrological variability due to changes in glacial melt and snowmelt patterns	↑	High (4)		Moderate (3)	High (4)		Low (2)	**Moderate (8)**	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. Incorporate short and medium weather forecast monitoring into daily operational procedures to allow for preparedness planning and control measure to be implemented. Ensure management and monitoring plans clearly detail the measure required to manage flood and GLOF risks, impact and management/mitigation actions.
	Water-related (Acute)	Drought	Uncertain	High (4)		Low (2)	Moderate (3)		Low (2)	**Low (6)**	Very low or low risk from future climate change - no additional mitigation required
	Water-related (Acute)	Heavy precipitation events and an increase in extreme precipitation events and flooding	↑	Moderate (3)		Moderate (3)	Moderate (3)		Low (2)	**Low (6)**	
	Water-related (Acute)	Glacial Lake Outburst Floods (GLOF)	↑	High (4)		Moderate (3)	High (4)		Low (2)	**Moderate (8)**	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. Incorporate short and medium weather forecast monitoring into daily operational procedures to allow for preparedness planning and control measure to be implemented. Ensure management and

Receptor	Climate Variable	Climate Hazard	Climate Trend	Hazard	Potential Impact(s)	Exposure	Magnitude of Impact	Embedded and Committed mitigation Measures	Vulnerability	Risk Rating	Additional Mitigation Required
											monitoring plans clearly detail the measure required to manage flood and GLOF risks, impact and management/mitigation actions.
	Solid-mass related (Chronic)	Soil erosion and solifluction	↑	High (4)	Damage to assets from rockfalls, debris flows and mudslides. Displacement waves in the reservoir causing overtopping and destabilise the reservoir rim. Upstream landslide / debris flow / avalanche causing surge in river flow. Higher sedimentation rate from upstream landslides could lead to earlier blockage.	High (4)	High (4)	Incremental commissioning of turbines with planned replacement Additional design measure incorporate in Stage 2 Dam development The design criteria have taken into consideration the effects of landslides by lowering impoundment rates. Annex 13-2: Reservoir Slope Stability(Volume 2) of this ESIA includes engineering measures to stabilize susceptible slopes and improve resilience of infrastructure to landslide movement. Anti-seepage measures e.g. grout curtain to ensure seepage in acceptable limits, reducing possible instability. Management and Monitoring Plans will be developed to manage sedimentation, erosion and slope stability (including the Landslide Management and Monitoring Plan). Further detailed hydrology, GLOF, landslide-dam-break, sedimentation and climate change studies have been commissioned under RFP NO. RHPP/CS/QCBS/05. The study will include the modelling of deposition patterns within the reservoir to inform management strategies	High (4)	**High (16)**	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. Conduct safety assessments related to landslides and displacement of water, and implement findings. Ensure management and monitoring plans clearly detail the measure required to manage sedimentation and landslide impacts. Monitor sedimentation rates and how severe weather events exacerbate sedimentation to undertaken when additional clearance or maintenance is required on key components. Acceptance of reduced storage capacity within the reservoir over time.
	Solid-mass related (Acute)	Landslide, avalanche and subsidence.	↑	High (4)		High (4)	High (4)		Low (2)	**Moderate (8)**	
Dam (Stage 2)	Temperature-related (Chronic)	Changing temperature and temperature variability	↑	Very low (1)	Material degradation and reduced durability (above ground assets) from expansion or contraction. Increased damage and/or instability. Increased maintenance requirements.	Very low (1)	Very low (1)	Materials selected according to strength and durability characteristics. Dam design reviewed by Dam Safety PoE (DSPoE) and risk management plan in place and being implemented. Inspection and maintenance procedure and program in place. Built infrastructure (such as roadways) will act as fire breaks. The Project area has minimal vegetation cover.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Temperature-related (Acute)	Heatwave	↑	Moderate (3)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Temperature-related (Acute)	Cold wave / frost	↓	Low (2)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Temperature-related (Acute)	Wildfire	↑	Low (2)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Wind-related (Chronic)	Changing wind patterns	Uncertain	Very low (1)	Overtopping of dam from increased wave height during strong winds.	Very low (1)	Very low (1)	Dry freeboard includes for the allowance for permanent settlement, wave run up and GLOF.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Wind-related (Acute)	Increase in storm conditions	Uncertain	Low (2)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Water-related (Chronic)	Changing precipitation patterns, types (rain, hail, snow/ice)	↑	Very low (1)	Heavy precipitation, flooding, GLOF events and glacial melt /or exceeding of flood design levels. Drainage systems, culverts and crossings overwhelmed and	Very low (1)	Very low (1)	The reservoir full supply level will increase from 1,065 masl to 1,290 masl by 2038. Designed for the 1 in 10,000 year flood event and the PMF level. Dry freeboard includes for the allowance for permanent settlement, wave run up and	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Water-related (Chronic)	Water stress	No significant change	Very low (1)		Low (2)	Very low (1)		Moderate (3)	**Low (3)**	

Receptor	Climate Variable	Climate Hazard	Climate Trend	Hazard	Potential Impact(s)	Exposure	Magnitude of Impact	Embedded and Committed mitigation Measures	Vulnerability	Risk Rating	Additional Mitigation Required
	Water-related (Chronic)	Precipitation or hydrological variability due to changes in glacial melt and snowmelt patterns	↑	High (4)	become damage or result in overtopping of the dam. Potential safety issues. Flooding causing erosion of dam and damage to spillways. Seasonal fluctuations in water levels.	Moderate (3)	High (4)	GLOF. Additional freeboard has been taken into consideration for the risk of GLOFs. Rapid drawdown able to be undertaken without affecting the safety of the dam. The Emergency Preparedness Plan includes a GLOF monitoring program in the catchment to complement any flood forecasting system. The Emergency Preparedness Plan requires that GLOFs or PMF changes in peak flows will be regularly updated using the latest climate change data and projections for the region. Designed and built in such a way that erosion damage caused by sediments running along it can be easily repaired by isolating part of the spillway. Steel lining or other anti-erosion materials in place. The Emergency Preparedness Plan requires scouring impacts to be verified during operation and stabilize or infill where necessary if there are changes to original design assumptions. Further detailed hydrology, GLOF, landslide-dam-break, sedimentation and climate change studies have been commissioned under RFP NO. RHPP/CS/QCBS/05.	Low (2)	**Moderate (8)**	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. Incorporate short and medium weather forecast monitoring into daily operational procedures to allow for preparedness planning and control measure to be implemented. Ensure management and monitoring plans clearly detail the measure required to manage flood and GLOF risks, impact and management/mitigation actions.
	Water-related (Acute)	Drought	Uncertain	High (4)		Low (2)	Moderate (3)		Low (2)	**Low (6)**	Very low or low risk from future climate change - no additional mitigation required
	Water-related (Acute)	Heavy precipitation events and an increase in extreme precipitation events and flooding	↑	Moderate (3)		Moderate (3)	Moderate (3)		Low (2)	**Low (6)**	
	Water-related (Acute)	Glacial Lake Outburst Floods (GLOF)	↑	High (4)		Moderate (3)	High (4)		Low (2)	**Moderate (8)**	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. Incorporate short and medium weather forecast monitoring into daily operational procedures to allow for preparedness planning and control measure to be implemented. Ensure management and monitoring plans clearly detail the measure required to manage flood and GLOF risks, impact and management/mitigation actions.
	Solid-mass related (Chronic)	Soil erosion and solifluction	↑	High (4)	Damage to assets from rockfalls, debris flows and mudslides. Displacement waves in the reservoir causing overtopping and destabilise the reservoir rim. Upstream landslide / debris flow / avalanche causing surge in river flow. Higher sedimentation rate from upstream landslides could lead to earlier blockage.	High (4)	High (4)	The design criteria have taken into consideration the effects of landslides by lowering impoundment rates. Annex 13-2: Reservoir Slope Stability (Volume 2) of this ESIA includes engineering measures to stabilize susceptible slopes and improve resilience of infrastructure to landslide movement. Anti-seepage measures e.g. grout curtain to ensure seepage in acceptable limits, reducing possible instability. Management and Monitoring Plans will be developed to manage sedimentation, erosion and slope stability (including the Landslide Management and Monitoring Plan). Further detailed hydrology, GLOF, landslide-dam-break, sedimentation and climate change studies have been commissioned under RFP NO. RHPP/CS/QCBS/05. The study will include the modelling of deposition patterns within the reservoir to inform management strategies	High (4)	**High (16)**	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. Conduct safety assessments related to landslides and displacement of water, and implement findings. Ensure management and monitoring plans clearly detail the measure required to manage sedimentation and landslide impacts. Monitor sedimentation rates and how severe weather events exacerbate sedimentation to undertaken when additional clearance or maintenance is required on key components. Acceptance of reduced storage capacity within the reservoir over time.
	Solid-mass related (Acute)	Landslide, avalanche and subsidence.	↑	High (4)		High (4)	High (4)		Low (2)	**Moderate (8)**	

Receptor	Climate Variable	Climate Hazard	Climate Trend	Hazard	Potential Impact(s)	Exposure	Magnitude of Impact	Embedded and Committed mitigation Measures	Vulnerability	Risk Rating	Additional Mitigation Required
Reservoir	Temperature-related (Chronic)	Changing temperature and temperature variability	↑	Very low (1)	Increased biological growth, algae blooms, or vegetation from higher water temperatures causing. Reduced oxygen concentration and increased stagnation Increased evaporation rates.	Low (2)	Low (2)	The reservoir is an oligotrophic system with low nutrient content and no significant anthropogenic inputs of nutrients to move the system along the spectrum to being eutrophic.	Very low (1)	**Very Low (2)**	Very low or low risk from future climate change - no additional mitigation required
	Temperature-related (Acute)	Heatwave	↑	Moderate (3)		Low (2)	Low (2)		Very low (1)	**Very Low (2)**	
	Temperature-related (Acute)	Cold wave / frost	↓	Low (2)		Low (2)	Low (2)		Very low (1)	**Very Low (2)**	
	Temperature-related (Acute)	Wildfire	↑	Low (2)		Very low (1)	Very low (1)		Very low (1)	**Very Low (1)**	
	Wind-related (Chronic)	Changing wind patterns	Uncertain	Very low (1)	Increased wave height during strong winds.	Very low (1)	Very low (1)	Dry freeboard includes for the allowance for permanent settlement, wave run up and GLOF.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Wind-related (Acute)	Increase in storm conditions	Uncertain	Low (2)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Water-related (Chronic)	Changing precipitation patterns, types (rain, hail, snow/ice)	↑	Very low (1)	Draw down of the reservoir in periods of high flow events. Seasonal fluctuations in water levels. Increased evaporation rates.	Very low (1)	Very low (1)	Staged and incremental filling of reservoir Rapid drawdown able to be undertaken without affecting the safety of the dam. The Emergency Preparedness Plan includes a GLOF monitoring program in the catchment to complement any flood forecasting system. The Emergency Preparedness Plan requires that GLOFs or PMF changes in peak flows will be regularly updated using the latest climate change data and projections for the region. Further detailed hydrology, GLOF, landslide-dam-break, sedimentation and climate change studies have been commissioned under RFP NO. RHPP/CS/QCBS/05. Design takes into account a hydrological study (December 2024) which considers the most recent climate change predictions and models in line with Good Practice.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Water-related (Chronic)	Water stress	No significant change	Very low (1)		Low (2)	Very low (1)		Moderate (3)	**Low (3)**	
	Water-related (Chronic)	Precipitation or hydrological variability due to changes in glacial melt and snowmelt patterns	↑	High (4)		High (4)	High (4)		Low (2)	**Moderate (8)**	Monitor seasonal and long term weather forecasts and incorporate these into management of water levels to aid anticipation of water levels.
	Water-related (Acute)	Drought	Uncertain	High (4)		High (4)	High (4)		Low (2)	**Moderate (8)**	
	Water-related (Acute)	Heavy precipitation events and an increase in extreme precipitation events and flooding	↑	Moderate (3)		Moderate (3)	Moderate (3)		Low (2)	**Low (6)**	Very low or low risk from future climate change - no additional mitigation required
	Water-related (Acute)	Glacial Lake Outburst Floods (GLOF)	↑	High (4)		Moderate (3)	High (4)		Low (2)	**Moderate (8)**	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. Conduct safety assessments related to landslides and displacement of water, and implement findings. Incorporate short and medium weather forecast monitoring into daily operational procedures to allow for preparedness planning and control measure to be implemented. Ensure management and monitoring plans clearly detail the measure required to manage flood and GLOF risks, impact and management/mitigation actions.
	Solid-mass related (Chronic)	Soil erosion and solifluction	↑	High (4)	Displacement waves in the reservoir. Upstream landslide / debris flow /avalanche causing surge in river flow. Higher sedimentation rate decreases reservoir storage capacity Damage to assets from	High (4)	High (4)	The design criteria have taken into consideration the effects of landslides by lowering impoundment rates. Annex 13-2: Reservoir Slope Stability (Volume 2) of this ESIA includes engineering measures to stabilize susceptible slopes and improve resilience of infrastructure to landslide movement. Anti-seepage measures e.g. grout curtain to	High (4)	**High (16)**	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. Ensure management and monitoring plans clearly detail the measure required to manage sedimentation and landslide impacts.
	Solid-mass related (Acute)	Landslide, avalanche and subsidence.	↑	High (4)		High (4)	High (4)		Low (2)	**Moderate (8)**	

Receptor	Climate Variable	Climate Hazard	Climate Trend	Hazard	Potential Impact(s)	Exposure	Magnitude of Impact	Embedded and Committed mitigation Measures	Vulnerability	Risk Rating	Additional Mitigation Required
					rockfalls, debris flow and mudslides.			ensure seepage in acceptable limits, reducing possible instability. Management and Monitoring Plans will be developed to manage sedimentation, erosion and slope stability (including the Landslide Management and Monitoring Plan). Further detailed hydrology, GLOF, landslide-dam-break, sedimentation and climate change studies have been commissioned under RFP NO. RHPP/CS/QCBS/05. The study will include the modelling of deposition patterns within the reservoir to inform management strategies			Monitor sedimentation rates and how severe weather events exacerbate sedimentation to undertaken when additional clearance or maintenance is required on key components. Acceptance of reduced storage capacity within the reservoir over time.
Powerhouse, transformers, turbines	Temperature-related (Chronic)	Changing temperature and temperature variability	↑	Very low (1)	Overheating and failure of equipment. Components become more brittle and degrade from extreme temperatures.	Very low (1)	Very low (1)	Powerhouse, turbines and transformer cavern is underground and provided with ventilation shaft. Forced air to be installed from 2025. Inspection and maintenance procedure and program in place. The current turbines have been installed with temporary impellers. The impellers will be replaced in 2024. Built infrastructure (such as roadways) will act as fire breaks.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Temperature-related (Acute)	Heatwave	↑	Moderate (3)		Low (2)	Low (2)		Very low (1)	**Very Low (2)**	
	Temperature-related (Acute)	Cold wave / frost	↓	Low (2)		Low (2)	Low (2)		Very low (1)	**Very Low (2)**	
	Temperature-related (Acute)	Wildfire	↑	Low (2)		Very low (1)	Very low (1)		Very low (1)	**Very Low (1)**	
	Wind-related (Chronic)	Changing wind patterns	Uncertain	Very low (1)	Power outage form lightning strike	Very low (1)	Very low (1)	Powerhouse, turbines and transformer cavern is underground and provided with ventilation shaft. Direct power generation from turbines	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Wind-related (Acute)	Increase in storm conditions	Uncertain	Low (2)		Low (2)	Low (2)		Very low (1)	**Very Low (2)**	
	Water-related (Chronic)	Changing precipitation patterns, types (rain, hail, snow/ice)	↑	Very low (1)	Density currents within the river may enter intakes of turbines and cause abrasion of the mechanical equipment. Heavy precipitation, flooding, GLOF events and glacial melt leading to flooding of and damage to assets and equipment. Power outages while equipment is repaired or replaced. Seasonal fluctuations in river flow.	Very low (1)	Very low (1)	The reservoir full supply level will increase from 1,065 masl to 1,290 masl by 2036. Designed for the 1 in 10,000 year flood event and PMF level. Dry freeboard includes for the allowance for permanent settlement, wave run up and GLOF. Additional freeboard has been taken into consideration for the risk of GLOFs. The Emergency Preparedness Plan includes a GLOF monitoring program in the catchment to complement any flood forecasting system. The Emergency Preparedness Plan requires that GLOF or PMF changes in peak flows will be regularly updated using the latest climate change data and projections for the region. Backup power supply (diesel generator raised above flood level or appropriately protected) is in place to ensure continued operation of gates in the event of a power failure related to flooding of powerhouse. Further detailed hydrology, GLOF, landslide-dam-break, sedimentation and climate change studies to be commissioned under RFP NO. RHPP/CS/QCBS/05.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Water-related (Chronic)	Water stress	No significant change	Very low (1)		Low (2)	Very low (1)		Very low (1)	**Very Low (1)**	
	Water-related (Chronic)	Precipitation or hydrological variability due to changes in glacial melt and snowmelt patterns	↑	High (4)		Low (2)	Moderate (3)		Very low (1)	**Low (3)**	
	Water-related (Acute)	Drought	Uncertain	High (4)		Very low (1)	Low (2)		Very low (1)	**Very Low (2)**	
	Water-related (Acute)	Heavy precipitation events and an increase in extreme precipitation events and flooding	↑	Moderate (3)		Moderate (3)	Moderate (3)		Low (2)	**Low (6)**	
	Water-related (Acute)	Glacial Lake Outburst Floods (GLOF)	↑	High (4)		Moderate (3)	High (4)		Low (2)	**Moderate (8)**	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. Incorporate short and medium weather forecast monitoring into daily operational procedures to allow for preparedness planning and control measure to be implemented. Ensure management and monitoring plans clearly detail the measure required to manage flood

Receptor	Climate Variable	Climate Hazard	Climate Trend	Hazard	Potential Impact(s)	Exposure	Magnitude of Impact	Embedded and Committed mitigation Measures	Vulnerability	Risk Rating	Additional Mitigation Required
											and GLOF risks, impact and management/mitigation actions.
	Solid-mass related (Chronic)	Soil erosion and solifluction	↑	High (4)	Increased sediment load and deposition resulting in outlet blockages, upstream flooding, and corrosion of gates and turbines and M&E. Damage from high quartz content in fines. Increased maintenance requirements.	Low (2)	Moderate (3)	Effective operation conditions of the reservoir can help to control the overall sedimentation, adjusting the operation rule of the reservoir to the sedimentation patterns. Ongoing emptying of sediment traps and monitoring deposition. Dredging of sediment accumulation at key areas including power intakes and spillway intakes (as required). Management and Monitoring Plans will be developed to manage sedimentation, erosion and slope stability (including the Landslide Management and Monitoring Plan). Further detailed hydrology, GLOF, landslide-dam-break, sedimentation and climate change studies have been commissioned under RFP NO. RHPP/CS/QCBS/05.	Moderate (3)	**Moderate (9)**	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. Ensure management and monitoring plans clearly detail the measure required to manage sedimentation and landslide impacts. Monitor sedimentation rates and how severe weather events exacerbate sedimentation to undertaken when additional clearance or maintenance is required on key components.
	Solid-mass related (Acute)	Landslide, avalanche and subsidence.	↑	High (4)		High (4)	High (4)		Low (2)	**Moderate (8)**	
Spillway (High level outlets and Remote tunnel) and Headrace Tunnel	Temperature-related (Chronic)	Changing temperature and temperature variability	↑	Very low (1)	Increased temperatures stimulate plant growth in reservoir with negative impacts on intakes. Increased maintenance requirements to maintain ground clearance.	Very low (1)	Very low (1)	Very low Oligotrophic system at full supply level therefore unlikely to result in the stimulation of plant growth Operation and maintenance procedures including debris clearance, will be adjusted based on need.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Temperature-related (Acute)	Heatwave	↑	Moderate (3)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Temperature-related (Acute)	Cold wave / frost	↓	Low (2)		Very low (1)	Very low (1)		Very low (1)	**Very Low (1)**	
	Temperature-related (Acute)	Wildfire	↑	Low (2)		Very low (1)	Very low (1)		Very low (1)	**Very Low (1)**	
	Wind-related (Chronic)	Changing wind patterns	Uncertain	Very low (1)	Increased volume of wind blow debris entering spillways.	Very low (1)	Very low (1)	Operation and maintenance procedures including debris clearance, will be adjusted based on need.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Wind-related (Acute)	Increase in storm conditions	Uncertain	Low (2)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Water-related (Chronic)	Changing precipitation patterns, types (rain, hail, snow/ice)	↑	Very low (1)	Changes in downstream water release and lower minimum environmental flows, damaging habitats and causing flooding. Heavy precipitation, flooding, GLOF events and glacial melt /or exceeding of flood design levels. Drainage systems, culverts and crossings overwhelmed and become damage or result in overtopping of the dam. Draw down of the reservoir in periods of high flow events. Potential safety issues. Flooding causing erosion of dam	Very low (1)	Very low (1)	The volume of water transferred from summer to winter shall remain unchanged (as documented in TEAS Document Design criteria Rev E). Designed for the 1 in 10,000 year flood event and PMF level. Dry freeboard includes for the allowance for permanent settlement, wave run up and GLOF. Additional freeboard has been taken into consideration for the risk of GLOFs. Rapid drawdown able to be undertaken without affecting the safety of the dam. The Emergency Preparedness Plan includes a GLOF monitoring program in the catchment to complement any flood	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Water-related (Chronic)	Water stress	No significant change	Very low (1)		Low (2)	Very low (1)		Very low (1)	**Very Low (1)**	
	Water-related (Chronic)	Precipitation or hydrological variability due to changes in glacial melt and snowmelt patterns	↑	High (4)		Moderate (3)	High (4)		Low (2)	**Moderate (8)**	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. Incorporate short and medium weather forecast monitoring into daily operational procedures to allow for preparedness planning and control measure to be implemented.

Receptor	Climate Variable	Climate Hazard	Climate Trend	Hazard	Potential Impact(s)	Exposure	Magnitude of Impact	Embedded and Committed mitigation Measures	Vulnerability	Risk Rating	Additional Mitigation Required
					and damage to spillways. Increased debris in reservoir from increased runoff, leading to increased risk of blocking intakes.			forecasting system. The Emergency Preparedness Plan requires that GLOFs or PMF changes in peak flows will be regularly updated using the latest climate change data and projections for the region. The Emergency Preparedness Plan states that the length of the reservoir will reduce the risk of sudden blockage of spillways from large debris. Spillways to protect dam and allow safe passage of water up to the PMF level. Concrete slabs or lining for strength and surface finishing for water flow of high speeds (up to 30 m/s). Concrete surface treatment to prevent cavitation (due to high-speed flow). Above 30 m/s, additional mitigation such as aeration devices will be provided. Steel lining or other anti-erosion materials in place. The Emergency Preparedness Plan staes that regular inspections of tunnel lining for evidence of cavitation and other types of damage will take place. The Emergency Preparedness Plan requires scouring impacts to be verified during operation and stabilize or infill where necessary if there are changes to original design assumptions. Operation and maintenance procedures including debris clearance, will be adjusted based on need. Modelling of the operational discharge regime will be part of the Cascade Dam and Reservoir Operating Plan, including flood routing. Further detailed hydrology, GLOF, landslide-dam-break, sedimentation and climate change studies have been commissioned under RFP NO. RHPP/CS/QCBS/05			Ensure management and monitoring plans clearly detail the measure required to manage flood and GLOF risks, impact and management/mitigation actions.
	Water-related (Acute)	Drought	Uncertain	High (4)		Very low (1)	Low (2)		Very low (1)	**Very Low (2)**	Very low or low risk from future climate change - no additional mitigation required
	Water-related (Acute)	Heavy precipitation events and an increase in extreme precipitation events and flooding	↑	Moderate (3)		Moderate (3)	Moderate (3)		Low (2)	**Low (6)**	
	Water-related (Acute)	Glacial Lake Outburst Floods (GLOF)	↑	High (4)		Moderate (3)	High (4)		Low (2)	**Moderate (8)**	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. Incorporate short and medium weather forecast monitoring into daily operational procedures to allow for preparedness planning and control measure to be implemented. Ensure management and monitoring plans clearly detail the measure required to manage flood and GLOF risks, impact and management/mitigation actions.
	Solid-mass related (Chronic)	Soil erosion and solifluction	↑	High (4)		Very low (1)	Low (2)	Operation and maintenance procedures including debris clearance, will be adjusted based on need. Designed and built in such a way that erosion damage caused by sediments running along it can be easily repaired by isolating part of the spillway. Concrete slabs or lining for strength and surface finishing for water flow of high speeds (up to 30 m/s). Concrete surface treatment to prevent erosion (due to sediment flow). Management and Monitoring Plans will be developed to manage sedimentation, erosion and slope stability (including the Landslide Management and Monitoring Plan). Further detailed hydrology, GLOF, landslide-dam-break, sedimentation and climate	Very low (1)	**Very Low (2)**	Very low or low risk from future climate change - no additional mitigation required
	Solid-mass related (Acute)	Landslide, avalanche and subsidence.	↑	High (4)	Increased debris in reservoir from increased runoff, leading to increased risk of blocking intakes. Debris flows can block outlet tailraces and cause damage.	High (4)	High (4)		Moderate (3)	**High (12)**	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. Ensure management and monitoring plans clearly detail the measure required to manage sedimentation and landslide impacts. Monitor sedimentation rates and how severe weather events exacerbate sedimentation to undertaken when additional clearance or maintenance is required on key components

Receptor	Climate Variable	Climate Hazard	Climate Trend	Hazard	Potential Impact(s)	Exposure	Magnitude of Impact	Embedded and Committed mitigation Measures	Vulnerability	Risk Rating	Additional Mitigation Required
								change studies have been commissioned under RFP NO. RHPP/CS/QCBS/05.			
Access roads and replacement bridges	Temperature-related (Chronic)	Changing temperature and temperature variability	↑	Very low (1)	Material degradation and reduced durability (above ground assets) from expansion or contraction. Increased damage and/or instability. Increased maintenance requirements.	Very low (1)	Very low (1)	Materials selected according to strength and durability characteristics. The Project area has minimal vegetation cover.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Temperature-related (Acute)	Heatwave	↑	Moderate (3)		Moderate (3)	Moderate (3)		Low (2)	**Low (6)**	
	Temperature-related (Acute)	Cold wave / frost	↓	Low (2)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Temperature-related (Acute)	Wildfire	↑	Low (2)		High (4)	Moderate (3)		Low (2)	**Low (6)**	
	Wind-related (Chronic)	Changing wind patterns	Uncertain	Very low (1)	Debris and road blockages impeding access.	Very low (1)	Very low (1)	Critical operation equipment - access to that equipment have alternative access/egress routes for emergency situations.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Wind-related (Acute)	Increase in storm conditions	Uncertain	Low (2)		Low (2)	Low (2)		Moderate (3)	**Low (6)**	
	Water-related (Chronic)	Changing precipitation patterns, types (rain, hail, snow/ice)	↑	Very low (1)	Heavy precipitation, flooding, GLOF events and glacial melt leading to overwhelmed drainage systems and flooding of access infrastructure. Flooding damaging roads and restricting access for maintenance. Material degradation and reduced durability (above ground assets) corrosion, or rain ingress. Increased damage and/or instability. Increased maintenance requirements.	Very low (1)	Very low (1)	The drainage design for roads includes an allowance for climate change. Critical operation equipment - access to that equipment have alternative access/egress routes for emergency situations. Materials selected according to strength and durability characteristics.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Water-related (Chronic)	Water stress	No significant change	Very low (1)		Very low (1)	Very low (1)		Very low (1)	**Very Low (1)**	
	Water-related (Chronic)	Precipitation or hydrological variability due to changes in glacial melt and snowmelt patterns	↑	High (4)		Low (2)	Moderate (3)		Low (2)	**Low (6)**	
	Water-related (Acute)	Drought	Uncertain	High (4)		Very low (1)	Low (2)		Very low (1)	**Very Low (2)**	
	Water-related (Acute)	Heavy precipitation events and an increase in extreme precipitation events and flooding	↑	Moderate (3)		Moderate (3)	Moderate (3)		Low (2)	**Low (6)**	
	Water-related (Acute)	Glacial Lake Outburst Floods (GLOF)	↑	High (4)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Solid-mass related (Chronic)	Soil erosion and solifluction	↑	High (4)	Debris and road blockages impeding access.	Very low (1)	Low (2)	The drainage design for roads includes an allowance for climate change. Critical operation equipment - access to that equipment have alternative access/egress routes for emergency situations. Materials selected according to strength and durability characteristics. The Emergency Preparedness Plan requires key slopes to be monitored and, where necessary, install rock fall protection	Very low (1)	**Very Low (2)**	Very low or low risk from future climate change - no additional mitigation required
	Solid-mass related (Acute)	Landslide, avalanche and subsidence.	↑	High (4)		Moderate (3)	High (4)		Moderate (3)	**High (12)**	Regularly inspect critical access routes for landslide and rockfall debris and implement clearance measures. Incorporate short and medium weather forecast monitoring into daily operational procedures to allow for preparedness planning and control measure to be implemented.

Receptor	Climate Variable	Climate Hazard	Climate Trend	Hazard	Potential Impact(s)	Exposure	Magnitude of Impact	Embedded and Committed mitigation Measures	Vulnerability	Risk Rating	Additional Mitigation Required
								measures, repair and precautionary scaling of loose rock to reduce the risk of access roads becoming blocked. Critical operation equipment - access to that equipment have alternative access/egress routes for emergency situations.			
Permanent offices and maintenance facilities	Temperature-related (Chronic)	Changing temperature and temperature variability	↑	Very low (1)	Material degradation and reduced durability (above ground assets) from expansion or contraction. Increased maintenance requirements.	Very low (1)	Very low (1)	Materials selected according to strength and durability characteristics. Buildings constructed on site will be constructed to international standards. The Project area has minimal vegetation cover.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Temperature-related (Acute)	Heatwave	↑	Moderate (3)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Temperature-related (Acute)	Cold wave / frost	↓	Low (2)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Temperature-related (Acute)	Wildfire	↑	Low (2)		High (4)	Moderate (3)		Low (2)	**Low (6)**	
	Wind-related (Chronic)	Changing wind patterns	Uncertain	Very low (1)	Damage to buildings from strong winds or lightning strike. Dust storms causing damage to above ground equipment.	Very low (1)	Very low (1)	Materials selected according to strength and durability characteristics. Buildings constructed on site will be constructed to international standards.	Low (2)	**Very Low (2)**	Very low or low risk from future climate change - no additional mitigation required
	Wind-related (Acute)	Increase in storm conditions	Uncertain	Low (2)		Moderate (3)	Low (2)		High (4)	**Moderate (8)**	Develop and implement an inspection, maintenance and repair regime for identifying and rectifying storm damage (including dust storms) to buildings. Incorporate short and medium weather forecast monitoring into daily operational procedures to allow for preparedness planning and control measure to be implemented.
	Water-related (Chronic)	Changing precipitation patterns, types (rain, hail, snow/ice)	↑	Very low (1)	Material degradation and reduced durability (above ground assets) corrosion, or rain ingress. Increased damage and/or instability. Increased maintenance requirements. Increased frequency, distribution and severity of wildfires, damaging assets.	Very low (1)	Very low (1)	Materials selected according to strength and durability characteristics. Buildings constructed on site will be constructed to international standards. Design criteria include anti-erosion and corrosion protection. Increased maintenance requirements for above ground infrastructure allocated should they be required.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Water-related (Chronic)	Water stress	No significant change	Very low (1)		Low (2)	Very low (1)		Low (2)	**Very Low (2)**	
	Water-related (Chronic)	Precipitation or hydrological variability due to changes in glacial melt and snowmelt patterns	↑	High (4)		Low (2)	Moderate (3)		Low (2)	**Low (6)**	
	Water-related (Acute)	Drought	Uncertain	High (4)		Low (2)	Moderate (3)		Low (2)	**Low (6)**	
	Water-related (Acute)	Heavy precipitation events and an increase in extreme precipitation events and flooding	↑	Moderate (3)		Moderate (3)	Moderate (3)		Moderate (3)	**Moderate (9)**	Ensure drainage design for permanent buildings and surrounding area has sufficient capacity for future climate change. Develop and implement a management plan of inspecting and clearing drains so that they are fit for purpose.
	Water-related (Acute)	Glacial Lake Outburst Floods (GLOF)	↑	High (4)		Low (2)	Moderate (3)		Moderate (3)	**Moderate (9)**	Develop and implement an inspection, maintenance and repair regime for identifying and rectifying flood damage to buildings. Incorporate short and medium weather forecast monitoring into daily operational procedures to allow for preparedness planning

Receptor	Climate Variable	Climate Hazard	Climate Trend	Hazard	Potential Impact(s)	Exposure	Magnitude of Impact	Embedded and Committed mitigation Measures	Vulnerability	Risk Rating	Additional Mitigation Required
											and control measure to be implemented.
	Solid-mass related (Chronic)	Soil erosion and solifluction	↑	High (4)	Damage to buildings	Very low (1)	Low (2)	Buildings constructed on site will be constructed to international standards.	Low (2)	**Low (4)**	Very low or low risk from future climate change - no additional mitigation required
	Solid-mass related (Acute)	Landslide, avalanche and subsidence.	↑	High (4)		High (4)	High (4)		Moderate (3)	**High (12)**	Locate permanent building away from areas at risk of landslides, rockfall. Develop and implement a management plan to inspect buildings and surrounding areas for signs of ground movement, and repair or manage as necessary.
Transmission lines	Temperature-related (Chronic)	Changing temperature and temperature variability	↑	Very low (1)	Expansion of transmission lines in higher temperature increasing sag. Ice buildup on lines increasing weight and breakage potential Damage to transmission lines from wildfires, damaging assets.	Very low (1)	Very low (1)	The design of the transmission line included for maximum, minimum and average temperatures, ice thickness and severe weather events. Emergency situations including fire have been considered in the emergency situations within the CASA-1000 Transmission line ESIA.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Temperature-related (Acute)	Heatwave	↑	Moderate (3)		Moderate (3)	Moderate (3)		Low (2)	**Low (6)**	
	Temperature-related (Acute)	Cold wave / frost	↓	Low (2)		Moderate (3)	Low (2)		Low (2)	**Low (4)**	
	Temperature-related (Acute)	Wildfire	↑	Low (2)		High (4)	Moderate (3)		Low (2)	**Low (6)**	
	Wind-related (Chronic)	Changing wind patterns	Uncertain	Very low (1)	Damage to transmission lines during high winds Lightning risk to transmission lines.	Very low (1)	Very low (1)	The design of the transmission line included for maximum wind speed, severe weather events and lightning strike. Lightning protection incorporated in the tower design, as stated in the CASA-1000 Transmission line ESIA..	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Wind-related (Acute)	Increase in storm conditions	Uncertain	Low (2)		Moderate (3)	Low (2)		Low (2)	**Low (4)**	
	Water-related (Chronic)	Changing precipitation patterns, types (rain, hail, snow/ice)	↑	Very low (1)	Destabilization of transmission lines from flood damage to foundations	Very low (1)	Very low (1)	The design of the transmission line included for severe weather events. Emergency situations including flooding have been considered in the emergency situations within the CASA-1000 Transmission line ESIA	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Water-related (Chronic)	Water stress	No significant change	Very low (1)		Very low (1)	Very low (1)		Very low (1)	**Very Low (1)**	
	Water-related (Chronic)	Precipitation or hydrological variability due to changes in glacial melt and snowmelt patterns	↑	High (4)		Low (2)	Moderate (3)		Very low (1)	**Low (3)**	
	Water-related (Acute)	Drought	Uncertain	High (4)		Very low (1)	Low (2)		Very low (1)	**Very Low (2)**	
	Water-related (Acute)	Heavy precipitation events and an increase in extreme precipitation events and flooding	↑	Moderate (3)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Water-related (Acute)	Glacial Lake Outburst Floods (GLOF)	↑	High (4)		Low (2)	Moderate (3)		Low (2)	**Low (6)**	
	Solid-mass related (Chronic)	Soil erosion and solifluction	↑	High (4)	Destabilization of transmission lines from landslide, avalanche or subsidence	Very low (1)	Low (2)	Emergency situations including geophysical processes have been considered in the emergency situations within the CASA-1000 Transmission line ESIA.	Very low (1)	**Very Low (2)**	Very low or low risk from future climate change - no additional mitigation required
	Solid-mass related (Acute)	Landslide, avalanche and subsidence.	↑	High (4)		Moderate (3)	High (4)		Moderate (3)	**High (12)**	Ensure measures are in place to monitor likelihood of landslide or rockfall occurrences. Develop and implement a management plan to ensure any damage incurred to transmission lines and supports are rectified with minimal disruption to power supply.

Receptor	Climate Variable	Climate Hazard	Climate Trend	Hazard	Potential Impact(s)	Exposure	Magnitude of Impact	Embedded and Committed mitigation Measures	Vulnerability	Risk Rating	Additional Mitigation Required
Human health	Temperature-related (Chronic)	Changing temperature and temperature variability	↑	Very low (1)	High temperatures and heatwaves causing heat stress for personnel. H&S risk from wildfire.	Very low (1)	Very low (1)	Health and Safety procedures in place to manage current heat stress for personnel, procedures will be updated in response to changing environmental conditions. Workers are largely below ground. The Environmental and Social Management Plan (ESMP), and associated action plans will set out measures for labor management and occupational health and safety. This will include: Development and implementation of a Labor Policy and Operational Workers' Code of Conduct; Training on the Operational Workers Code of Conduct; Contracts which follow the Labor Code, and meet the Labor Management Procedures document; and an Occupational Health and Safety Management Plan to address potential occupational health and safety risks presented by the operation of the Project.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Temperature-related (Chronic)	Heat Stress	↑	Moderate (3)		High (4)	High (4)		Low (2)	**Moderate (8)**	Ensure the Occupational Health and Safety Management Plan includes for managing risks from heat stress and wildfire. Incorporate short and medium weather forecast monitoring into daily operational procedures to allow for preparedness planning and control measure to be implemented.
	Temperature-related (Acute)	Heatwave	↑	Moderate (3)		Moderate (3)	Moderate (3)		Low (2)	**Low (6)**	Very low or low risk from future climate change - no additional mitigation required
	Temperature-related (Acute)	Cold wave / frost	↓	Low (2)		Low (2)	Low (2)		Low (2)	**Low (4)**	
	Temperature-related (Acute)	Wildfire	↑	Low (2)		High (4)	Moderate (3)		Low (2)	**Low (6)**	
	Wind-related (Chronic)	Changing wind patterns	Uncertain	Very low (1)	H&S risk from storms and wind blown debris.	Very low (1)	Very low (1)	The ESMP, and associated action plans will set out measures for labor management and occupational health and safety. This will include: Development and implementation of a Labor Policy and Operational Workers' Code of Conduct; Training on the Operational Workers Code of Conduct; Contracts which follow the Labor Code, and meet the Labor Management Procedures document; and an Operational Health and Safety and Security Management Plan to address potential occupational health and safety risks presented by the operation of the Project.	Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Wind-related (Acute)	Increase in storm conditions	Uncertain	Low (2)		High (4)	Moderate (3)		Low (2)	**Low (6)**	
	Water-related (Chronic)	Changing precipitation patterns, types (rain, hail, snow/ice)	↑	Very low (1)	H&S risk from flooding.	Very low (1)	Very low (1)		Very low (1)	**Very Low (1)**	Very low or low risk from future climate change - no additional mitigation required
	Water-related (Chronic)	Water stress	No significant change	Very low (1)		Very low (1)	Very low (1)		Very low (1)	**Very Low (1)**	
	Water-related (Chronic)	Precipitation or hydrological variability due to changes in glacial melt and snowmelt patterns	↑	High (4)		Low (2)	Moderate (3)		Very low (1)	**Low (3)**	
	Water-related (Acute)	Drought	Uncertain	High (4)		Very low (1)	Low (2)		Very low (1)	**Very Low (2)**	
	Water-related (Acute)	Heavy precipitation events and an increase in extreme precipitation events and flooding	↑	Moderate (3)		High (4)	High (4)		Low (2)	**Moderate (8)**	Ensure the Occupational Health and Safety Plan includes for managing risks from flooding and GLOF. Incorporate short and medium weather forecast monitoring into daily operational procedures to allow for preparedness planning and control measure to be implemented.
	Water-related (Acute)	Glacial Lake Outburst Floods (GLOF)	↑	High (4)		High (4)	High (4)		Low (2)	**Moderate (8)**	
	Solid-mass related (Chronic)	Soil erosion and solifluction	↑	High (4)	H&S risk from landslides, debris flows or avalanche.	Very low (1)	Low (2)		Very low (1)	**Very Low (2)**	Very low or low risk from future climate change - no additional mitigation required
	Solid-mass related (Acute)	Landslide, avalanche and subsidence.	↑	High (4)		High (4)	High (4)		Low (2)	**Moderate (8)**	Ensure the Occupational Health and Safety Plan includes for managing risks from landslide / rockfall.

10.7.9. During operation phase, the majority of risks posed to the Project by climate change are considered to be very low or low. However high risks have been identified in relation to water and solid mass climate-related variables, and moderate risks in relation to solid mass, temperature, water and wind climate-related variables. It is also important to note that climate-related risks on the same receptor as a result or consequence of multiple climate hazards may also occur on the Project. For example, increasing sedimentation over time may exacerbate impacts of GLOF events or hydrological variability as the reservoirs capacity changes, impacting energy production.

It is considered that the mitigation measures identified (embedded and committed as well as additional measures) would be sufficient to manage these combined impacts, however when applying and developing additional measures, the combined nature of climate-related risks should be taken into account. Recommendations for additional risk mitigation measures are detailed in **Section 10.8**.

10.8 CRVA MITIGATION AND ENHANCEMENT MEASURES

10.8.1. Where the CRVA identified medium or high risks (no very high risks were identified), additional mitigation measures (beyond those noted in the 'Embedded and Committed Mitigation Measures' column of the CRVA) have been identified to further reduce the risk to the Project from climate hazards.

10.8.2. The additional mitigation measures identified are high level recommendations and it will be the responsibility of the design team to develop detailed measures and engineering solutions, as necessary, and the DSPOE (or other such party) to develop and implement applicable management plans, monitoring and inspection regimes.

10.8.3. A summary of the recommended additional mitigation measures is provided in **Table 10-11** with further information provided below.

Table 10-11 – Summary of moderate and high risks and additional mitigation measures

Receptor	Climate hazard	Additional mitigation measures
Construction Assets and Temporary Works	Soil erosion and solifluction Landslide, avalanche and subsidence.	Develop and implement measures to manage the risks posed by potential mudflows which may adversely impact on the construction phase works.
Energy Generation (construction and operational phase)	Soil erosion and solifluction Landslide, avalanche and subsidence.	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. The studies include the estimation of impact of climate change on sediment yield. A second study will model the deposition patterns within the reservoir and include density current venting. Ensure management and monitoring plans clearly detail the measure required to manage sedimentation and landslide impacts. Monitor sedimentation rates and how severe weather events exacerbate sedimentation and identify when additional clearance or maintenance is required on key components.
Energy Generation (operational phase)	Precipitation or hydrological variability due to changes in glacial melt and snowmelt patterns Drought Heavy precipitation events and an increase in extreme precipitation events and flooding Glacial Lake Outburst Floods (GLOF)	Implement findings and recommendations from further studies commissioned under RFP NO. RHPP/CS/QCBS/05. Monitoring of sedimentation rates and how severe weather events exacerbate sedimentation to undertaken when additional clearance or maintenance is required on key components. Record weather patterns to increase understanding of when GLOF events are more likely so as to plan for the potential occurrence of such events and minimize impacts. Incorporate short and medium weather forecast monitoring into daily operational procedures to

Receptor	Climate hazard	Additional mitigation measures
		allow for preparedness planning and control measure to be implemented. Acceptance of reduced power generation over time due to sedimentation and increased hydrologic variability.
Dam (Stage 1) Dam (Stage 2) Reservoir	Soil erosion and solifluction Landslide, avalanche and subsidence	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. Conduct safety assessments related to landslides and displacement of water, and implement findings. Ensure management and monitoring plans clearly detail the measures required to manage sedimentation and landslide impacts. Monitoring of sedimentation rates and how severe weather events exacerbate sedimentation to undertaken when additional clearance or maintenance is required on key components. Acceptance of reduced storage capacity within the reservoir over time.
Dam (Stage 1) Dam (Stage 2) Reservoir Powerhouse, transformers, turbines Spillway (High level outlets and Remote tunnel) and Headrace Tunnel	Precipitation or hydrological variability due to changes in glacial melt and snowmelt patterns Glacial Lake Outburst Floods (GLOF)	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. Incorporate short and medium weather forecast monitoring into daily operational procedures to allow for preparedness planning and control measure to be implemented. Ensure management and monitoring plans clearly detail the measure required to manage flood and GLOF risks, impact and management/mitigation actions.
Reservoir	Precipitation or hydrological variability due to changes in glacial melt and snowmelt patterns Drought	Monitor seasonal and long term weather forecasts and incorporate these into management of water levels to aid anticipation of water levels.
Spillway (High level outlets and Remote tunnel) and Headrace Tunnel Powerhouse, transformers, turbines	Soil erosion and solifluction Landslide, avalanche and subsidence.	Implement findings and recommendations of further studies commissioned under RFP NO. RHPP/CS/QCBS/05. Ensure management and monitoring plans clearly detail the measure required to manage sedimentation and landslide impacts. Monitor sedimentation rates and how severe weather events exacerbate sedimentation to undertaken when additional clearance or maintenance is required on key components.

Receptor	Climate hazard	Additional mitigation measures
Access roads and replacement bridges	Landslide, avalanche and subsidence.	Regularly inspect critical access routes for landslide and rockfall debris and implement clearance measures. Incorporate short and medium weather forecast monitoring into daily operational procedures to allow for preparedness planning and control measure to be implemented.
Permanent offices and maintenance facilities	Increase in storm conditions	Develop and implement an inspection, maintenance and repair regime for identifying and rectifying storm damage (including dust storms) to buildings. Incorporate short and medium weather forecast monitoring into daily operational procedures to allow for preparedness planning and control measure to be implemented.
	Heavy precipitation events and an increase in extreme precipitation events and flooding	"Ensure drainage design for permanent buildings and surrounding area has sufficient capacity for future climate change.
	Landslide, avalanche and subsidence.	"Locate permanent building away from areas at risk of landslides, rockfall.
Transmission lines	Landslide, avalanche and subsidence.	Ensure measures are in place to monitor likelihood of landslide or rockfall occurrences. Develop and implement a management plan to ensure any damage incurred to transmission lines and supports are rectified with minimal disruption to power supply.
Human health	Heavy precipitation events and an increase in extreme precipitation events and flooding	Ensure the Occupational Health and Safety Management Plan includes for managing risks from flooding and GLOF. Incorporate short and medium weather forecast monitoring into daily operational procedures to allow for preparedness planning and control measure to be implemented.
	Heat Stress	Ensure the Occupational Health and Safety Management Plan includes for managing risks from heat stress and wildfire. Incorporate short and medium weather forecast monitoring into daily operational procedures to allow for preparedness planning and control measure to be implemented.
	Landslide, avalanche and subsidence.	Ensure the Occupational Health and Safety Management Plan includes for managing risks from landslide / rockfall.

10.8.4. Due to the iterative and developing nature of additional studies and management plans for the Project, the CRVA has noted that there is a commitment to undertake more detailed hydrology, GLOF, landslide-dam-break, sedimentation and climate change studies which will further inform the design, construction and operation of the Project. These studies must be undertaken by competent experts, and the findings of these studies must be incorporated into the Project in order to provide increased operational safety and provide resilience to the effects of future climate change.

10.8.5. Similarly, the development and implementation of measures outlined in management and monitoring plans (including the Landslide Management and Monitoring Plan), emergency procedures and plans, and the Occupational Health and Safety Management Plan must all include measures which account for the effects of climate change. For some aspects (landslides, rockfalls, sedimentation), the impacts of climate change would not change the nature of the situation, but occurrences may become more frequent or intense. As such, recommendations to ensure the effective and safe operation of the Project will need to be sufficient within the monitoring and management plans. Where climate change may result in hazards such as wildfire, heat stress, storms and flooding, the management and emergency preparedness plans should include measures to manage the risk to an acceptable level.

10.8.6. Developing a regular inspection regime which embeds measures to reduce the impacts of climate hazards on access roads and permanent buildings should be implemented. The inspection regime may include ensuring drainage infrastructure is not blocked, that buildings are in a good state of repair to minimize storm damage and ensuring access roads are accessible. The frequency of such inspection and subsequent repair or maintenance works should be considered in line with seasonal weather variations, prior to forecast events and after the occurrence of an event.

10.8.7. In addition to the above additional mitigation measures, the following good practice recommendations are made to enhance the resilience of the Project.

- The CRVA should be considered as an iterative tool which will require review and update as the Project design develops, as further studies are completed, as additional mitigation measures are identified and implemented and as climate projection data is updated. Throughout the operational lifetime of the Project, the CRVA should also be periodically updated as the impacts of actual weather events are realized.
- A list of severe and extreme weather-related incidents should be maintained and the impact to the Project recorded against the weather event. This may include windspeeds which resulted in damage to buildings or increased wave height; temperature which resulted in degradation of deformation of materials, precipitation volumes which result in flooding. By recording such data, thresholds can be identified which, when exceeded, require maintenance or emergency measures to be initiated.
- Weather forecasts should be routinely checked for extreme events to allow time to react and put into place any measure to ensure the Project assets and employees / contractors are not unduly disrupted by such weather events.
- Management, monitoring and preparedness plans should be periodically reviewed and updated as the impacts form extreme or sever weather events are realized. Where necessary additional measures to manage risks posed by a changing climate and extreme weather events should be made to the plans.
- Calculations which are relied on for the operation of the Project should be periodically reviewed to ensure they are sufficient to accommodate climate change projections.

- When Project components are replaced during the planned replacement program, replacement components should be sufficient to accommodate future climate change projections for the lifetime of the component.

10.9 RESIDUAL EFFECTS

10.9.1. Once the additional mitigation measures are implemented, the impacts that have a risk rating of **high** and **moderate** prior to mitigation would be downgraded to **low** or **very low** and there would be no residual effects.

10.9.2. This should be confirmed through review and update of the CRVA as the Project progresses to confirm that the mitigation measures have been carried out through the Project processes, and implemented through management plans as recommended.

10.10 TRANSITION RISK - LEGISLATIVE FRAMEWORK, POLICY AND GUIDANCE

10.10.1. The approach followed for this assessment is the European Investment Bank (EIB) Standard 5 – Climate Change (EIB5) which sets out the requirement for projects to assess, manage and monitor project-related transition climate risks. EIB5 aims for the Transition Risk Assessment to build resilience and adaptive capacity in response to current and future climate change-induced impacts.

10.10.2. The EIB defines transition risks in line with the Taskforce for Climate-related Financial Disclosure Framework (TCFD) (TCFD, 2024). TCFD includes recommendations of the disclosures to be considered and the themes of a transition risk assessment, namely; policy, technology and market changes used to facilitate the change to a lower carbon economy. Transition risks may pose varying levels of financial and reputation risks on the Project.

10.11 TRANSITION RISK – ASSESSMENT METHODOLOGY

10.11.1. The purpose of the transition risk assessment is to assess climate-related risks and opportunities on the Project's existing and proposed assets, arising from the transition to a lower carbon economy, under a high and a low emission scenario.

10.11.2. A current scenario is based on the Project construction phase that is ongoing and anticipated for completion in 2032 with gradual reservoir filling until full capacity in 2038. The future scenarios assess the transition risks against a high and low emission scenario when the Project is in full operation in the 2030 decade.

10.11.3. The assessment of transition risks follows the steps set out by the TCFD Framework:

- Screening of the policy, technological and market risks and opportunities relevant to the Project;
- Assessment of relevant scenarios for the Project; 2023 has been assigned for the current baseline, and future scenarios include a 2030 high emission, and a 2030s low emission scenario; and
- A likelihood and impact rating are assigned to each relevant risk, giving a final risk rating (low / medium / high). The likelihood of the risk is based on its occurrence within Tajikistan or the renewable energy industry. The impact is based on an assessment of the scale of outcome for any given risk. Wider context of transition risk is provided by national and sector commentaries available via the IEA and World Bank.

ASSESSMENT LIMITATIONS

10.11.4. The national policy framework in Tajikistan is, in common with other national Governments, a dynamic document, reflecting ongoing international commitments to climate mitigation and adaptation targets. The current assessment uses known policy commitments and objectives, as well as wider market details available.

10.12 TRANSITION RISK ASSESSMENT

10.12.1. In the context of climate change, transition risks arise due to the necessary changes that are required during the shift to a lower carbon economy, including policy and market changes, technological advances, reputational risks to higher emitting operations and a lack of resilience to climate impacts and future climate projections.

10.12.2. Several transition risks and opportunities relevant to the Rogun HPP have been identified, including policy and legal, technology and market risks in line with the EIB (and subsequent TCFD) guidance.

10.12.3. The following subsections detail:

- **Risk**: in line with EIB guidance;
- **Impact**: specific impact on the Rogun HPP;
- **Context**: review of data received on aspects and process of the construction, operation and maintenance of the Rogun HPP;
- **Current scenario**: the risk rating for the 2023 construction period;
- **Future scenario**: the risk rating for the 2030 operation period; and
- **Summary**: outlining the requirements for management.

POLICY AND LEGAL CHANGES

Risk 1

- Enhanced GHG and climate reporting obligations and monitoring for future reporting obligations.

Impact on Rogun HPP

- Resources will be needed to record full GHG emissions from construction, operation and maintenance, including recording offset emissions of the Rogun HPP; as well as monitoring and understanding future reporting obligations.

Context

10.12.4. Tajikistan is a member of the IEA's EU4Energy Program, a collaborative program designed to support countries in implementing sustainable energy policies and energy sector development. The program is made up of five components to assist Eastern and Central Asian countries in reporting on energy sources and demand.

10.12.5. Of relevance to the Rogun HPP are Component 1: enhanced energy data management and Component 3: generate an improved energy legislative and regulatory framework and implemented policy recommendations as well as promote investments in key energy infrastructure strategic projects. This suggests that reporting of GHG emissions may become more stringent, whilst also being influenced by surrounding countries following commitments to reduce overall national emissions.

10.12.6. The FP040 project by the Green Climate Fund (2023) aims to protect Tajikistan's hydropower from climate risks. There are three elements to the project:

- Adopting best international practices;
- Re-training Tajik hydropower operators; and
- Assessing and managing climate risks.

10.12.7. The funds show progress for Tajikistan in developing a framework for efficient management of hydropower projects.

10.12.8. It is likely that Tajikistan's requirement to report at a country level will feed down to a project level, and reporting requirements will increase under the low emission scenario. The regulatory landscape for climate and carbon in Tajikistan is not considered to be a leader in policy frameworks, therefore the risk remains low for the high emission scenario.

Current Scenario

2023		
Current Scenario		
Likelihood	**Impact**	**Risk**
Low	Low	**Low**

Future Scenario

2030s					
Low Emissions Scenario			**High Emissions Scenario**		
Likelihood	**Impact**	**Risk**	**Likelihood**	**Impact**	**Risk**
High	Low	**Low**	Medium	Low	**Low**

Summary

10.12.9. The assessment of enhanced GHG and climate reporting obligations and monitoring for future reporting obligations has revealed low risks in both scenarios. Hydropower resources are at the core of Tajikistan's Energy Sector and an integral part of its targets set out in its Nationally Determined Contribution (NDC). More stringent future reporting of GHG emissions is more likely to focus on fossil-fuel generating assets rather than renewable generation.

10.12.10. Rogun JSC, as operators of Rogun HPP, should maintain monitoring regimes for the reporting of GHG emissions ensuring that existing and future reporting requirements can be met.

Risk 2

- Exposure to litigation and mandates on existing services.

Impact on Rogun HPP

- Periodic monitoring and strategic horizon scanning will be required to understand the Project's exposure to environmental litigation; carbon reduction requirements, climate resilience, water

management and land use requirements and changes in social expectations regarding resource sharing and conservation.

Context

10.12.11. The Tajikistan Development Strategy by 2030 explicitly seeks to expand hydropower generation as one of the targets to increase overall electricity production. Alongside this generation target is regulation in respect of both water resource efficiency and maintenance or enhancement of biodiversity. In developing the Rogun HPP these two elements need to be suitably accounted for in both construction and operation of the scheme. The financial risk is that more rigorous and precise measures will be required following updates to regulations, particularly under a low emission scenario, where protection of water resources and biodiversity is likely to be more stringent.

"The Water Codex of the Republic of Tajikistan contains provisions for particular uses of water for which there is a charge and for compensation of damage to water sources (Tajikistan Ministry of Justice 2020)".

"The Law of the Republic of Tajikistan on Protection and Use of Flora defines principles of protection and rational use of flora, determines the legal, economic and social basis in this area and is directed on preserving and protecting flora (Tajikistan Ministry of Justice 2018)".

10.12.12. The Program for Reforming the Water Sector of Tajikistan for 2016-2025 contains adaptation measures through the development of a long-term strategy for the use and protection of water resources, development of seasonal and annual plans for the distribution and management of water resources in river basins, restoration of irrigation infrastructure and improvement of conditions for its maintenance and operation, and introduction of new water-saving technologies (Tajikistan Ministry of Justice 2015). It notes that hydropower plays an important role in the efficient functioning of all sectors of the economy. It also highlights that the use of water in power generation does not impact either resource availability, or overall water quality.

10.12.13. Based on the recommendations provided in the Biodiversity assessment (summarized in **Section 8.11** of this report) being implemented, it is understood that all residual impacts on biodiversity will be reduced to where the significance of the effect is **minor**. The exception to this is the alteration of the Vakhsh River into a deep lake, where the significance remains as a **moderate** effect. The transition risk is therefore assessed as **low** under the 2030 low emissions scenario and **low** under the 2030 high emissions scenario.

Current Scenario

2023		
Current Scenario		
Likelihood	**Impact**	**Risk**
Low	Low	**Low**

Future Scenarios

2030s					
Low Emissions Scenario			**High Emissions Scenario**		
Likelihood	**Impact**	**Risk**	**Likelihood**	**Impact**	**Risk**
Medium	Low	**Low**	Medium	Low	**Low**

Summary

10.12.14. The assessment of exposure to litigation and mandates on existing services has revealed low risk in the low emission scenario and low risk in the high emission scenario. Rogun JSC as operators of Rogun HPP will need to monitor changes to regulatory requirements as they are published and ensure compliance is maintained.

Risk 3

- Policy changes associated with write-offs, asset impairment and early retirement of existing fossil fuel vehicles and machinery due to policy changes.

Impact on Rogun HPP

- An increase in the requirement for the replacement of vehicles and machinery with lower carbon options.

Context

10.12.15. The number of vehicles during operation will be small, with access required only for maintenance and servicing. The majority of these will be light vehicles with HGVs only required if components need replacing. Crane use is likely to be limited to replace turbine units.

10.12.16. Under a low emission scenario there may be a requirement to replace operational vehicles with lower carbon alternatives; however, due to the low number involved, the risk remains low in both the high and low emission scenarios.

Current Scenario

2023		
Current Scenario		
Likelihood	**Impact**	**Risk**
Low	Low	**Low**

Future Scenario

2030s					
Low Emissions Scenario			High Emissions Scenario		
Likelihood	Impact	Risk	Likelihood	Impact	Risk
Medium	Low	**Low**	Low	Low	**Low**

Summary

10.12.17. The assessment of policy changes associated with write-offs, asset impairment, and early retirement of fossil fueled vehicles and machinery due to policy changes has revealed low risks in both scenarios. Rogun JSC as operators of Rogun HPP will be required to monitor policy changes to allow any required replacement of assets can be factored into planned replacement regimes.

TECHNOLOGY CHANGES

Risk 1

- Technological advances causing existing products to become obsolete and substituted with lower emissions options.

Impact

- Costs of replacing assets, plant and machinery and other equipment.
- Extra resource needed for replacing assets plant and machinery and other equipment.

Context

10.12.18. There are several energy-dependent assets within the Project, namely; the powerhouse, turbines, power supplies, permanent maintenance facilities and site offices. Hydropower is a well-established technology and the means of energy generation (conversion of potential energy into electricity) will not substantially change in future. Innovation in optimizing components within the powerhouse or turbine can be incorporated within planned major maintenance periods (where relevant).

Construction

10.12.19. It is understood that the contractor team is currently working to replace diesel engines used during construction with electrical engines. Five new electrical engines were commissioned for the construction of the Rogun HPP in 2021. A high capacity conveyor belt, or 'Flying Belt System', has also being installed on site to transport construction material around the site, replacing diesel vehicles.

Operation

10.12.20. The entirety of the assets will be powered by the Project; however, there will be two diesel back-up generators on standby should supply shortages impact the HPP.

10.12.21. The opportunity to substitute to lower emission assets is low, making the overall risks under each of the future scenarios also low.

Current Scenario

2023		
Current Scenario		
Likelihood	**Impact**	**Risk**
Low	Low	**Low**

Future Scenario

2030s					
Low Emissions Scenario			**High Emissions Scenario**		
Likelihood	**Impact**	**Risk**	**Likelihood**	**Impact**	**Risk**
Low	Low	**Low**	Low	Low	**Low**

Summary

10.12.22. The assessment of technological advances causing existing products to become obsolete and substituted with lower emissions options has revealed low risks in both scenarios. Rogun JSC as operators of Rogun HPP should ensure replacement of assets with lower emission options can be factored into planned replacement regimes.

Risk 2

- Updates and innovations within hydropower production are driven by policy changes.

Impact

- Policy driven technology updates mean extended periods of maintenance to replace key assets. This results in loss of revenue due to impaired, or no, energy generation.

Context

10.12.23. Hydropower is well established as an energy source, though there are several innovation trends focused on increasing the resilience and capacity of hydropower plants. The five main themes when understanding the development of hydropower are:

i. Hydropower flexibility;

ii. Hydropower digitalization;

iii. Energy storage and variable speed turbines;

iv. Generators with current-controlled rotors; and

v. Fish-friendly hydropower technologies.

10.12.24. Under a low emissions scenario, it is possible that the policy transition will be more stringent thereby putting pressure on technological developments to achieve a lower carbon scenario. As such, under a low emission scenario the risk would be Medium.

10.12.25. Under a high emissions scenario, it is likely the Project design will be capable of meeting current and projected policies and targets, given the current political landscape in Tajikistan.

Current Scenario

2023		
Current Scenario		
Likelihood	**Impact**	**Risk**
Low	Low	**Low**

Future Scenario

2030s					
Low Emissions Scenario			**High Emissions Scenario**		
Likelihood	**Impact**	**Risk**	**Likelihood**	**Impact**	**Risk**
Medium	Medium	**Medium**	Medium	Low	**Low**

Summary

10.12.26. The assessment of updates and innovations within hydropower production driven by policy changes has revealed medium risk in the low emission scenario and low risk in the high emission scenario. Rogun JSC as operators of Rogun HPP will need to ensure that upgrades and innovation are suitably planned to minimize the financial, and loss in energy production, impacts.

MARKET CHANGES

Risk 1

- Inability to reconnect to Central Asian Power System (CAPS).

Impact

- Network balancing challenges due to inability to export power outputs in periods of higher domestic demand.

Context

10.12.27. Prior to 2009, electricity network resilience was facilitated through Tajikistan's connection to the CAPS. This was particularly important in meeting winter peak demand periods, through parallel operation with Uzbekistan. Without a re-connection to this system, management of the output from the Rogun HPP will be challenging given no means of exporting surplus power in this scenario. There is potential for difficulties in load management, causing network imbalances and potential need to curtail output from the scheme. This would mean inefficient operation and make integration of other renewable generation (solar and wind) harder to achieve.

10.12.28. Existing infrastructure provides export capacity between Tajikistan and Uzbekistan/Kyrgyzstan and on to Kazakhstan. This capacity is greater than the amount of generation capacity currently required to meet existing power purchase agreements with Kazakhstan. This has been secured through

completion of the first phase of synchronization work with the CAPS. Full synchronization is anticipated for completion in 2027.

10.12.29. The CASA – 1000 project is developing network transmission infrastructure in Tajikistan, Afghanistan and Pakistan, interconnected with Kyrgyzstan. This will ultimately facilitate network resilience in the region and enable power flows from the Rogun HPP to neighboring countries.

10.12.30. Given uncertainty in availability of funding and therefore in timescales of delivery of the CASA-1000 project, there is a medium risk under a low emission scenario. The risk under a high emission scenario is medium due to the scenario analysis that there will be a more relaxed transition to a lower carbon economy under a high emission scenario.

Current Scenario

2023		
Current Scenario		
Likelihood	**Impact**	**Risk**
Medium	Low	**Low**

Future Scenarios

2030s					
Low Emissions Scenario			**High Emissions Scenario**		
Likelihood	**Impact**	**Risk**	**Likelihood**	**Impact**	**Risk**
Medium	Medium	**Medium**	Medium	Medium	**Medium**

Summary

10.12.31. The assessment of uncertainty in market signals has revealed medium risk in the low emission scenario and medium risk in the high emission scenario. Rogun JSC as operators of Rogun HPP will need to monitor the market status to ensure any potential risks are identify early and measures can be implemented in a timely manner. Current infrastructure capacity, and planned synchronization with the CAPS, should ensure sufficient cross-border export capacity to enable all existing power purchase agreements and further capacity agreements as more generation capacity comes on line.

10.13 BIBLIOGRAPHY

Abdullaev, S. F., and Sokolik, I. N. (2019). *Main Characteristics of Dust Storms and Their Radiative Impacts: With a Focus on Tajikistan.* Retrieved from Journal of Atmospheric Science Research Volume 02(02).

Climate Analytics . (2023). *Climate Impact Explorer.* Retrieved from https://climate-impact-explorer.climateanalytics.org/

Copernicus . (2024). *Copernicus Interactive Climate Atlas*. Retrieved from https://atlas.climate.copernicus.eu/atlas

EIB. (2022). *Environmental and Social Standards.* Retrieved from https://www.eib.org/attachments/publications/eib_environmental_and_social_standards_en.pdf

EIB Group. (2020). *Climate Bank Roadmap 2021-2025.* Retrieved from https://www.eif.org/files/records/eib_group_climate_bank_roadmap_en.pdf

GFDRR. (2020). *ThinkHazard*. Retrieved from https://thinkhazard.org/en/report/239-tajikistan

Global Support Programme. (n.d.). *Supporting Tajikistan to advance their NAP process.* Retrieved from https://www.globalsupportprogramme.org/projects/supporting-tajikistan-advance-their-nap-process

Government of Tajikistan. (2019). *National Climate Change Adaptation Strategy of the Republic of Tajikistan.* Retrieved from https://www.preventionweb.net/publication/national-strategy-adaptation-climate-change-republic-tajikistan-period-2030#:~:text=The%20National%20Strategy%20for%20Adaptation,agriculture%2C%20land%20tenure%20and%20food

IHA. (2019). *Hydropower Sector Climate Resilience Guide.* Retrieved from https://assets-global.website-files.com/5f749e4b9399c80b5e421384/5fa7e38ce92a9c6b44e63414_hydropower_sector_climate_resilience_guide.pdf

IPCC. (2018). *IPCC Glossary.* Retrieved from IPCC Glossary https://www.ipcc.ch/site/assets/uploads/2018/11/sr15_glossary.pdf).

Jones et al. (2020). *Climate Change Increases the Risk of Wildfires.* Retrieved from https://tyndall.ac.uk/working-papers/climate-change-increases-the-risk-of-wildfires/

Meteoblue. (2024). *Observed historical climate & weather data for Roghun.* Retrieved from https://www.meteoblue.com/en/weather/historyclimate/climateobserved/roghun_tajikistan_1220701

Official Journal of the European Union. (2023). *Commission Delegated Regulation (EU) 2023/2486.* Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:C_202300111

OSCE. (n.d.). *Natural Hazards in Tajikistan*. Retrieved from https://www.osce.org/files/f/documents/1/7/408008.pdf

Swiss Re. (2020). *CatNet – the online natural hazard atlas.*

TCFD. (2024). *Task Force for Climate-related Financial Disclosure (TCFD).* Retrieved from https://www.fsb-tcfd.org/about/

UNDP. (n.d.). *Tajikistan Climate Change Adaptation .* Retrieved from https://www.adaptation.undp.org/explore/central-asia/tajikistan

World Bank . (2020). *Climate Change Knowledge Portal.* Retrieved from https://climateknowledgeportal.worldbank.org/

World Bank. (2018). *ESS1: Assessment and Management of Environmental and Social Risks and Impact.* Retrieved from https://documents1.worldbank.org/curated/en/142691530216729197/ESF-Guidance-Note-1-Assessment-and-Management-of-Environmental-and-Social-Risks-and-Impacts-English.pdf

World Bank. (2018). *ESS3: Resource Efficiency and Pollution Prevention Management.* Retrieved from https://documents1.worldbank.org/curated/en/112401530216856982/ESF-Guidance-Note-3-Resource-Efficiency-and-Pollution-Prevention-and-Management-English.pdf

World Bank. (2018). *ESS4: Community Health and Safety.* Retrieved from https://documents1.worldbank.org/curated/en/290471530216994899/ESF-Guidance-Note-4-Community-Health-and-Safety-English.pdf

World Bank. (2020). *Climate Change in Tajikistan .* Retrieved from https://zoinet.org/wp-content/uploads/2018/01/TJK-climate-summary-en.pdf

World Bank. (2020). *Tajikistan Climate Data – Projections.* Retrieved from https://climateknowledgeportal.worldbank.org/country/tajikistan/climate-data-projections

World Bank Group. (2021). *Climate Change Knowledge Portal.* Retrieved from https://climateknowledgeportal.worldbank.org/country/tajikistan/climate-data-projections

World Resources Institute. (2021). *Aqueduct Water Risk Atlas.* Retrieved from https://www.wri.org/data/aqueduct-water-risk-atlas

World Resources Institute. (2024). *Aqueduct Water Risk Atlas*.

JSC “Rogun HPP”

State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT – UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Volume1, Chapter 11: Noise and Vibration



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11 NOISE AND VIBRATION

11.1.1. The assessment of potential noise and vibration impacts generated by Project activities, was undertaken in line with the requirements of the WB ESS1: Assessment and Management of Environmental and Social Risks and Impacts.

11.1.2. A description of ambient noise baseline conditions is presented in **Volume 2, Annex 7.1 – Baseline Conditions Report** and a summary is provided in **Volume 1, Chapter 7** of this ESIA.

11.1.3. In 2014, an environmental and social assessment of the Rogun hydropower plant was undertaken by Poyry. The ESIA report identified several sources of noise and vibration from construction activities:

- The use of explosives, vehicle movements and the operation of machines; and
- The use of equipment in the turbine hall and the movement of vehicles through the access roads in the tunnels.

11.1.4. The ESIA identified mitigation measures with the objective of reducing noise levels to comply with Tajik and other applicable noise limits. Mitigation measures included, among others:

- Use adequate and well-maintained construction and transportation equipment including state-of-the-art built in systems (muffler) to reduce the noise. The contractor must develop a maintenance program to ensure to keep noise within legally permitted limits;
- Instruct the workforce to avoid unnecessary noise;
- Use adequate and state of the art techniques for blasting, which do not exceed the exposition time to the noise;
- Workers exposed to excessive noise must be equipped with PPE (e.g. ear protectors) and have a limited exposure period;
- The quarry must be located a sufficient distance to any populated area;
- Separate installation areas, for example mechanical workshops etc. from areas that are used by people for temporary housing and recreation; distance should be at least 10 m;
- Noise and vibration associated with the use of explosives needs to be monitored with a maximum sound pressure level of 136 dB;
- Avoid any noise intensive activities such as metalworking, blasting (in quarries) etc. during nighttime; and
- Avoid transporting of material (rock, concrete, etc.) during night, if they have to pass villages.

11.1.5. The ESIA recommended compliance with noise standards set by international organisations such as WHO or with Tajik legislation. Several management and monitoring plans to facilitate implementation of the mitigation measures were proposed.

11.2 LEGISLATIVE FRAMEWORK, POLICY AND GUIDELINES

11.2.1. National legislation and international lender standards applicable to noise and vibration is described in **Volume 1, Chapter 2: Legislation and Standards** of this ESIA.

TAJIKISTAN NATIONAL LEGISLATION

11.2.2. In Tajikistan, control of noise and vibration falls under the wider category of ‘environmental pollution’ in terms of the Law of the Republic of Tajikistan on Environmental Protection No. 760 (2011), as amended:

- Article 27 refers to the limits on noise and vibration to protect health and the environment; and
- Article 52 requires individuals and legal entities to prevent harmful industrial noises and vibrations.

11.2.3. The Tajikistan noise standards are stipulated in Sanitary Norm 2.2.4/2.1.8.562-96 for noise levels at workplaces, residential and public buildings and for work activities and sensitive receptors. Sound levels and equivalent sound levels for typical work activities and workplaces are presented in **Table 11-1**.

Table 11-1 - Sanitary Standards for Work Activities (SN 2.2.4/2.1.8.562-96)

Type of work, workplace	Sound pressure level, dB, per octave band, Hz[1]									Overall sound level, dBA
	31.5	63	125	250	500	1k	2k	4k	8k	
All work activities at production facilities and work places	107	95	87	82	78	75	73	71	69	80
Driver cab (truck)	100	87	79	72	68	65	63	61	59	70

Notes

1. More stringent standards for certain types of activity may be established, accounting for the intensity and severity of the activity in accordance with guidance in SN 2.2.4/2.1.8.562-96 Table 1.

2. It is forbidden to stay even for a short time in areas with sound pressure levels above 135 dB in any octave band.

Reproduced from 'Table 2' of the Sanitary Standards SN 2.2.4/2.1.8.562-96

11.2.4. Sound levels in residential and public buildings and in residential areas are presented in **Table 11-2**.

[1] Octave bands are a method of filtering constant noise into smaller segments to identify noise levels at different frequencies

Table 11-2 - Permissible Noise Levels in Private and Public Buildings and Residential Areas (SN 2.2.4/2.1.8.562-96)

Location/Activity	Time of day	Sound level, $L_{eq,T}$ dBA[2]	Maximum sound level L_{max}, dBA[3]
Living rooms of apartments, living quarters of holiday homes, boarding houses, boarding houses for the elderly and disabled, sleeping quarters in preschool institutions and boarding schools	0700 – 2300 2300 – 0700	40 30	55 45
Hotel rooms and dormitory living areas	0700 – 2300 2300 – 0700	45 35	60 50
Areas directly adjacent to residential buildings, clinics, outpatient clinics, dispensaries, rest homes, boarding houses, boarding houses for the elderly and disabled, preschool institutions, schools and other educational institutions, libraries	0700 – 2300 2300 – 0700	55 45	70 60
Areas directly adjacent to the buildings of hotels and dormitories	0700 – 2300 2300 – 0700	60 50	75 65

11.2.5. Clause 383: Time and Activity Control of Sanitary Norm 2.2.4/2.1.8.562-96 specifies several restrictions to specific construction activities:

- Construction work from 22:00 to 06:00 on sites located at a distance of 100 m from residential areas will be prohibited;
- Construction work on sites located at 150 m from critical areas, such as schools or medical facilities, is prohibited from 18:00 to 08:00; and
- Noisy construction activities (such as the use of crushers) near residential areas or important facilities are prohibited.

INTERNATIONAL LENDER REQUIREMENTS

11.2.6. World Bank Environmental and Social Standards (ESS) that are applicable to noise management include:

- World Bank ESS2: Labour and Working Conditions – conditions of work that are likely to be hazardous include, among others, noise and vibration levels that are damaging to health;
- World Bank ESS3: Resource Efficiency and Pollution Prevention – the objective to avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution, including noise and vibration; and
- World Bank ESS4: Community Health and Safety - adverse impacts on the health and safety of project-affected communities during the project life cycle from both routine and nonroutine circumstances should be avoided.

[2] L_{eq} an average decibel value without a frequency weighting for a non-constant noise
[3] L_{max}, the maximum sound level, during a measurement period or a noise event

11.2.7. In addition to the above, examples of general and industry-specific Good International Industry Practice (GIIP) are provided in:

- WB Environmental Health and Safety (EHS) Guidelines - General EHS Guidelines: Introduction (2007) – Section 1.7 provides detailed guidance for management of noise beyond the site boundary. Section 2.3 provides guidance on occupational exposure to noise;
- WB Good Practice Note: Environmental, Health and Safety Approaches for Hydropower Projects (2018) – noise and vibration is included as a source of pollution to be managed during both the construction and operation phase.

Noise Level Guidelines

11.2.8. WB General EHS Guideline document provides noise levels for measured noise impacts from a project facility or operations. The Guideline states that the maximum increase in background levels should not exceed 3 dB at the nearest receptor location off-site or the noise levels in **Table 11-3** should not be exceeded.

Table 11-3 - Noise Level Guidelines

Receptor	1 Hour Threshold L_{Aeq}[4]
Residential, Institutional, Educational	Daytime: 53dB (07:00 – 22:00) Night-time: 45dB (22:00 – 07:00)
Industrial, commercial	Daytime and night-time: 70dB

World Bank Group (2007). Environmental, Health and Safety Guidelines: Noise Management.

11.2.9. The General EHS Guidelines also provide noise limits for workplaces and selected noise levels relevant to the Project are presented in Table 11-4.

Table 11-4 - Noise Limits for Various Working Environments

Location/Activity	Equivalent Level (LA_{eq}, 8hr)[a]	Maximum (LA_{max}, F)[b]
Light industry (decreasing demand for oral communication)	50-65 db(A)	110 db(A)
Hospitals	30-35 db(A)	40 db(A)

Notes:

a. LA_{eq} is the Equivalent Continuous A-Weighted Sound Pressure Level and is defined as the A-weighted sound pressure level of steady sound
b. The LA_{max} is the maximum value that the A-weighted sound pressure level reaches during a measurement period LA_{max} F, or Fast, is averaged over a time constant of 125 milliseconds on a sound level meter

11.2.10. The Guidance document references the ACGIH5 Guidelines that provide health-based values regarding safe levels of exposure to physical agents in the workplace; currently 85 dB(A) for an 8-

[4] LA_{eq} is the A-weighted (a frequency weighting to better reflect the human ear), equivalent continuous sound pressure level expressed in decibels (dB)
[5] American Conference of Governmental Industrial Hygienists

hour period, based on a 3-dB exchange rate. For shorter exposure times, permissible noise levels can be higher, with 90 dB(A) being the limit for an 8-hour duration.

11.2.11. The WHO Noise Guidelines, updated in 2018, provide recommended average sound pressure levels for outdoor exposure to, among others, road traffic noise. The WHO strongly recommends that the noise level generated by road traffic is below 53 dB L_{den} and below 45 dB L_{night} during the daytime and nighttime hours respectively.

11.2.12. Directive 2000/14/EC of the European Parliament and of the Council of 8 May 2000 on the approximation of the laws of the Member States relating to the noise emission in the environment by equipment for use outdoors, as amended, specifies the permissible sound power level for specified construction equipment including compaction machines, dozers, loaders, graders and excavators; and the guaranteed sound power level of equipment subject to noise marking[6], including concrete or mortar mixers.

11.2.13. Directive 2002/44/EC of 25 June 2002 on the Minimum Health and Safety Requirements Regarding the Exposure of Workers to the Risks Arising from Physical Agents (Vibration) aims to provide a minimum level of protection based on timely detection of adverse health effects arising or likely to arise from exposure to mechanical vibration, especially musculo-skeletal disorders to ensure worker health and safety.

PROJECT NOISE LIMITS

11.2.14. For the construction phase, the noise limits are the Tajikistan maximum permissible sound levels for typical work activities and workplaces as presented in **Table 11-1** and the Tajik maximum permissible sound levels for private and public buildings and residential areas, as presented in **Table 11-2**.

11.2.15. For the operational phase, the Project noise limits are the WB Guideline noise level in **Table 11-3** for outdoor areas and the noise limits for working locations in **Table 11-4** for indoor areas.

11.2.16. The Project noise limits are an amalgamation of the Tajikistan noise standards and World Bank EHSGs levels and are presented in **Table 11-5**.

Table 11-5 - Project Noise Limits

Location/Activity	Duration	Construction	Operation	Source
Crusher/conveyor/ quarry	LA_{eq},8h	70 dB(A)	-	Tajik legislation
	LA_{max},fast	110 dB(A)	-	
Workshops	LA_{eq},8h	65 dB(A)	65 dB(A)	WB General EHS Guidelines
	LA_{max},fast	110 dB(A)	110 dB(A)	
Residential areas	LA_{eq},1hr (daytime)	53 dB (A)	53 dB (A)	WHO 2018
	LA_{eq},1hr (nighttime)	45 dB (A)	45 dB (A)	

[6] The affixing on the equipment of the CE marking defined in Decision 93/465/EEC accompanied by the indication of the guaranteed sound power level

Location/Activity	Duration	Construction	Operation	Source
Hospitals/clinics	LA_{eq},8h	35 dB(A)	35 dB(A)	
	LA_{max},fast	40 db(A)	40 db(A)	

VIBRATION

11.2.17. Construction activities that generate vibration impacts include:

- Blasting;
- Operation of earth moving equipment; and
- HGV movements.

11.2.18. No measurements of vibration were taken on the site visit in May 2023 and none of the contractors monitor vibration as part of their environmental or occupational health monitoring.

11.2.19. Impacts due to vibration have been scoped out of the assessment as the geology of the area, described in **Volume 1, Chapter 12: Geology and Soils** of this ESIA, is a mix of igneous and sedimentary rock and, considering the combination of the geological characteristics, the management of blasting activity under Tajikistan regulatory requirements, the exponential attenuation of blast vibration with distance[7] and that there are no buildings on the Project site within 500 m of a blast site, the blasting activities undertaken site are unlikely to impact off-site receptors.

11.2.20. In addition, vehicles passing the village of Pasi Muhraho may cause vibration but as the vehicles travelling on the road passing the village are relatively light, it is unlikely that the vibration resulting from vehicle movements will impact on the houses and other structures within the village.

11.3 ASSESSMENT METHODOLOGY

11.3.1. The approach to the assessment has been to combine the primary data collected during a site visit in May 2023 and personal observations made during visits (primary data) with a review of historic data and information provided by the Contractors and other Project literature (secondary data).

11.3.2. The assessment methodology is described in **Volume 1, Chapter 5: Methodology** of this ESIA.

AREA OF INFLUENCE

11.3.3. The Area of Influence (AoI) extends to the distance at which the noise level generated at source is not likely to exceed the background noise level, including:

- Locations around the construction site with notable noise sources including the quarries, borrow pits, stockpiles, batching/mixing plant, conveyor and dam wall working face; and
- Indoor areas including tunnels used as haul roads and caverns where construction activities are undertaken.

[7] Vibration can be described in the form of a general exponential equation: $A=kW^bD^n$, where:

- A is a measure of the peak vibration amplitude (or velocity);
- W is the explosive charge weight per delay;
- D is the distance from the blast; and
- k, b, and n are constants determined by a given site or blasting procedure.

IMPACT MAGNITUDE

11.3.4. The magnitude of the potential impact considers the duration, extent, reversibility and likelihood of the impact. The impact magnitude categories are described in **Table 11-6** and reflect that activities undertaken during the construction and operational phases either meet or exceed the Project noise limits; or may result in a 3dBA increase in background noise levels.

Table 11-6 - Impact Magnitude Categories

Impact Magnitude	Construction and Operational Phase
Large	The Project noise limit is exceeded for a given activity or location or the background noise level is exceeded by more than 3 dBA at a specific location
Very Small	The Project noise limit is not exceeded for a given activity or location or the background noise level is not exceeded by more than 3 dBA at a specific location

RECEPTOR SENSITIVITY

11.3.5. The receptors impacted by noise include workers on site and residents of local communities around the site where noise levels may be elevated due to construction or operational activities. Sensitivity is also a function of land use where:

- Commercial or industrial uses are not considered noise sensitive as activities within these areas are generally compatible with higher noise levels; and
- Residential and institutional uses, including worker accommodation and facilities, are considered noise sensitive, especially at nighttime.

11.3.6. For both the construction and operational phase, the sensitivity of workers on site and residents of local communities is considered **high** given that noise may induce medical conditions, such as hearing loss and tinnitus, stress, sleep disturbance and cardiovascular problems. Activities undertaken in designated outdoor or indoor areas may also be disturbed or disrupted by noise levels and the sensitivity of these receptors is described in **Table 11-7**.

Table 11-7 - Receptor Sensitivity

Sensitivity	Description and Examples
High	Workers on site and residents of the local communities. Locations where activities would be disrupted by noise. For example, hospitals, schools, recreational areas, residential spaces and places of worship
Medium	Locations where activities would not be disrupted but may be disturbed by noise. For example, offices, sports grounds and light industry
Low	Locations where activities would not be disrupted or disturbed by noise. For example, heavy industry and factories

11.3.7. The location of receptors relative to noise sources is described in **Table 11-8**.

Table 11-8 - Receptor Location

Receptor Name	Approximate Distance from Nearest Working Area (km)	Approximate Direction from Nearest Working Area	Applicable Phase
On-Site Workers	Adjacent	N/A	Construction and Operation
Rogun City (residential, school, hospital and worker accommodation)	1.5 2.0 2.2	NW ((right-bank stabilization) NW (left bank stabilization) NW (main dam site)	Construction
Pasi Muhraho Village	1.1 1.8	NW (right-bank stabilization) W-NW (left bank stabilization)	Construction
	Adjacent	Paved Road	Construction and Operation
We-Build Worker Accommodation and Clinic	2.0	W (Quarry 17 crusher plant)	Construction

11.3.8. The distance has been measured as the shortest distance between the noise source and receptor locations.

EFFECT SIGNIFICANCE

11.3.9. As described in **Volume 1, Chapter 5: Methodology** of this ESIA, the significance of effects is a combination of the receptor sensitivity and the impact magnitude. Where the significance of the effect is moderate or major, the effect is considered significant, and mitigation measures are required. Where the significance is minor or negligible, the effect is considered not significant, and no mitigation measures are proposed.

11.4 IMPACTS AND EFFECTS

11.4.1. The activities that generate potential noise impacts during the construction phase and the indicative noise levels are shown in **Table 11-9**.

Table 11-9 - Construction Activity Location and Indicative Noise Level

Activity Conveyor	Location	Measurement Distance (m)	Indicative Noise Level (dB (Leq,T))[a]	Maximum Noise Level (dB(Lmax))	WB Thresholds (outdoor)b	Tajik Sanitary Standard (work activities)
Blasting	Quarry 26/26a, main dam right bank lower area, main dam right bank	-	-	-	70	
Heavy earth moving equipment	Cofferdam (mostly vehicle engine noise)	-	81	103	70	
Crusher plant	Quarry 15, Quarry 17, Quarry 26	30	98	98	70	
		50	85	94	70	
Small plant and equipment operation	Localized	-	-	-	-	
		2	81	84	70	

Activity Conveyor	Location	Measurement Distance (m)	Indicative Noise Level (dB (Leq,T))[a]	Maximum Noise Level (dB(Lmax))	WB Thresholds (outdoor)b	Tajik Sanitary Standard (work activities)
Conveyor operation		10	77	80	70	
Vehicle movements	Haul road	15 m[d]	76	95	70	
	DT4 Tunnel	10 m[d]	86	99		80
Construction Site 1		400 m[d]	60	75	55[c]	

Notes:

a – Sanitary Norm 2.2.4/2.1.8.5.6.2-96, clause 5.3.1

b – industrial, commercial

c – daytime

d – distance of measurement from main construction activity

11.4.2. The activities that generate potential noise impacts during the operational phase include:

- Transformer operation;
- Vehicle movements; and
- Small plant and equipment operation.

11.5 CONSTRUCTION PHASE

11.5.1. Sound intensity follows an inverse square law and noise levels decrease by approximately 6 dB for a doubling of distance from a point source over open terrain[8]. Consideration of potential noise impacts on receptors uses the attenuation of noise with distance to determine the impact magnitude.

BLASTING

11.5.2. Potential noise impacts arise from blasting activity currently undertaken at Quarry 26/26a, at the main dam site and at specific locations of the left bank and right bank. No blast noise measurements were recorded during the site visit in May 2023; but the literature notes that noise from a blast may impact human receptors.

[8] In acoustics, the inverse-square law in a field is understood as sound radiating into space from a source uniformly in all directions and the sound pressure level decreases 6 dB, on an unweighted scale, each time the distance from the point source is doubled. OSHA Technical Manual (OTM) Section III: Chapter 5 Noise. https://www.osha.gov/otm/section-3-health-hazards/chapter-5#whatisnoise

Impact Assessment

11.5.3. On the construction site, workers have a **high** sensitivity in indoor and outdoor areas where noise is generated.

11.5.4. The procedure for blasting in open areas and tunnels is described in Annex 10 – Drilling and Blasting Management Subplan of the Occupational Health and Safety Management Plan (WeBuild, 2020). The measures already in effect to minimise the potential impact of noise from blasting on workers include:

- Restricting open air blasting times to shift changeover and workforce break times (usually between 12:00-13:00 and 18:00-19:00) to ensure that a minimal workforce is exposed to the noise;
- Evacuating workers to more than 50 m from the blast zone at least 30 minutes prior to the blast to ensure that exposure to the blast noise is minimised;
- Ensuring that all acoustic barriers are in place; and
- Ensuring that all workers undertaking activities associated with blasting and workers in the vicinity of the blast site have appropriate Personal Protection Equipment (PPE) including appropriate hearing protection.

11.5.5. The timing of blast activities to minimise the number of workers in indoor and outdoor areas who are exposed to the blast and the evacuation of workers from the blast zone effectively avoids the potential impact of excessive noise on workers who would be exposed. The evacuation distance reduces the noise impact magnitude to **very small** and the residual impact is **minor,** and no new mitigation is proposed.

11.5.6. The worker accommodation currently located within Construction Site 1 is approximately 2000 m from the nearest site of blasting activity at the main dam site, worker accommodation at Construction Site 2 is at least 1500 m from the main dam site and worker accommodation in Rogun City is approximately 2000 m from the main dam site.

11.5.7. The village of Pasi Muhraho is approximately 2000 m from the nearest blasting activity at the main dam site and Rogun City residential areas and the Hospital are at least 2200 m from the main dam site when measured to the entry checkpoint on the Rogun City boundary.

11.5.8. Given the exponential decrease of noise levels with distance, where noise levels decrease by 6 dB with a doubling of the distance from the noise source, the potential impact of blasting at the main dam site and Quarry 26/26a is effectively attenuated by the distance and topography between the location of noise sources and the receptor locations. The magnitude of blast noise impact on residents is **very small**, the significance of the effect is **minor**.

Mitigation Measures

11.5.9. The following mitigation measures have been identified to further minimize the noise due to blasting activity on site should grievances regarding blasting noise be received from workers or the local community:

- A maximum level for air blast overpressure of 115 dB (Lin Peak[9]) shall be exceeded for no more than 5 % of blasts over a 12-month period; and

[9] Lin Peak (Linear Peak) is the maximum level of air pressure fluctuation measured in decibels without frequency weighting.

- Ground vibration (peak particle velocity) shall neither exceed 5 mm/second on 9 out of 10 consecutive blasts, nor exceed 10 mm/second at any time. (Standard for Responsible Mining, 2018).

11.5.10. The mitigation measures will form part of the requirements of the JSC Rogun **Volume 3, B9 Outline Blasting and Explosives Management Plan** of this ESIA that will be used by contractors to prepare detailed management plans.

EARTH MOVING EQUIPMENT AND VEHICLE MOVEMENTS

11.5.11. There are 26 km of surface roads on the construction site, the majority of which are unpaved, that are primarily used by dump trucks to haul spoil from the crusher plant, stockpile areas, dump sites and the main dam site.

11.5.12. The site roads are also used by buses to transport shift workers commuting from site accommodation and surrounding villages to work locations. A fleet of smaller vehicles is used by contractor personnel to move around the site.

11.5.13. On the construction site, earth moving equipment, concrete mixer trucks and dump trucks are concentrated at the left and right bank stabilization works and the main dam (cofferdam) site and in routes connecting the various Project components.

11.5.14. The sensitivity of workers in outdoor areas where heavy earth moving equipment and construction vehicles are in operation throughout an 8-hour shift is **high**.

11.5.15. Locations opposite the left bank stabilisation site where receptors have a **high** sensitivity to noise include the Pasi Muhraho village, worker accommodation at Construction Site 2, worker accommodation in Construction Site 1, worker accommodation in Rogun City, the Hospital, residential areas and the clinics operated by JSC Rogun and WeBuild. The short-term noise measurement at Construction Site 1 in May 2023 noted noise from construction traffic on the site road network, private vehicles and general settlement noise.

11.5.16. During the site visit in May 2023, the noise level measurement of 60 dB(L_{eq}) taken approximately 3m from the façade of one of the accommodation buildings at Construction Site 1 exceeded the Project standard of 45 dB(A) which is usually the nighttime limit but applied in this instance to take into consideration that shift workers sleep during daytime.

11.5.17. The magnitude of the potential impact of noise generated by the movement of heavy equipment and construction vehicles is **large** and the significance of the effect is **major**.

Mitigation Measures

11.5.18. Given the limited accessibility on the left bank and right bank and the layout of the stabilization works site, the installation of acoustic barriers is not feasible. The following mitigation measures have been identified to reduce the potential impact of noise from heavy earth moving equipment and construction vehicles on the site:

- Ensure that earth moving equipment and vehicles are well maintained and servicing and repairs are recorded;
- Install noise attenuation devices such as mufflers and acoustic panels to minimise engine noise, replace noisy exhaust systems and turn off equipment and vehicles not in use;

- Ensure that the speed limits of 40 km/h aboveground and 20 km/h tunnels are enforced on the site roads;
- Install sound dampening mats in the equipment operator cabins to reduce noise levels, particularly while the machine is operating at full-throttle, to meet Project limits for drivers (70 dB);
- Ensure that plant and equipment procured from European suppliers complies with Directive 2000/14/EC;
- Provide workers in outdoor or indoor areas who are exposed to a noise level exceeding 70dB with appropriate hearing protection, especially where exposure is for the duration of an 8-hour shift; and
- Install acoustic barriers and insulation, where appropriate, at sensitive receptor locations, particularly at worker accommodation to ensure that sleeping quarters meeting the Project nighttime standard for residential areas is met during day and night.

11.5.19. All noise mitigations will be incorporated into **Volume 3, B2: Outline Noise and Vibration Management Plan** of this ESIA that will be prepared by JSC Rogun and used by contractors to prepare detailed management plans.

11.5.20. Site-wide requirements for onsite and offsite traffic movements will be described in **Volume 3, On-Site Traffic Management Plan** and **Volume 3, Off-Site Traffic Management Plan** of this ESIA respectively; and these requirements will also be relevant to the preparation of the detailed management plans to be prepared by contractors.

Residual Effect Significance

11.5.21. With the implementation of the mitigation measures, the significance of the effect of potential noise on site workers, Pasi Muhraho village, worker accommodation in Construction Site 1, worker accommodation in Rogun City, the Hospital and residential areas and the WeBuild clinic will be reduced to **moderate**.

11.5.22. Given that a moderate effect is significant, further measures to be implemented include:

- Monitor noise levels at all high-sensitivity receptor locations, including the Hospital, to check ambient noise levels relative to the Project noise limits;
- Install acoustic barriers and insultation, where appropriate, at sensitive receptor locations, to ensure that Project standards are met; and
- Provide workers in areas exposed to noise levels that frequently or consistently exceed the Project noise limits for outdoor and indoor areas periodic medical hearing checks.

CRUSHER AND CONVEYOR OPERATION

11.5.23. Crusher plants are operated at Quarry 15, Quarry 17 and Quarry 26 on the left bank.

11.5.24. Receptors having a **high** sensitivity to noise include the workers on site, Pasi Muhraho village adjacent to Construction Site 2, worker accommodation in Construction Site 1; worker accommodation in Rogun City, the Hospital and residential areas during nighttime (23:00 – 07:00).

11.5.25. There are no receptors located within 2500 m of the crusher plant at Quarry 15.

Impact Assessment

11.5.26. There are five crusher plants in operation at Quarry 17. The distance between two adjacent crushers on Quarry 17 is approximately 300 m and given the logarithmic addition of airborne noise levels from

multiple sources the overall noise level from the crushers operating independently or concurrently would not be substantially different.

11.5.27. A covered conveyor of approximately 4 km in length has been installed to transport aggregate from the crusher at Quarry 15 and crushers at Quarry 17 to the entrance of Tunnel 4.

11.5.28. Spot noise measurements of up to 20 minutes duration were taken at an operational crusher during the site visit in May 2023. The short-term measurement taken 30 m from the crusher was 89 dB LA_{eq},T and 85 dB LA_{eq},T at 50m from crusher. Both measurements exceed the project standard of 70 dB(A).

11.5.29. The sensitivity of outdoor areas where workers are present during working hours is **high**, the magnitude of the potential impact of noise from operation of the crusher plants is **large** and the significance of the effect is **major**.

11.5.30. The main conveyor systems on the site include:

- Quarry 15 crusher plant to the KT9 tunnel entrance – approximately 4000 m;
- Quarry 17 stockpiles to the KT9 tunnel entrance – approximately 500 m; and
- Quarry 22 crusher plant to the terrace above the main dam site, the 'flying conveyer' – approximately 1400 m.

11.5.31. Spot noise measurements were also taken at 2 m from the conveyor with a resulting noise level of 81 dB(A); and a noise level of 77 dB(A) at 10 m, both noise levels exceeded the Project standard.

11.5.32. The closest receptor to the crushers and conveyor in Quarry 17 is the worker accommodation in Construction Site 1 located at least 1500 m to the south-west. Given the distance between the locations, the magnitude of the potential impact is **very small**, the significance of the effect is **minor,** and no mitigation is proposed.

11.5.33. The village of Pasi Muhraho, worker accommodation at Construction Site 2 and worker accommodation in Rogun City, residential areas, the Hospital and WeBuild clinic are all a minimum of 2000 m to the south-west of the nearest Quarry 17 crushers and conveyor, and the magnitude of the potential impact is **very small,** and the significance of the effect is **minor** and no mitigation is proposed.

11.5.34. Quarry 26/26a is located to the south-south-east of the main dam site and there are two crusher plants in operation. The worker accommodation in Construction Site 1, Construction Site 2 and the village of Pasi Muhraho, are approximately 3500 m to north and north-north-east respectively. Given the exponential attenuation of noise with distance, noise from the Quarry 26/26a crusher is unlikely to impact on the worker accommodation at Construction Site 1 or Construction Site 2, the village of Pasi Muhraho or at sensitive locations in Rogun City. With the distance of these locations from Quarry 26/26a, the magnitude of the potential impact of noise from the crusher plant is **very small** and the significance of the effect is **minor,** and no mitigation is proposed.

Mitigation Measures

11.5.35. The installation of acoustic barriers around the crusher plant site is not feasible and the following mitigation measures have been identified:

- Ensure that the crusher plant is well maintained, use noise attenuation devices such as mufflers and acoustic panels within the equipment to minimise noise;

- Follow manufacturers operating instructions for the start-up and shutdown procedures, and efficiently feeding the primary, secondary and tertiary crushers;
- Ensure that workers do not stay in areas where noise levels exceed the Project noise limit for longer than necessary during an 8-hour shift;
- Follow manufacturers operating instructions for the start-up and shutdown procedures and efficient loading of the conveyor;
- Ensure that the conveyor is well maintained and install noise attenuation devices such as acoustic panels within the equipment to minimise noise; and
- Ensure that no worker is exposed to a noise level exceeding 70dB without having appropriate hearing protection.

Residual Impact Significance

11.5.36. With the implementation of the mitigation measures, the magnitude of the potential impact will reduce to **medium** and the significance of the effect to **moderate**.

11.5.37. Given that a moderate effect remains significant, further measures to be implemented include:

- Monitor noise levels at locations of high-sensitivity receptors to check ambient noise levels relative to the Project noise limits; and
- Provide workers in areas exposed to noise levels that exceed the Project noise limits for outdoor and indoor areas periodic medical hearing checks.

TUNNELS

11.5.38. There are 70 km of underground roads in tunnels, of which 6 km of underground roads will remain during the operational phase. The tunnels are used for vehicle access to the site and the daily traffic count at the entrance of T3 tunnel is approximately 35 vehicles per hour. There is also plant and equipment, including ventilation fans, operating in the tunnels.

11.5.39. Workers are in the tunnels to manage vehicle movements and rest areas and facilities for workers are in the tunnels. The sensitivity of workers in the tunnels during a 12-hour shift is **high**.

Impact Assessment

11.5.40. There is currently limited data available on flows of vehicles on-site. However, the daily traffic flow at the entrance of T3 tunnel is approximately 852 vehicles per day. 86 dB LA_{eq},T at approximately 10 m from main construction activities and this level exceeds the Project standard of 70 dB(A). The magnitude of the potential impact of the noise levels in the tunnel on workers during a 12-hour shift is **large** and the significance of the impact is **major**.

Mitigation Measures

11.5.41. The following mitigation measures have been identified to minimise traffic noise in the tunnels:

- Enforce the speed limit of 20 km/h in the tunnels for all vehicles;
- Ensure that vehicles are well maintained and install noise attenuation devices such as mufflers and silencers;
- Enclose noisy machinery with sound-absorbing material to reduce the nose when operating;
- Switch off machinery in the tunnels when not in operation; and
- Ensure that no worker in the tunnel is exposed to a noise level exceeding 70dB without having appropriate hearing protection.

Residual Effect Significance

11.5.42. With the implementation of the mitigation measures, the significance of the effect will be reduced to **moderate**. Given that a moderate effect remains significant, further measures to be implemented include:

- Monitor noise levels within the tunnels to check noise levels relative to the Project noise limits; and
- Provide workers in areas exposed to noise levels that exceed the Project noise limits for indoor areas periodic medical hearing checks.

CONSTRUCTION SITE 1 DEMOLITION

11.5.43. Building and structures on Construction Site 1 will be demolished and all scrap materials will be cleared from the site by 2027 prior to flooding of the lower terrace as the height of the reservoir increases. New worker accommodation facilities will be built on Construction Site 2, and all workers will be relocated to the new accommodation facilities prior to demolition works commencing.

Impact Assessment

11.5.44. Many of the structures are constructed with a steel frame and corrugated iron cladding and can be readily dismantled and removed without generating excessive noise. The abandoned structures may contain concrete slabs, but it is likely that these will remain in situ.

11.5.45. Detailed management plans will be prepared by contractors for the demolition activities and will comply with the JSC Rogun requirements described in **Volume 3, B4: Outline Demolition Management Plan** of this ESIA and the JSC Rogun requirements described in **Volume 3, B2: Outline Noise and Vibration Management Plan** of this ESIA.

11.5.46. The nearest sensitive receptor to Construction Site 1 is the worker accommodation in Rogun City that is on a terrace above the Construction Site 1, approximately 400 m from the closest structure on Construction Site 1 that will be demolished.

11.5.47. Another sensitive receptor is the Pasi Muhraho village adjacent to Construction Site 2. Although the layout of Construction Site 2 is not finalised, the placement of mechanical workshops, machine shops, waste separation yards, washdown and parking areas relative to the Pasi Muhraho village is critical to comply with Project noise limits.

11.5.48. The sensitivity of the area of worker accommodation in Rogun City and the Pasi Muhraho village is **high**, the magnitude of the potential impact is **small,** and the significance of the effect is **moderate**.

Mitigation Measures

11.5.49. The following mitigation measures have been identified:

- Dismantle steel frame structures and corrugated iron cladding to minimise noise levels;
- Establish noise barriers around concrete structures that require heavy earth-moving equipment for demolition;
- Ensure that earth moving equipment and vehicles are well maintained, use noise attenuation devices such as mufflers and acoustic panels to minimise engine noise and turn off equipment and vehicles not in use;
- As far as possible, plan the deconstruction and demolition work to sequentially move away from the Rogun City boundary; and

- Plan the routes used by construction vehicles to minimise the impact on the Pasi Muhraho village adjacent to Construction Site 2.

Residual Impact Significance

11.5.50. With the implementation of the mitigation measures, the magnitude of the potential impact **small** and the significance of the effect is **minor**.

11.6 OPERATIONAL PHASE

VEHICLE MOVEMENTS

11.6.1. The receptors that have a **high** sensitivity to noise from vehicle movements include outdoor areas where workers are present and residents Pasi Muhraho village and Rogun City, the Hospital and general residential areas.

11.6.2. Given that the 6km of underground roads that remain in the operational phase will not require workers to be stationed in the tunnel to manage traffic movements, there will be no impact on workers from the movement of vehicles through the tunnels and this is scoped out of the operational phase assessment.

11.6.3. Under normal conditions, Rogun HPP will operate uninterrupted over a 24-hour period, and a system of shift work will result in vehicle movement twice a day. The Project operational fleet is mostly light vehicles with HGV for maintenance work and specialised vehicles such as ambulances and fire engines. Workers will not be stationed alongside roads during their shifts and the impact of noise is scoped out of the assessment.

Impact Assessment

11.6.4. Given the workforce of approximately 600 personnel during the operational phase, the number of vehicle movements on site and between the site, Rogun City and surrounding villages will be substantially reduced when compared to the construction phase. Personnel will likely reside in Rogun City and the majority will commute to site using the shuttle bus service; the minority will commute by private vehicle. Specialised vehicles will be used to transport oversized and heavy loads to site in compliance with regulatory requirements.

11.6.5. The magnitude of the potential impact of vehicle noise on workers and residents of Pasi Muhraho and Rogun City is **very small,** and the significance of the effect is **minor**.

Mitigation Measures

11.6.6. Although the potential impact is minor, the following mitigation measures have been identified to further minimise the impact of vehicle noise:

- Enforce the site speed limit of 40 km/h, particularly in areas where workers congregate at shift changeover, around bus shelters, and at the entrance to the Rogun site;
- Enforce the speed limit along the route that passes between Rogun City and the village of Pasi Muhraho;
- Ensure vehicles are mechanically well maintained to reduce engine noise;
- Monitor noise levels at location of high-sensitivity receptors in Rogun City and Pasi Muhraho to check that noise levels comply with the Project noise limits; and
- Install acoustic fencing or similar noise barriers at sensitive receptors, such as residential, institutional and educational locations in the village of Pasi Muhraho, if necessary.

Residual Effect Significance

11.6.7. The implementation of the mitigation measures will reduce the significance of the effect to **negligible**.

OTHER NOISE SOURCES

Transformer Room

11.6.8. As described in **Volume 1, Chapter 3: Project Description** of this ESIA, an underground transformer room will accommodate the five transformers that will connect the turbines to the aboveground substation. With Rogun HPP currently operating at reduced capacity, transformers on site are operating below the maximum load capacity.

Impact Assessment

11.6.9. Personnel working in high voltage areas are required to adhere to occupational health and safety (OHS) regulations, including limits on exposure to noise levels. Compliance with OHS regulations will effectively reduce the potential impact of exposure to noise level through the mandatory use of hearing protection and limits on the duration of exposure. The magnitude of the impact is **very small,** and the significance of the effect is **minor,** and no further mitigation is proposed.

11.6.10. Noise from the transformer room will effectively be contained in the underground location and potential impacts from offsite noise have been scooped out of the assessment.

Turbine Hall

11.6.11. As described in **Chapter 3: Project Description** of this ESIA, Rogun HPP will operate six turbines in an underground turbine hall (also referred to as the powerhouse). Currently there are two turbines in operation at a reduced capacity; and these will be upgraded to match the boilerplate capacity of the four new turbines to be installed.

Impact Assessment

11.6.12. As for the transformer room, compliance with OHS regulations will effectively reduce the potential impact of exposure to noise level through the mandatory use of hearing protection and limits on the duration of exposure and no mitigation is proposed for workers.

11.6.13. Regular noise monitoring is currently undertaken in the turbine hall. Measurements indicate that noise levels are 75-80 dB, and this exceeds the Project standard. The source of noise has been identified as the construction work undertaken in the nearby tunnels. However, the specific turbine model for the Rogun HPP is unknown, but Franci's turbines typically operate within a sound level range of 81.95-104 dB, and, at the lower level, the noise level may exceed the Project standard. The magnitude of the potential impact is **large**, and the significance of the effect is **major**.

Mitigation Measures

11.6.14. The following mitigation measures have been identified to minimise noise levels within the turbine hall:

- Implement the mitigation measures identified for noise from construction activities undertaken in tunnels as described in **Section 11.5.41**;
- Ensure that the turbines commissioning process includes a noise analysis under different intake flows to optimise the noise levels; and

- Ensure that no worker in the turbine hall is exposed to a noise level exceeding 70dB without having appropriate hearing protection.

Residual Effect Significance

11.6.15. With the implementation of the mitigation as described for construction activities in tunnels, the significance of the effect is reduced to **moderate**. As a moderate effect is considered significant, further mitigation is required, including:

- Noise monitoring as described in **Section 11-7** is required until the construction activities are completed; and
- The requirement for a noise monitoring program described in **Section 11-7** includes the operational phase.

11.6.16. Noise from the turbines will effectively be contained in the underground location and potential impacts from noise on offsite locations have been scoped out of the assessment.

Spillway

11.6.17. The Rogun HPP is designed to discharge water through the turbines with surplus water stored in the reservoir until it reaches the full supply level, when the excess water is then discharged.

11.6.18. The Climate Risk and Vulnerability Assessment (CRVA) done in **Volume 1, Chapter 10: Climate Resilience** of this indicates that, over the next century, summer precipitation is expected to decrease but winter precipitation will increase significantly, and the total annual precipitation is expected to increase as a result. Temperatures are expected to generally increase and as a result, more precipitation is expected to occur as rain and less as snow. Glaciers in the upper catchment of the Project are expected to continue melting with increased melt water flooding in the next few decades. This has the potential to increase annual and inter-annual variability, leading to greater average flow volumes and greater variability.

11.6.19. The Dam Safety Panel of Experts (DSPOE) has considered spillway alternatives in the context of maximum probable flood (MPF) event management and proposed that two mid-level tunnels and one mid-level outlet, complemented by one surface spillway will provide acceptable protection at Rogun HPP against the MPF at the reservoir full level of 1290 masl.

Impact Assessment

11.6.20. Depending on the annual filling rate, the Rogun reservoir is expected to take between 9 and 22 years to fill. During the filling phase, in the event of a flood, water will pass through right-bank mid-level diversion tunnels and outlet. Once the reservoir has reached full capacity, the spillway will convey water from extreme events that cannot be released via the mid-level tunnels, outlet. In combination, the tunnels, outlets and spillway will be capable of discharging 7100 m^3/s at a water level of 1290 masl.

11.6.21. During the operational phase, the spillway will only operate during extreme conditions and workers will not be in proximity to the spillway during a flood event. As such, the potential impact of noise from spillway water flow on sensitive receptors has been scoped out of the assessment.

11.7 MONITORING AND ADAPTIVE MANAGEMENT

11.7.1. Site-wide E&S standards and guidelines will be established by JSC Rogun in **Volume 3, B2: Outline Noise and Vibration Management Plan** of this ESIA. The document will specify the

Project noise limits for sensitive receptors, identify the overarching requirements for noise abatement techniques, alignment with other Project management plans, the responsibilities and coordination required for implementation, monitoring and reporting to JSC Rogun.

11.7.2. For the construction phase, the EPC Contractor and sub-contractors will each prepare detailed noise management plan that comply with the site-wide E&S standards and guidelines established by JSC Rogun. The detailed plans will be reviewed and approved by the Engineer's Representative and/or PMG. For the operational phase, the detailed management plan will be prepared and implemented by JSC Rogun as the operator of Rogun HPP.

11.7.3. In the absence of representative noise measurements to quantify the noise level at notable noise source locations, mitigation measures identified in this ESIA may not be sufficient and residual effects may remain significant. This has been addressed by including a requirement for further measures to be implemented, specifically for noise monitoring to be undertaken to check noise levels relative to the Project standards.

11.7.4. The noise monitoring to be undertaken requires a comprehensive and systematic program to be developed and implemented for the construction and operational phases. The monitoring program should be developed by acoustic specialists with expertise and experience of preparing monitoring plans for large construction sites having multiple types of noise-generating activities.

11.7.5. Specific requirements for noise monitoring include:

- Sampling should be carried out using a Type 1 sound level meter (SLM) that meets all appropriate IEC standards and is subject to annual calibration by an accredited laboratory;
- The following acoustic indices should be recoded and reported: LAeq (T), LAIeq (T), statistical noise level LA90, LAFmin and LAFmax, octave band or 3rd octave band frequency spectra; and
- The SLM should be located approximately 1.5 m above the ground and no closer than 3 m to any reflecting surface.

11.7.6. An assessment of vibration must be done that is aligned with GIIP such as Directive 2002/44/EC that requires:

- Daily exposure limit values standardized to an eight-hour reference period shall be 1.15 m/s^2; and
- Daily exposure action value standardised to an eight-hour reference period shall be 0.5 m/s^2.

11.7.7. The JSC Rogun requirements for a noise and vibration monitoring program are described in **Volume 3, B2: Outline Noise and Vibration Management Plan** of this ESIA.

11.8 SUMMARY

11.8.1. A summary of the construction and operational noise impacts from the Project, before and after mitigation, is presented in **Table 11-10** and **Table 11-11** respectively.

Table 11-10 - Summary of Noise Impact Assessment (Construction)

Impact	Blasting (Main dam site and Quarry 26/26a)		Earth Moving Equipment and Vehicle Operation		Crusher and Conveyor Operation	
Receptor	**Workers (indoors and outdoors)**	**Pasi Muhraho village, Construction Site 1 worker accommodation; Rogun City worker accommodation, Hospital, residential areas and WeBuild clinic**	**Workers (indoors and outdoors)**	**Pasi Muhraho village, Construction Site 1 worker accommodation; Rogun City worker accommodation, Hospital, residential areas and WeBuild clinic**	**Workers (indoors and outdoors)**	**Pasi Muhraho village, Construction Site 1 worker accommodation; Rogun City worker accommodation, Hospital, residential areas and WeBuild clinic**
Receptor Sensitivity	High	High	High	High	High	High
Frequency	Periodic	Periodic	Periodic	Periodic	Periodic	Periodic
Likelihood	Certain	Certain	Certain	Certain	Certain	Certain
Extent	Local	Local	Local	Local	Local	Local
Duration	Medium-term	Medium-term	Medium-term	Medium-term	Medium-term	Medium-term
Magnitude	Very Small	Very Small	Large	Large	Large	Very Small
Effect	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse
Direct / Indirect	Direct	Direct	Direct	Direct	Direct	Direct
Significance of Effect	**Minor**	**Minor**	**Major**	**Major**	**Major**	**Minor**
Mitigation (Y/N)	Yes	Yes	Yes	Yes	Yes	No
Residual Significance	**Minor**	**Minor**	**Moderate**	**Moderate**	**Moderate**	**Minor**

Impact	Tunnels	Plant, Equipment and Vehicle Noise		Construction Site 1 Demolition
	Workers	Workers	Pasi Muhraho village, Construction Site 1 worker accommodation; Rogun City worker accommodation, Hospital, residential areas and WeBuild clinic	Pasi Muhraho village, Construction Site 1 worker accommodation; Rogun City worker accommodation, Hospital, residential areas and WeBuild clinic
Receptor Sensitivity	High	High	High	High
Frequency	Constant	Periodic	Periodic	Periodic
Likelihood	Certain	Certain	Certain	Certain
Extent	Local	Local	Local	Local
Duration	Medium-term	Medium-term	Medium-term	Short-term
Magnitude	Large	Large	Medium	Small
Effect	Adverse	Adverse	Adverse	Adverse
Direct / Indirect	Direct	Direct	Direct	Direct
Significance of Effect	**Major**	**Major**	**Moderate**	**Moderate**
Mitigation (Y/N)	Yes	Yes	Yes	Yes
Residual Significance	**Moderate**	**Moderate**	**Minor**	**Minor**

Table 11-11 - Summary of Noise Impact Assessment (Operation)

Impact	Vehicle Movements Residents of Pasi Muhraho and Rogun City	Other Noise Sources (Transformer Room) Workers	Other Noise Sources (Turbine Hall) Workers
Receptor Sensitivity	High	High	High
Frequency	Constant	Constant	Constant
Likelihood	Certain	Certain	Certain
Extent	Local	Local	Local
Duration	Long-term	Long-term	Long-term
Magnitude	Very Small	Very Small	Large
Effect	Adverse	Adverse	Adverse
Direct / Indirect	Direct	Direct	Direct
Significance of Effect	**Minor**	**Minor**	**Major**
Mitigation (Y/N)	Yes	No	Yes
Residual Significance	**Negligible**	**Minor**	**Moderate**

Address

JSC “Rogun HPP”

State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT - UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Volume 1, Chapter 12: Soils and Geology



NOVEMBER 2024

PUBLIC

JSC “Rogun HPP”

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ROGUN HYDROPOWER PROJECT - UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

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PUBLIC

PROJECT NUMBER

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DATE: NOVEMBER 2024

QUALITY CONTROL

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12 SOILS AND GEOLOGY

12.1.1. This chapter presents the impact assessment for Soils and Geology for the Project. Soils and geology impacts are described in Section 12.4 using the assessment methodology described in **Volume 1, Chapter 5: ESIA Methodology** of this ESIA. A summary of the results of the impact assessment is also presented in Section 12.5.

12.1.2. Significant adverse effects of moderate or higher have been reassessed following mitigation. Mitigation already set out in **Volume 1, Chapter 3: Project Description** of this ESIA, has been incorporated into the initial assessment.

12.2 LEGISLATIVE FRAMEWORK, POLICY AND GUIDANCE

12.2.1. The Land Code of the Republic of Tajikistan (327 of 1996), as amended on 19-07-2022, sets out the provisions for safeguarding and the effective use of land, land use rights and allocation of land, and provides measures to reduce deterioration of land to support ecological function.

12.2.2. Article 51 of the Land Code sets out the aims and objectives for managing land and preventing degradation from economic activities and developments including requirements to:

- ensure the improvement and restoration of land that is being degraded or disturbed;
- create a mechanism for accounting and verification of the ecological condition of lands, as well as provide land users with ecological standards approved by orders established by the Government of the Republic of Tajikistan.

12.2.3. Article 52 of the Code sets out the requirements on land users to:

- Ensure an appropriate site layout to avoid or reduce potential land degradation
- Restore and improve soil fertility, as well as other properties of the land;
- Protect land from water and wind erosion, mudflows, waterlogging, swamping, compaction, salinisation, pollution by industrial wastes, chemical and radioactive substances and other degradation;
- Maintain agricultural lands to reduce overgrowth (e.g. with weeds, trees and bushes), and other types of degradation to the cultural value or soils structure;
- Appropriate stripping, storage and preservation of topsoil during construction;
- Restoration and/or rehabilitation of soil fertility and properties of the land.

12.2.4. Article 52 also requires all works to ensure timely restoration of soils or where this is not possible, conservation of lands shall be considered in any orders established by the Government of the Republic of Tajikistan

12.2.5. Article 53 of the Code sets out the overarching requirements on developers regarding use of the land. The article requires all developments to be undertaken in a sustainable manner, and where degradation of the land occurs as a result of construction, commissioning or operation of any structures, techniques or technologies, requires appropriate measures to be implemented in compliance with environmental protection, sanitary protection measures or any special requirements as detailed in orders by the Government of the Republic of Tajikistan.

12.2.6. Articles 54 and 101 of the code establish the polluter pays principle with levies and fines for developers polluting or otherwise degrading land quality during construction or operation of facilities.

INTERNATIONAL LENDER REQUIREMENTS

12.2.7. Lenders' environmental and social standards (ESS) detail specific requirements relating to the protection of and prevention of degradation to soils and geology.

12.2.8. World Bank ESS3 sets out the guidance for managing raw materials appropriately and sustainably. Paragraph 5 sets out the need to identify technically and financially feasible options for using raw materials efficiently, as well as requiring the incorporation of cleaner production measures where appropriate.

12.2.9. Paragraph 10 of ESS3 sets out the additional requirements to meet GIIP as described in the World Bank Environmental, Health and Safety (EHS) Guidelines to reduce use where the project is expected to be a significant user of raw materials.

12.2.10. Paragraphs 11 to 14 of ESS3 set out the requirements for minimising the potential for pollution to the environment including pollution to land. It requires the developer to identify historic pollution and as well as the party responsible for the pollution, and to ensure remediation to GIIP or National requirements whichever is most stringent. It also requires the developer to use GIIP to minimize emissions in line with the mitigation hierarchy.

12.2.11. Paragraphs 19 to 20 of ESS3 identify the key requirements for the management of chemicals and other hazardous materials to minimize the potential for pollution to soils. In addition, Section D (paragraphs 21 to 25) set out in detail the requirements where pesticides or herbicides are planned to be used.

12.2.12. In general, all lender Environmental and Social Standards/Guidelines including ADB, AIIB, and EIB are broadly consistent with the World Bank ESS. Key differences between lender standards and the World Bank Environmental and Social Framework (ESF) are:

- Many of the standards advocate, and the EIB Environmental and Social Standards (2022) require, the application of the Circular Economy in terms of material use and prevention of pollution.
- The AIIB ESF Framework (2024) explicitly requires an Asbestos Management Plan to be developed for Projects for the removal and disposal of asbestos materials.
- The EIB requires the implementation of BAT and the EU IPPC BREF (BAT Reference) notes, as appropriate, for assessing technically and financially feasible alternatives to minimize pollution.

12.2.13. Typical Good International Industry Practise (GIIP) is set out in the World Bank EHS General and associated Sector Specific Guidelines. Key measures relating to Soils and Geology are:

- Section 1.5 of the General EHS guidelines provides detailed GIIP for managing Hazardous Materials for the prevention of pollution to soils, including appropriate handling and storage of solid and liquid materials (e.g. chemicals, fuels, oils), and the incorporation of secondary containment (e.g. use of bunded double skinned tanks etc.).
- Section 1.8 of the General EHS guidelines provide a detailed description for the identification, management, treatment and remediation of Contaminated land, including the requirement for a contaminated land risk assessment, and GIIP remediation requirements.

12.2.14. Sector specific guidelines of key relevance to Soils and Geology with specific requirements are:

- For quarries and other areas of waste rock (e.g. Quarry 26A) the Environmental, Health and Safety Guidelines for Mining (2007) are relevant which includes specific requirements for

managing the potential for pollution from Acid Rock Drainage (ARD) and Acid Mine Drainage (AMD) as well as for managing waste rock dumps and potential drainage and pollution due to leaching.

- For all borrow pit areas (e.g.) the Environmental, Health, and Safety Guidelines for Construction Materials Extraction (2007) provide GIIP for managing leachate and waste materials areas for extracting gravels, clay and other construction materials.
- For all fuel storage areas, the Environmental, Health, and Safety Guidelines for Retail Petroleum Networks (2007) provide GIIP for underground and above ground storage tanks for Fuels and oils to prevent pollution to soils.

12.3 ASSESSMENT METHODOLOGY

12.3.1. The assessment methodology for describing the magnitude of impact, sensitivity of receptors, and significance of effects, is described in **Table 12-1** to **Table 12-3.**

12.3.2. The assessment of the Project has been undertaken primarily through a desk-based study using available information relating to geology and soils.

12.3.3. The baseline data has been informed by the following resources:

- Aerial imagery – OS Maps and Google Earth;
- Desk-based review of existing publicly available information;
- Existing Project information provided by PMG, Rogun JSC and Primary Contractors; and
- Site visit observations and stakeholder engagement.

DETERMINING SIGNIFICANT EFFECTS

12.3.4. The significance of each effect is assessed based on the magnitude of change due to the Project, and the sensitivity of the affected receptor to the change.

12.3.5. The determination of magnitude is based on available data and professional judgement. The most important considerations are duration, extent, reversibility, and likelihood. The definitions of these key criteria for Soils and Geology, and how they are considered to define magnitude, are presented in **Table 12-1**.

Table 12-1 – Magnitude criteria

Magnitude	Criteria
Large	▪ Change is likely to cause a direct adverse permanent or long-term (> 10 years) effect on a local to regional scale ▪ Change at a regional to National scale, periodic (multiple occurrence) to constant impact, likely to adversely affect the quality/value of the soil, but recovery is predicted in the medium term (i.e. 3 -10 years). ▪ Permanent changes to geological features of regional /national importance ▪ Nationally significant or transboundary contaminant release, soil degradation or subsidence event
Medium	▪ Change at a local to regional scale, periodic (multiple occurrence) to constant impact, likely to adversely affect the quality/value of the soil, but recovery is predicted in the medium term (i.e. 3 -10 years). ▪ Local direct adverse, permanent or long-term / permanent effects. ▪ Permanent impacts to geology at a local to regional scale ▪ Local to regional contaminant release to soil with the potential for migration to receptors

Magnitude	Criteria
	▪ Local to regional soil degradation or subsidence
Small	▪ Change likely to adversely affect the quality/value of the soil but reversible in the short term (< 3 years), at a local scale. ▪ Local, small spillage causing localised impact, or localised soil degradation or subsidence ▪ Reversible, localised impacts to geology e.g. borrow pits
Very Small	▪ Receptor change is essentially indistinguishable from natural background variation or baseline conditions that existed before the commencement of the Project. Could occur over any duration or geographic extent.
Beneficial	▪ Impacts leading to positive effects on soil of any duration or scale

12.3.6. The sensitivity of the affected receptor is assessed on a scale of high, medium and low as defined in **Table 12-2.**

Table 12-2 – Sensitivity criteria

Sensitivity	Criteria
High	▪ Highly fertile soils suitable for arable agriculture ▪ Soils that are structurally prone to compaction or erosion, highly leachable and/or prone to contamination ▪ Soils which host shallow aquifers relied upon for potable abstraction, or essential for river baseflow ▪ Soils of specific characteristics (e.g. pH, carbon content, mineralogy) that supports or could support specific critical habitats ▪ Regionally or nationally significant geology (e.g. important economic, structural, or cultural geological form)
Medium	▪ Soils used for limited agricultural production, grazing or subsistence agriculture ▪ Soils that are less structurally prone to compaction or erosion, moderately leachable ▪ Soils of specific characteristics (e.g. pH, carbon content, mineralogy) that support or could support natural habitats ▪ Soils which host shallow aquifers relied upon for non-potable abstraction, or essential for river baseflow
Low	▪ Soils of low fertility which are not used and unsuitable for agriculture ▪ Soils that are robust to physical disturbance and/or impermeable to contamination ▪ Contaminated made-ground soils at brownfield sites ▪ Soils not able to support sensitive or important habitats

12.3.7. Impacts on soil and geology can be divided into two types – contamination, and loss/degradation. The sensitivity of the soils and geology in different areas of the Project with regard to these impacts is presented in **Table 12-3.**

Table 12-3 - Assessment of receptor sensitivity

Receptor	Sensitivity	Justification
Agricultural soils in the Inundation Zone and other areas outside of the main construction site	High	Red Ferralsols - Class 2, subclass s-a in the inundation zone. Fertile soils capable of supporting agriculture in the form of crops and identified in top two classes of arable soils
	Medium	Brown Cambisols – Class 3, subclass e. Fertile soils capable of supporting agriculture but limited in terms of types of crops etc which can be supported or grown.
	Low	Shallow Leptosols, Class 7, subclass s-d and sandy Arenosols, Class 8, subclass e. Neither capable of supporting arable crops, and the latter unsuitable for any type of crops or other types of farming activity.
Other soils	Medium	Soils in the construction area downstream of the dam which have not been disturbed. Not of high agricultural value, typically class 3, but capable of supporting some limited crops.
	Low	Remaining soils located in the Construction area. Most have been either stripped as part of the construction in the early 1970s and not reserved, or subject to historic contamination.
Geological Fault Zones in the inundation zone	High	The convergence of several fault lines in the area combined with the subsurface materials renders the area susceptible to surface landslides/soil movement which can affect soil distribution and depth.
All other geology	Low	Small shallow aquifers not used for potable or non-potable sources of water and do not support Critical or Priority habitats.

12.4 POTENTIAL IMPACTS AND EFFECTS

CONSTRUCTION PHASE

12.4.1. The impacts to soils and geology as a result of the Project, and the mitigation measures to be implemented, are described below under the following headings:

- Soil Loss and Degradation: Impacts to soils from clearance, storage, and other disturbance
- Soil Loss: Impacts to soils from inundation
- Soil Loss: Impacts from vehicle movements
- Soil and aquifer loss: Impacts from excavations and quarrying, and abstractions
- Contamination: Impacts to soils from demolition works
- Contamination: Impacts to soils and geology from historic pollution
- Contamination: Impacts to soils and geology from leaks and spills

12.4.2. Where applicable the impacts under each of the above headings are described for both the Main Rogun HPP Construction Site and Other Areas (e.g. inundation zone, left bank roads and bridges, new resettlement areas, etc).

Soil Loss and Degradation: Impacts to soils from clearance, storage, and other disturbance

12.4.3. Construction activities have the potential to remove completely or affect the structural integrity of soils through stripping of top and subsurface soils, storage of materials in stockpiles, erosion of soil from stockpiles and other construction disturbance areas (e.g. roads, road embankments and bridges exposed to wind and water erosion), as well as through compaction of subsoils.

12.4.4. The main sources of impact to soil structure and integrity during construction will be:

- Removal of topsoils in new areas for construction of ancillary works using mechanical diggers.
- Compaction Rollers.
- Temporary access roads and vehicles including trucks etc.
- Material laydown areas, and construction areas
- Temporary stockpiles of soils
- Temporary accommodation areas (e.g. for roads and other works)
- Improperly managed wastewater.

Impact Assessment

Main Rogun HPP Construction Site.

12.4.5. Within the historic construction area of the Rogun HPP much of the topsoil and subsoil was stripped during the early part of construction in the 1980s and have either been removed or reused in the project area during that period. As such remaining topsoil is very limited and is mainly comprised of low value non-agricultural soils. Compaction of underlying subsoils is extensive and has been undertaken over many decades, and therefore remaining integrity is likely to be limited.

12.4.6. The sensitivity of soils in this area is considered to be **Low**, with further expansion of construction in this area limited due to progressive inundation. Any magnitude of impact is likely to be **Small** in the main construction area.

12.4.7. Downstream of the dam (Construction Area 5) proposals for new accommodation areas and construction camps are being developed, with some accommodation being constructed (Nov 2024). These areas contain some soils of value for landscaping and for re-use. Soils are typically in this area of low agricultural potential but retain natural seedbanks for other uses, with some soils capable of supporting limited crops. Given the potential for some soils of higher value in this area, taking a precautionary approach the sensitivity of soils in Construction area 5 is considered to be **Medium**.

12.4.8. Construction is ongoing downstream of the dam; however, adequate stripping and storage of topsoils and subsoils was not observed on-site at the time of the visit. Stripping each layer in order and storing soils in separate stockpiles according to type is crucial to ensure structural integrity and intrinsic value on reuse can be retained.

12.4.9. Given the speed at which the development of Construction Area 5 is taking place a precautionary approach to the assessment has been taken. Canteen facilities and accommodation for Lot 3 is already well advanced, and further construction for other lots is in development. The construction area will be in place for between 5 and 10 years with some potential for areas to remain beyond construction (e.g. maintenance facilities and storage areas).

12.4.10. Any stockpiles are likely to be required for at least 1 year before re-use can be completed. Where stockpiles are not managed effectively integrity could be compromised in the medium term (3-5 years) lengthening recovery on re-use.

12.4.11. Once soils have been stripped compaction of subsoils is likely to occur with some hardstanding being laid down (tarmac and concrete) and remaining areas hardened and compacted through truck movements. The downstream construction area itself, however, is local in scale, and therefore a **Medium** magnitude has been applied.

12.4.12. The significance of the effects is likely to be **Moderate** for downstream of the Dam in areas of Construction Area 5 subject to new development and **Negligible** for other areas of the main construction site.

Other Areas – (Left bank roads and bridges, new resettlement areas etc.)

12.4.13. Outside of the main construction area, within the inundation zone, soils are more heterogenous and comprise some areas of high fertility soils. The exact distribution of these soils and depths is not clearly mapped, given the steepness of the slopes, seismic activity, and high potential for small scale landslides, although soils maps of the areas and site observations confirm the presence of some High and Medium value agricultural soils.

12.4.14. Works are ongoing outside of the main construction site to support delivery of the Project, including replacing roads and bridges on the left bank. Resettlement is also ongoing with sites for newly resettled people being identified on an ongoing basis. Many of the designs and specific locations are in development or unknown at present. Soils in these areas are already disturbed/lost so have **Low** sensitivity, though pockets of soils remain that have **Medium** sensitivity.

12.4.15. The earthmoving activities to create temporary laydown areas for construction materials and construction site infrastructure (e.g. temporary offices, worker accommodation, etc) have the potential to damage soil structure through compaction. Soil compaction typically increases density and soil strength and reduces soil porosity and soil hydraulic properties, affecting yields. In sloping landscapes, compaction may also lead to increased runoff and erosion.

12.4.16. Compaction effects on surface topsoils (up to 45cm) and sub-soils can result in erosion and below average crop yields over a longer period of time (up to 10 years), although mechanical loosening of subsoils can be undertaken to promote structural recovery and improved vegetation cover to reduce erosion.

12.4.17. Taking a precautionary approach and using the worst-case scenario of construction of the left Bank Roads occurring at a regional scale, the Magnitude of the effect is considered to be **Medium**. The significance of the effect is therefore **Moderate** for productive agricultural soils outside of the main construction area and **Minor** for Low sensitivity soils in other areas including areas already disturbed by construction activities.

Mitigation and Enhancement Measures

12.4.18. Before any Contractor mobilizes into areas not previously used for construction, they will be required to develop Construction Method Statements that shall be reviewed and approved by the PMC and the HSE Manager prior to any commencement of work. These will include (but are not limited to):

- Sequence of Operation,
- Requirements for Site Mobilisation including equipment,

- Full description of Construction activities including design and good construction management practises proposed for the work,
- Identification of relevant ESMPs applicable to the site, and how procedures and designs will accommodate ESMP requirements,
  Layouts including laydown areas, stockpile location and design, office areas, storage and waste areas etc.,
- Location of known sensitive receptors,
- Detailed construction methods for the permanent facilities including methods for topsoil stripping and stabilisation methods for stockpiles in situ for over 4 months,
- Definition and method statement for drainage requirements around all permanent structures including roads, road embankments and bridges to reduce rainfall runoff erosion and any potential stream erosion,
- Waste Management requirements and details on waste disposal, supply chain and disposal locations for different waste streams (as outlined in Volume 3, B3: Outline Non-hazardous and Hazardous Waste Management Plan)
- Management of contaminated materials, either on-site or offsite, as directed by the PMC
- Wastewater management and disposal requirements
- Soil surveys for new construction areas, including stockpile locations and stockpile protection measures
- Conceptual plans for site rehabilitation including regrading, replanting and any restoration works (Volume 3, B7: Outline Site Rehabilitation Plan).

12.4.19. At any new greenfield land occupied by the Project, either at new construction areas or outside of the main construction site (i.e. for all roads, bridges, new transmission lines, etc.), a pre-construction survey (detailed in Volume 3, A11: Ancillary Works Plan) shall be completed by suitably qualified staff to identify soil types and areas of potential high sensitivity soil types. The pre-construction survey must be completed prior to submission of construction method statements, and any mitigation measures identified and incorporated into the ESMP for the works prior to commencement of any construction or clearance works.

12.4.20. In advance of construction works the area to be prepared will be marked using wooden pegs and coloured tapes/ribbons. Areas for storage of topsoil storage and other special areas will be designated and marked out using tape/ribbons of different colours. The exact colour coding will be defined in the Construction Method statement to be developed prior to any clearance or construction work commencing.

12.4.21. Existing areas of contamination identified during preconstruction surveys, recorded in Rogun JSC's inventory of contaminated areas, or identified by Contractors shall be removed and disposed of as hazardous waste prior to general topsoil stripping and compaction. Excavated material will be sampled and analysed in a laboratory for potential contaminants. Where materials are identified as unsuitable for reuse these will be stored in designated waste areas for disposal. Suitable, uncontaminated material will be stored in designated areas, segregated from topsoil stockpiles, and used for backfilling and ground restoration.

12.4.22. To prevent loss of the soil resource, typical construction methods for these types of works require stripping of topsoils which are stored in stockpiles over the short term, typically up to 4 months. The larger area of construction disturbance on the left bank will likely require stripping over a more

extensive area. On completion of the construction activities, soils are typically reused to restore damaged areas.

12.4.23. Topsoils and subsoils shall be stripped in separate layers and stored in separate stockpiles to prevent mixing.

12.4.24. Once topsoil has been stripped, a vibratory roller will be used to compact the soils in defined areas as required. These areas will be defined in the site layouts and method statements. Other areas will be left free from compaction.

12.4.25. Topsoil stockpiles will be designed to be stable, with slopes of not more than 2m high with 45-degree slopes. Stockpiles shall not be located within 10m of a waterbody, as far as practicable. Topsoil stockpiles must be designed and located so as not to impede general runoff and flow within drainage lines.

12.4.26. Stockpiles being stored for longer durations (over 4 months) shall require a stockpile management plan to be developed, which shall detail the long-term stabilisation and management requirements, as well as detailed monitoring and remediation measures.

12.4.27. Stockpiles being stored for longer durations (over 4 months) will be stabilised as appropriate (using technical or vegetative means) to prevent erosion and degradation of the resource.

12.4.28. Topsoil stockpiles will be monitored to ensure that they remain viable and are not subject to excessive erosion pressures. If practicable during the storage period, the exposed surfaces will be temporarily vegetated

12.4.29. Training to be provided to workers and supervisors on the importance of soil rehabilitation and correct procedures to safeguard soil stockpiles

12.4.30. Land rehabilitation shall commence when directed by the PMC and as soon as practicable after the completion of construction in an area, including regrading as necessary, spreading of stored topsoil as appropriate, protection from erosion, seeding or planting of vegetation, protection from grazing (with fencing if necessary) until vegetation is self-sustaining. A Rehabilitation / Reinstatement Plan shall be developed to guide all rehabilitation activities.

12.4.31. The effects of compaction on replaced soils can be ameliorated through soil loosening and allowing natural freeze thaw cycles to take place, especially in soils with high agricultural potential, with yields returning to normal in the short to medium term (1 to 3 years depending on the soil types).

12.4.32. A final inspection shall be undertaken of rehabilitated areas to verify that requirements of the rehabilitation program have been met.

Residual Effects

Implementation of these measures will reduce the potential effects to Minor significance.

Soil Loss: Impacts to soils from inundation

Impact Assessment

12.4.33. Within the inundation zone soils are heterogenous, comprising a range of soil types with varying potential to support agricultural crops. Inundation to form the reservoir will result in effective soil loss across approximately 170km^2. Although not all soils will technically be lost, they will be removed from potential for arable production indefinitely.

12.4.34. Flooding of the inundation zone will also impact soils and subsoils, where wave action and runoff will result in erosion of soils in the drawdown zone (area between the summer high-water level and winter low-water level).

12.4.35. Whilst volumes of high and medium sensitivity soils capable of supporting crops are not considered to be large in terms of total soil in the inundation zone, they have been used by local communities for subsistence food production. Many of those relying on the soils that are to be inundated are project affected people (PAP) from communities being resettled. Further detail regarding this impact is presented in **Volume 1, Chapter 17: Socio-Economics** of this ESIA.

12.4.36. Specific mapping of soils at a local and habitat level has not been undertaken due to the heterogeneity and steepness of the terrain, and with the area being subject to minor landslides. As such a precautionary approach has been taken to assessing the potential impact of soil loss from inundation with a **Medium** magnitude applied as a result of across a regional scale.

12.4.37. The significance of the effect is therefore considered to be **Major** for High Sensitivity soils and **Moderate** for Medium sensitivity soils.[1] All other soils would be Minor.

Mitigation and Enhancement Measures

There is no mitigation for the loss of soils in the inundation zone. The stripping and translocation of High potential soils in the inundation zone for translocation to higher ground, or resettlement sites, would be both prohibitively costly and impractical.

Residual Effects

12.4.38. Since no mitigation of the impact is possible the residual effects remain unchanged. The significance of the loss of soil through inundation remains **Major** for High Sensitivity soils and **Moderate** for Medium sensitivity soils. All other soils would be **Minor**.

Soil Loss: Impacts from vehicle movements

12.4.39. Vehicles move daily to and from the site during construction for deliveries, mobile plant, and worker transport. This may cause significant erosion, especially in very dry periods and in locations where the soil is fragile. Sensitivity of soils is rated **Low** to **Medium** in light of the significant disturbance to soils in construction and other disturbed areas.

12.4.40. Outside of the main construction site vehicle movements between local villages and Rogun are frequent. Main roads are generally paved and currently in good condition, other smaller roads are generally degraded and in need of repairs, or are compacted with no hardstanding.

12.4.41. Further out from the main construction site, vehicles are less frequent and comprise local traffic mainly in cars. Construction work for the Left Bank Roads and Bridges, and resettlement introduces more frequent and larger vehicles sometimes along the more degraded roads.

12.4.42. Vehicle movements have the potential to introduce erosion to soils and rocks in close proximity to the roads, especially where these roads are not well marked, or new roads are required.

[1] Sensitivity criteria defined in **Table 12-2**

Impact Assessment

12.4.43. Vehicle movements are generally constrained to designated access tracks to reduce the impact on soils. However, outside of the main construction site and Rogun City, especially with work on the Left Bank and also for resettlement, there is potential for vehicles to move around the site or beyond approved access routes.

12.4.44. Access tracks and construction areas are damped down with water in the drier months to reduce the potential for soil loss through vehicle entrainment of dust.

12.4.45. Given the short duration of the works in any given area outside of the main construction site, and the well-established network of access routes on the Rogun HPP site, the magnitude of the impact is considered to be **Small**, with significance from **Negligible** to **Minor** in more sensitive soil areas.

Mitigation and Enhancement Measures

12.4.46. To reduce impacts further, especially to highly sensitive receptors, it is recommended that the following additional measures are incorporated:

- Develop a Construction Method Statement for the construction of roads, that shall be reviewed and approved by the PMC and the HSE Manager prior to any commencement of road building. This will include as aspects listed in section 12.4.18.

- A Traffic Management Plan (**Volume 3, A9**) shall be implemented to manage construction traffic. This shall include, but not be limited to:

  - Identification and demarcation of approved access routes.
  - Segregation of incoming and outgoing traffic to prevent risk of collisions or overuse.
  - Off-road driving will be prohibited except for in emergency situations.
  - Regrading of access routes where these are required for longer durations.
  - Where access routes are subject to wind erosion and monitoring of these routes shows damping with water is insufficient, consideration shall be given to alternative means such as chemical binding or other measures.

12.4.47. Further detail regarding requirements for the Traffic Management Plan are provided in **Volume 1, Chapter 22: Traffic and Transport** of this ESIA.

Residual effects

12.4.48. With the implementation of these measures the residual effects are considered to be **Negligible**.

Soil and aquifer loss: Impacts from excavations and quarrying, and abstractions

Main Rogun HPP Construction Site.

12.4.49. Excavations are required for the main construction site and potentially for construction materials in the form of borrow pits for the construction of roads, bridges, quarries and borrow pits.

12.4.50. The extraction of materials from these sites can permanently impact the geology, hydrogeology, topography and soil condition of the area. Deeper excavations can change hydrogeological aquifers and routing of water through the aquifers, as well as require dewatering. Compaction of soils in the surrounding area from vehicle movements where this is not managed appropriately can render subsoils unable to support natural drainage properties.

12.4.51. Siting of the borrow pits shall be informed by site geology and avoidance of sensitive receptors (e.g. communities, surface water courses, critical habitat). Impacts to surface waters would be primarily through any run-off or discharge from dewatering. These impacts are covered under in **Volume 1, Chapter 13: Water** of this ESIA.

12.4.52. Impacts to groundwater, and in particular underlying aquifers, increase where the depth of the borrow pit lies in close proximity to, level or below the top of the aquifer. As the exact depth of the borrow pits is not yet defined, a precautionary approach to the assessment assumes excavations to this level. Given the potential for shallow aquifers to be present which could be used either for irrigation or an informal source of potable water in some villages the direct impacts on aquifers from this type of construction activity needs to be carefully considered.

12.4.53. Where excavations breach the aquifer or are at a depth to allow free movement of water upwards and downwards into the aquifer, dewatering may be required, which will reduce aquifer capacity for the duration of the excavation and use.

Impact Assessment

12.4.54. In the main construction area at Rogun HPP all borrow and quarry areas are clearly defined and additional facilities are not expected to be required. The main quarries and borrow pits operating downstream of the dam are clearly demarcated and lie on the left bank of the Vakhsh river. Underlying geology suggests that aquifers of significant quality and quantity are more likely to be associated with the Right Bank. Those on the left bank are superficial and not able to be used for potable water supply. Given the **Low** sensitivity of the area, and that extensive excavation has already taken place over many years, the magnitude of impact is assessed as being **Small**. The significance of the effect for these areas of the main construction site is considered to be **Minor.**

12.4.55. New areas of excavation may be required to support the development of the other supporting infrastructure works, and in particular the Left Bank Roads and Bridges which are required to replace those being lost through inundation. Areas of excavation are expected to be contained entirely within the construction areas and are assumed to be relatively small areas in terms of the amount of surface area disturbed.

12.4.56. Where borrow pits are required, these are likely to be small in number spaced out along the route of the roads.

12.4.57. Abstractions in other areas are likely to be of short duration for production of concrete materials etc., and of limited volumes.

12.4.58. The soils in new areas of disturbance are given a **Medium** sensitivity. The magnitude of this impact is assessed as **Medium**, leading to a **Moderate** significant effect for areas where soils and geology are of the highest sensitivity.

Mitigation and Enhancement Measures

12.4.59. To reduce impacts further, especially to highly sensitive receptors, it is recommended that the following mitigation measures are incorporated:

- Remediation measures shall be implemented immediately following construction, with guidance being taken from the Outline Site Rehabilitation Plan (**Volume 3, B7**).
- Where borrow pits are required an Excavation Spoil and Fill Storage Management Plan (**Volume 3, B1**) will be developed and implemented which details the Project approach to site selection,

usage and rehabilitation. Though no international GIIP guideline for borrow pits is available, several recent projects[2] provide best practice guidance for the siting, operation and restoration of borrow pits. Mitigation measures may include (but are not limited to):

- **For Site definition**:
  - Minimum setback of 100m from environmentally sensitive areas and residences;
  - Excavation and construction areas must be delineated with tape or other clear markers or barriers;
  - Inclusion of adequate space for all activities;
  - Estimated quantity and type of resources to be extracted;
  - Defined Sequence of Operation;
  - Location and definition of stockpile locations;
  - Location and procedures for waste management;
  - Type, source and quantity of water required for operation;
  - Site operating procedures; and
  - Consultation requirements with the adjacent communities and stakeholders.
- **For Construction**:
  - All excavations are to be designed to reduce footprint and depth as far as practicable. Excavations shall not go below the depth of the water table where possible;
  - Retain as much vegetation as possible to maintain slope stability;
  - Topsoil to be stripped, retained and preserved for restoration;
  - Excavated material shall be stripped in layers and stored separately to avoid mixing;
  - Construct ditches to divert water runoff away from site;
  - Define the stockpile management practices;
  - Optimise of internal-traffic routing to maximise distances to the closest sensitive receptors; and
  - Design separate footpaths to segregate pedestrians and vehicles.
- **For Operation**:
  - Limit the sediment from runoff by using sand traps or sediment ponds;
  - Limit pit depth above the water table; and
  - Limit the formation of ponds and accumulation of standing water to avoid vector larvae.
- **For Closure**:
  - Use the overburden for area recovery and revegetation;
  - Use non-conforming material for backfilling;
  - Re-grade perimeter berms and stockpiles;
  - Reuse topsoils on top of the overburden for restoration purposes;
  - Restore natural drainage;

[2] High Speed Rail (West Midlands - Crewe) Environmental Statement Volume 5: Technical appendices Borrow pits restoration strategy (CT-009-000). 2017. https://assets.publishing.service.gov.uk/media/5a81eaf440f0b62302699dcc/E30_CT_009_000_WEB.pdf

- Remove all waste materials, temporary structures and equipment;
- Re-establish vegetation for next land use and to minimise erosion; and
- Restore the gradient of the land to prevent fall-from-height risk.

- In other areas outside of the Main Rogun HPP Construction site, where borrow pit excavations may breach the aquifer depth, or water for abstraction may be required from groundwater sources, community engagement during the Pre-construction Survey Process shall identify whether there is the potential for formal or informal use to be present. If boreholes are present, the location, depth, use and estimated volumes of water from private boreholes and hand dug wells shall be calculated, and a method for monitoring and establishing any project impacts on the availability of water for communities will be developed. Adaptive management measures will be adopted in the event of Project impacts.
- Where impacts are predicted, liaise and work with communities to identify potential mitigation for loss of water resources and the timeframes to achieve this. This must be integrated into the Stakeholder Engagement Plan (SEP), and implemented before the impacts occur. Where there are potential impacts, frequency of engagement shall be determined using a risk-based approach to enable the early identification of issues and solutions.

Residual effects

12.4.60. The implementation of these measures will reduce impact magnitude to Very Small. The residual significance of the effect will therefore be **Minor**.

Contamination: Impacts to soils from demolition works

12.4.61. The main impacts to soils from demolition works are related to contamination. On the main construction site buildings and historical infrastructure dating back to the 1980s are either abandoned or where still in use, degraded.

12.4.62. A preliminary assessment of contaminated lands was completed in 2023 to identify the main sources of contamination on the HPP construction site. These are primarily associated with:

- Tank Farms (both disused and those in current use);
- Workshops;
- Abandoned/disused sewage facilities (septic tanks); and
- Old buildings and facilities such as concrete batching facilities, especially those containing Asbestos.

12.4.63. In 2025, JSC Rogun will conduct a more detailed site survey and develop a remedial plan, to be implemented prior to inundation by EPC or other Contractors.

12.4.64. Outside of the main construction site at Rogun HPP, risk from demolition is associated with the removal of structures at existing villages which need to be resettled. Buildings in these villages have been constructed using locally available and/or repurposed materials which may contain asbestos. Contaminated land in these areas may also be present from older vehicles and other sources of pollution. The specific type and quantity will vary locally.

12.4.65. Removal and demolition of this infrastructure has the potential, especially in the case of asbestos, to pollute soils over a long duration, with a risk for some types of pollution (e.g. oils and chemicals) infiltrating local aquifers, or where inundation occurs locally polluting the reservoir.

Impact Assessment

Main Rogun HPP Construction Site.

12.4.66. The Rogun HPP main construction site contains a legacy of buildings and infrastructure constructed in the 1980s. Legislation in the soviet era allowed (and still allows) for the use of asbestos containing materials in buildings. These buildings have been used and/or repurposed over many years, with the potential to damage the integrity of any Asbestos Containing Materials (ACMs), including roofing, walls, pipes, and water tanks amongst others. Historic and disused tanks and concrete batching plants also have the potential to contain asbestos materials.

12.4.67. In addition, removal of infrastructure including fuel tanks, septic tanks, batching plants, and old workshops, has the potential to introduce pollutants such as VOCs, oils and grease, toxic and heavy metals, as well as general detritus and old sludges (fuels, sewage etc) into the surrounding soils and infiltrate into any local groundwater.

12.4.68. Whilst much of the area where these buildings and infrastructure are located is due to be flooded, any pollutants will remain in the soils and retain capability of polluting the water column, with the risk being higher immediately after flooding and diminishing in time through attenuation of the pollutants.

12.4.69. Although the sensitivity of the soils and geology in this area is **Low**, it is considered that the scale of the construction site as well as the potential for legacy impacts in any soils to last beyond the lifetime of the reservoir constitute a **Large** magnitude.

12.4.70. For the main construction area, the significance of the effect is therefore considered to be **Major** as a result of hazardous substances in buildings potentially being released during demolition works.

Other Areas (inundation zone)

12.4.71. In the inundation zone, the main concern from demolition relates to the villages being resettled. Currently, PAPs living in the inundation zone are allowed to salvage materials from their existing houses to support the construction of their new homes in new resettlement areas.

12.4.72. Once asbestos containing materials, coatings, pipework etc are removed, there is a risk of fibres contaminating soils locally. The re-use of these materials risks damaging them even further potentially giving rise to long term effects in the new locations they are taken to. Removal of other infrastructure where present (e.g. garage structures, domestic gas/oil storage structures etc) may also cause leaks and spills to occur into the local soils.

12.4.73. Demolition works in the inundation zone associated with resettlement is the responsibility of the DFZ through their contractors. These are typically local contractors with varying degrees of awareness of such issues, especially in relation to asbestos.

12.4.74. The resettlement programme, and therefore demolition works, is occurring over a regional scale and over many years, although the actual effects on soils may be very local and spread over large areas. The magnitude of the impact is therefore considered to be **Medium**.

12.4.75. Soils in these areas are heterogenous some of which are high quality agricultural soils, although it is noted that in the inundation zone these will be lost due to flooding. Similarly in new resettled areas are likely to be of **Medium** to **High** sensitivity as the resettlement programme tries to move affected people to areas where agricultural activity can be established. Moving older infrastructure and/or damaged asbestos materials to these locations may therefore cause pollution to the new soils.

12.4.76. Taking a precautionary approach the significance of the effect is considered to be **Major** for the high sensitivity soils reducing to **Moderate** for medium sensitivity soils.

Mitigation and Enhancement Measures

12.4.77. To reduce impacts further, especially to highly sensitive receptors, the following additional measures are to be incorporated. For the main Rogun HPP construction site, the remedial plan to be developed by the PMC (in support of PMG) is to be implemented by the contractors undertaking the works. The plan shall include (but is not limited to):

- Location of buildings to be demolished;
- Location of existing services (gas, electricity, water etc);
- Ground conditions and locations of hazardous materials;
- Drawings/plans of the buildings including site access and egress, traffic and pedestrian routes etc.;
- Roles, responsibilities and training required and identification of special job requirements (e.g. qualifications for asbestos surveys or other specialist jobs);
- Demolition method statements including the sequence of works and full details on methods being used to undertake the works including:
    - Mobilisation & site set-up.
    - Traffic management
    - Termination, disconnection and capping off of live services.
    - Vehicle movements.
    - Asbestos removal
    - Soft strip (removal of fixtures, furniture etc and salvageable materials using hand held tools).
    - Hard or hand demolition followed by vehicular plant attendance and operation.
    - Hot cutting operations (cutting, burning or welding operations).
    - General Housekeeping and maintenance.
    - Completion and de-mobilisation.
- Consideration of HSE requirements relevant to demolition activities, including dust and air quality monitoring requirements and PPE. These will be aligned with the overarching Occupational Health and Safety Plan for the Project;
- Training required;

12.4.78. For demolition in the inundation zone associated with resettlement, the DFZ (or its Contractors shall develop a remedial plan approved by the PMC or develop this plan jointly with the PMC.

12.4.79. Rogun JSC shall arrange for sitewide asbestos surveys across the whole of the main construction site, using appropriately qualified personnel / contractors to identify structures where asbestos is and/or is potentially present. If suitably qualified asbestos removal specialists cannot be found within Tajikistan, international contractors should be used. The method for asbestos analysis should conform to the ISO 22262-2:2014 standard, or equivalent;

12.4.80. Once the survey has been completed an Asbestos Register and Asbestos Management Plan shall be developed by the party undertaking the survey, as part of the Demolition Plan. The Asbestos Management Plan will form part of the overarching Hazardous Materials Management Plan (HMMP) (as outlined in **Volume 3, B5**). The asbestos register shall include (but is not limited to):

- All known and presumed ACMs in all buildings;

- The type of ACMs present;
- How much asbestos there is and its condition, including dates of the original where possible and last inspection dates;
- Risk assessment of the potential for each ACM to release fibres and likelihood of disturbance during the day-to-day running of the building. The risk assessment should cover as a minimum:
    - the information gathered on the location, amount and condition of the ACMs
    - whether there is easy access to the ACMs
    - whether people work near an ACM in a way that is liable to disturb it
    - the numbers of people who use the area where the ACMs are
    - if demolition, maintenance, refurbishment or other work on the premises is likely to be carried out where the ACMs are.

- where asbestos is presumed to be located note should be made where the surveyor has been unable to access areas (these locations should be kept to a minimum)
- photographs to confirm location and for routine condition monitoring
- specific actions that need to be taken and dates these are required to be completed, and by which party
- evidence of actions being completed
- due date for the next condition assessment.

- Training requirements for recognition of Asbestos will be provided to all staff, including DFZ and their contractors, by the party undertaking the asbestos survey. Where specialist surveys are required for resettlement, DFZ will liaise with Rogun JSC and PMC to identify and use personnel with requisite qualifications, to manage asbestos risk during the resettlement process.
- No ACMs or potential ACMs shall be reused. Where ACMs or potential ACMs are found, this hazardous waste shall be disposed of in line with the recommendations of the asbestos survey and Asbestos Management Plan. The disposal requirements of asbestos in the Asbestos Management Plan will be aligned with the Hazardous Materials Management Plan and overarching Non-hazardous and Hazardous Waste Management Plan.

Residual effects

12.4.81. The implementation of these measures will reduce the significance of the effect to **Minor**.

Contamination: Impacts to soils from historic pollution

12.4.82. Activities which disturb the soil have the potential to mobilise contamination that is already present within the ground. Contamination may be in the form of hazardous chemicals or microbes. Whilst a walkover survey of the current construction area has been undertaken using theconceptual site model (**Volume 2, Annex 13-1: Contaminated Land**), it is possible that further contamination may be present in the construction areas that has not yet been identified.

12.4.83. In the inundation zone and for other works outside of the main Rogun HPP construction area (e.g. left bank roads and bridges etc., historic contamination may be present that has not yet been identified. Sources of potential historic contaminated materials include:

- Areas around construction equipment including tank farms, concrete batching areas, materials storage, waste facilities, septic tanks etc.
- Areas around roads and extensively used dirt tracks

- Abandoned and modern agricultural fields and livestock areas (especially where land application of manure occurs)
- Cemeteries and burial grounds
- Waste dumps and livestock burial pits (formal and informal).

Impact Assessment

Main Rogun HPP Construction Site.

12.4.84. Within the main Rogun HPP construction site historic pollution has been identified across widespread areas most notably associated with abandoned infrastructure such as the tanks farms, septic tanks and disused waste dump areas and infrastructure locations (see Volume 2: Annex 12.1 of this ESIA).

12.4.85. Construction activities can mobilise pollutants from local soils into wider areas, or waterbodies if not managed appropriately. This is especially the case where historic contamination is located downstream of the dam which indirectly could impact downstream sections of the Vakhsh river between Rogun and Nurek HPP.

12.4.86. Whilst the sensitivity of the soils and geology in this area is **Low to Medium**, historic contamination is widespread across the site, with pollution types likely to persist in the long term or permanently without some intervention. The majority of affected areas will also be inundated by 2038, which would potentially allow leaching of contaminants.

12.4.87. The magnitude is therefore considered to be **Large**, with significance **Moderate** for the main Rogun HPP construction area.

Other Areas

12.4.88. In other areas where construction may occur (e.g. Left Bank Roads and Bridges, new transmission lines, new resettlement areas etc)., sources of pollution are typically from local spills from vehicles, local septic tanks and other types of domestic pollution. Pollution around local roads which typically have not been graded or in poor repair can also cause localised pollution from vehicles.

12.4.89. There is also potential for informal livestock burial sites in and around local villages. Whilst not official, or technically prohibited, these types of sites are not uncommon, and there is potential for these to cause microbial contamination in a localised area.

12.4.90. Construction in these areas has the potential to mobilise pollutants more widely in soils of **Medium** to **High** sensitivity or allow infiltration into shallow aquifers.

12.4.91. Given that design details for some of these works is in development, or some areas have yet to be defined a precautionary approach to the assessment has been made. The magnitude is considered to be **Small** due to the localised nature of pollution types and extent. The significance is therefore **Minor** for medium sensitivity soils rising to **Moderate** for the most sensitive soil types.

Mitigation and Enhancement Measures

12.4.92. New tank farms will be designed and constructed in accordance with GIIP standards

12.4.93. A Hazardous Materials Management Plan (HMMP) shall be developed and implemented which includes measures related to the management of historic pollution. To reduce impacts further in

areas outside of the main Rogun HPP construction site, especially to highly sensitive receptors, the following measures will be incorporated:

- Sources of historic contamination will be identified and mapped as part of the Pre-construction Survey Process. This will include soil testing to identify chemical and biological contamination, and stakeholder engagement to identify any sources of contamination that are not officially registered, e.g., informal waste dumps or burial pits.
- Contaminated areas and known livestock burial sites shall be avoided where practicable through microrouting of the roads and bridges, any new transmission lines and or micrositing of construction areas and new resettlement areas.
- Where avoidance is not possible, materials shall be excavated and disposed of at registered hazardous material facilities. If livestock burial sites are identified and need to be excavated, this shall only be undertaken in consultation with the Veterinary Control Services of Tajikistan and with strict adherence to their requirements. Remediation shall be completed before construction activities can commence.
- For all contaminated soil and other contamination existing as a result of historical activities, the remedial plan will require this source of contamination to be isolated from reservoir water with an impermeable cap or by removal off-site to a facility licensed to treat or dispose the specific type of hazardous substances that caused the contamination. If no such facilities exist, JSC Rogun will take steps to store the contaminated media/materials until such a facility can be developed. Such storage will be designed to prevent releases to the environment and approved by the PMC.

Residual effects

12.4.94. With the implementation of these measures the residual effects are considered to be **Minor** for the main construction site and **Negligible** for the other areas**.**

Contamination: Impacts to soils and geology from leaks and spills

12.4.95. Construction activities have the potential to introduce contaminants to soils through a variety of sources, which can pollute soils once construction is complete, as well as leach into groundwater aquifers.

12.4.96. The main sources of leak and spill risk during construction will be:

- Vehicles: mobile plant, delivery vehicles, and worker / site visitor transport.
- Vehicle maintenance facilities
- Stationary plant and generators.
- Refuelling of vehicles and stationary plant
- Storage, use and transportation of fuel and lubricant.
- Storage, use and transportation of paints.
- Storage, use and transportation of cleaning chemicals.
- Storage, use and transportation of other chemicals (e.g., chemical grouting)
- Aggregate materials storage areas and stockpiles.
- Quarrying and material extraction.
- Concrete batching areas including material storage.
- Sanitary facilities (including septic tanks, temporary toilets and washing facilities).
- Hazardous waste storage: chemical containers (e.g., oil drums, paint and varnish tins).
- Contaminated materials (e.g., used spill kits, used medical supplies, contaminated soil).

Impact Assessment

Main Rogun HPP Construction Site.

12.4.97. Fuel and chemical storage is required both on-site within the construction area, and at workers' camps. Hazardous waste is also stored on site throughout construction for disposal at registered facilities. In some areas, the hazardous materials and waste storage areas are well designed and monitored, while other areas are less robust in application of GIIP. Vehicle maintenance facilities in some areas are also very well designed and managed with others managed less stringently. Existing management measures to prevent leaks and spills on-site include provision of spill kits etc., were observed for areas where known potential pollutants are present.

12.4.98. Water flowing through material stockpiles and concrete batching areas, as well as from vehicle washout areas were observed in some areas to be discharging directly into soils across open ground (**Volume 2, Annex 12-1: Contaminated Land**) of this ESIA, as well as through open ditches directly into the downstream Vakhsh river. Dumping of spoil and poor housekeeping on site were also observed in some areas.

12.4.99. Although the soils in this area are generally **Low** in sensitivity, the likelihood of contaminants continuing to be discharged to soils and polluting new areas as construction progresses, is certain and on a frequent basis, given the continuance of these practises, at least in the short to medium term. The magnitude of the impact is therefore considered to be **Large**, and significance of the effect is considered to be **Moderate.**

12.4.100. It is also important to consider this type of pollution in-combination effects from historic pollution and demolition works which also give rise to significant contamination effects in soils. Implementation of the mitigation to reduce these effects across all types of potential contamination is considered to be imperative in the immediate term.

Other areas (e.g. Left Bank Roads and Bridges etc)

12.4.101. Given the speed of construction along the new roads and at bridge locations, with construction in place for only a short period (up to 6 months) in any single location, it is likely that some spills will occur from materials and fuels in particular. The scale however will be local and of short duration.

12.4.102. Assuming a precautionary approach with a large spill (e.g. > 1000 L) with the potential to contaminate agricultural topsoils of high value receptors, the magnitude of the effect is considered to be **Medium**. The significance of the effects is likely to be **Moderate** for **Medium** sensitivity receptors and **Major** for **High** sensitivity.

Mitigation and Enhancement Measures.

- To reduce impacts further, especially to highly sensitive receptors, it is recommended that construction method statements be developed that include all aspects and mitigation measures listed in section 12.4.18.
- Furthermore, a Hazardous Materials Management Plan (HMMP) shall be compiled that:
    - Describes the process for purchasing including requirements and audit of purchase inventories,
    - Identifies substitutions to less hazardous materials where practicable,
    - Sets out the requirements for Standard Operating Procedures (SOPs) for the management of secondary containment structures, including integrity inspections and the removal of any accumulated fluid, such as rainfall, to ensure that the containment capacity is maintained.

- Sets out the method for ensuring access to hazardous materials storage areas shall be restricted.
- Sets out the design requirements for secondary containment for fuel storage tanks and for the temporary storage of other fluids such as lubricating oils and hydraulic fluids which is at least 110% of the largest container or 25% of the total volumes of fuel and fluids stored (whichever is greater).
- Sets out the procedures for ensuring refuelling and other fluid transfer only in areas with impervious surfaces, or where this is not possible (e.g. temporary construction camps) mandate the use of drip trays to avoid spills during refuelling.
- Sets out the training and awareness for transfer and handling of fuels and chemicals and the response to spills for workers involved in the handling of fuels and chemicals.
- Details any specific personal protective equipment (PPE) required to respond to an emergency and training on its use.
- Details the siting for spill kits, portable spill containment and clean up equipment where fuel and chemical handling and takes place.
- Identifies any hazardous substances present in or on building materials (e.g., PCBs, asbestos containing flooring or insulation, electrical components containing mercury). If present, ensure contaminated building materials are decontaminated or properly managed and disposed of in line with the waste management plan.
- Identify training requirements for personnel to remove potentially hazardous materials in building elements. Such materials should only be removed by specially trained personnel, and according to protocols detailed in the Hazardous Materials Management Plan (HMMP).

- The HMMP will cover all hazardous materials expected to be encountered including all hazardous wastes.

Residual Effects

12.4.103. Implementation of these mitigation measures at all sites will reduce the potential effects to **Minor** significance.

OPERATION PHASE

12.4.104. Impacts from ongoing operational activities at Rogun have the potential to result in leaks and spills resulting in the contamination of soils.

12.4.105. In addition, the Rogun Reservoir could potentially influence dam stability through impacts on geological features in close proximity to the dam and reservoir (i.e. the salt wedge and geological fault lines). These potential impacts are safety risks that have been addressed in the geotechnical and engineering design reports for the project, and are mentioned only briefly in this chapter for completeness.

Contamination: Impacts to soils from leaks and spills

12.4.106. Operation activities have the potential to introduce contaminants to soils through a variety of sources, which can pollute soils once construction is compete as well as leach into groundwater aquifers.

12.4.107. The main sources of leak and spill risk during the operational phase will be:

- Vehicles: mobile plant, delivery vehicles, and worker / site visitor transport.
- Vehicle maintenance facilities

- Stationary plant and generators.
- Storage, transportation and use of fuel and lubricants
- Storage, transportation and use of paints.
- Storage, transportation and use of cleaning chemicals.
- Storage, transportation and use of any other chemicals used during maintenance.
- Surface and below ground transformers and switch gear containing oils.
- Sanitary facilities (including septic tanks, temporary toilets and washing facilities).
- Hazardous waste storage: chemical containers (e.g., oil drums, paint and varnish tins).
- Contaminated materials (e.g., used spill kits, used medical supplies, contaminated soil).

12.4.108. Fuel and chemical storage is required on-site within the operational HPP.

12.4.109. Although the soils in this area are generally **Low** in sensitivity, the likelihood of contaminants continuing to be discharged to soils and pollute potentially new areas during the operational phase, is Likely and on a **Periodic** basis. The magnitude of the impact is therefore considered to be **Small**, and significance of the effect is considered to be **Negligible**.

12.4.110. The operation of the Hydropower plant will require use of fuels and other potentially contaminative substances which may be toxic and mobile within the environment. There is a potential for release of contaminants to ground which would have an impact on soils and an indirect impact on human health and the local environment.

12.4.111. Volumes of chemicals and materials are likely to be low, and maintenance activities carried out in specialists' facilities designed to GIIP which are retained following construction. Soils in this area are considered to be of **Low** sensitivity. Taking the precautionary approach the magnitude of the effect is considered to be **Small** with a significance of **Negligible**..

Mitigation and enhancement measures

12.4.112. To control potential contamination impacts in the Operational Phase, regular environmental audits shall be undertaken, and where systems are deficient in their adherence to GIIP requirements the applicable Operational Plans and Procedures must be reviewed, revised, and reissued to prevent recurrence of pollution incidents. All Plans and Procedures will undergo regular revision throughout the life of the project.

Potential impacts on geology and dam stability

12.4.113. A wedge-shaped geological unit comprising halite rock is a component of the Ionakhsh fault (the salt wedge) and is situated beneath the Rogun dam wall. There is a risk that as the Rogun reservoir fills the hydrostatic head of the less saline reservoir water will result in dissolution of the halite rock causing cavity formation and subsidence that could affect the integrity of the dam.

12.4.114. The Rogun dam and reservoir are located over or near several geological faults (Ionaksh, Gulizindan, Guissar and Vakhsh faults) that that could potentially increase the risk of substrate movement during seismic events

12.4.115. Both aspects present potential dam safety risks that have been addressed in engineering design for the Rogun HPP. Failure of the dam would be catastrophic.

Mitigation and enhancement measures

12.4.116. The risk associated with the salt wedge has been minimised by implementing hydraulic and grouting barriers, whose effectiveness is constantly monitored.

12.4.117. Risk associated with the local fault lines and seismicity has been addressed in the dam engineering designs that employ an earth and rock construction approach rather than rigid concrete.

12.5 SUMMARY

Table 12-4 – Summary of Soils and Geology Impacts (Construction)

Impact	Impacts from clearance and storage		Impacts from inundation	Impacts from vehicle movements	Impacts from excavations and quarrying, and abstractions	Impacts from demolition works		Impacts from historic pollution		Impacts from leaks and spills	
	Main Rogun HPP Site	Other Areas				Main Rogun HPP Site	Other Areas	Main Rogun HPP Site	Other Areas	Main Rogun HPP Site	Other Areas
Receptor sensitivity	Low to Medium	Low to Medium	Medium to High	Low to Medium	Low to Medium	Low	Medium to High	Low to medium	Medium to High	Low	Medium to High
Frequency	Periodic	Periodic	Constant	Periodic	Periodic	Infrequent	Infrequent	Constant	Constant	Periodic	Infrequent
Likelihood	Certain	Certain	Certain	Certain	Likely	Likely	Likely	Certain	Certain	Certain	likely
Extent	Local to Regional	Local to Regional	Regional	Local	Local	Local	Local	Local to Regional	Local	Local to Regional	Local
Duration	Medium-term	Short-term	Long-term	Short-term	Short-term	Permanent	Short-term	Permanent	Medium-term	Short-term	Short-term
Magnitude	Small to Medium	Medium	Medium	Small	Small to Medium	Large	Medium	Large	Small	Large	Medium
Effect	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Direct / Indirect	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct
Significance	Negligible to Moderate	Minor to Moderate	Moderate to Major	Negligible to Minor	Minor to Moderate	Major	Moderate to Major	Moderate	Minor to Moderate	Moderate	Moderate to Major
Mitigation (Y/N)	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Residual Significance	Minor	Minor	Moderate to Major	Negligible	Minor	Minor	Minor	Minor	Negligible	Minor	Minor

Table 12-5 – Summary of Soils and Geology Impacts (Operation)

Impact	Impacts from leaks and spills
Receptor sensitivity	Low
Frequency	Periodic
Likelihood	Likely
Extent	Local
Duration	Short-term
Magnitude	Small
Effect	Negative
Direct / Indirect	Direct
Significance	Negligible
Mitigation (Y/N)	N
Residual Significance	Negligible

PUBLIC

JSC “Rogun HPP”

State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT - UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Volume 1, Chapter 13: Impacts on Water



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List of Acronyms and Abbreviations

BWO	Basin Water Organisation
CASA	Central Asia-South Asia project
CIA	Cumulative Impact Assessment
DO	Dissolved oxygen
DSPOE	Dam Safety Panel of Experts
DT	Diversion tunnel
EAAA	Ecologically Appropriate Area of Analysis
EFlow	Environmental Flows
EIB	European Investment Bank
EPP	Emergency Preparedness Plan
EPP	Emergency Preparedness Plan
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESPOE	Environmental and Social Panel of Experts
ESS	Environmental and Social Standards
FSL	Full Supply Level
GHG	Greenhouse gas
GWh	Gigawatt-hours
HPP	Hydropower Project
IADT	Independent Assessment of Diversion Tunnels
ICWC	Interstate Commission for Water Coordination of Central Asia
m asl	meters above sea level
MCE	Maximum Credible Earthquake
MOL	Minimum Operation Level
MW	Megawatt
MWh	Megawatt-hours
PMF	Probable Maximum Flood
PR	Performance Requirements
ROR	Run-of-river
TBIA	Transboundary Impact Assessment
TEAS	Techno-Economic Assessment Study
USSR	Union of Soviet Socialist Republics
UWL	Upstream water level (= reservoir level)
VC	Valued Component
VEC	Valued Environmental Component
WB	World Bank

1 Introduction

1.1 Purpose of the Document

Rogun HPP is being constructed at the upstream end of a cascade of Hydropower Plants (HPP) located on the Vakhsh River in Tajikistan. The reservoirs regulate the seasonal flows in the Vakhsh River to supply domestic and irrigation water and to generate electricity for international and domestic consumption. The addition of the Rogun Reservoir, with a volume of 13.3 km³, to the cascade will increase the energy output with the installation of a 3,780 MW HPP.

The purpose of this Document is, after a short description of the situation, to

- address the issue of potential impacts of Rogun HPP on all environmental aspects related to water, and
- to develop and discuss mitigation measures that may be required or could be applied in order to reduce impacts to an acceptable level.

The present document is based on the following reports and studies:

- Coyne et Belier, ELC and IPA, 2014: TEAS (Techno-Economic Assessment Study), Phase II: Project Definition Options, Volume 3: Engineering and design, Chapter 5: Reservoir operation study; referred to as TEAS 2014.
- Pöyry, 2014: Rogun HPP: Environmental and Social Impact Assessment; referred to as 2014 ESIA.
- WSP, 2025: Rogun Hydropower Project –Updated Environmental and Social Impact Assessment; referred to as 2025 ESIA; from this, mainly the following Sections:
    - Volume2, Annex 13-1: Minimum Environmental Flow
    - Volume2, Annex 13-3: Water Resource Modelling
    - Volume 2, Annex 7-1: Baseline Conditions Report

The present document is prepared as part of the 2025 ESIA.

1.2 Importance of Water

1.2.1 Potential Impacts of HPPs

An HPP will normally have influence on surface water bodies in the following ways:

- Change of water discharge patterns downstream of the dam; here, three possible impacts have to be considered, namely:
    - Change in seasonal flow distribution; large HPPs with a high dam and a large storage reservoir are usually built with the aim to store water during the high flow season (in this case during summer), for using it during the low flow season (here winter) for generating electricity during the period when natural water discharge is lowest and electricity demand is highest. With very large reservoirs in comparison with natural river discharge, this can lead to a complete change in the seasonal flow patten in the downstream area.
    - Short-term flow changes; this happens when an HPP is operated with a peaking pattern, with the aim of closely following a changing demand, e.g. for making electricity available during daily peak demand hours. Hydropower plants, equipped with turbines that can be turned on and off very quickly, have the flexibility for such short-term changes. For the river downstream of the water outlet of the power plant this will lead to potentially very marked and very rapid changes in water discharge, varying in an extreme case between no water and full capacity of the turbines, potentially several times per day.
    - In the case of a deviation HPP, where the water taken from the dam will be conducted via channels or tunnels and a high penstock to be turbined and released at a distance downstream of the dam, the river between dam and outlet may remain without water; this stretch of river can be several km long, and it is even possible to divert the water in a way as to release it in a different river (transbasin diversion).

- Creation of a reservoir; in addition to the possibility for shifting water seasonally mentioned above, this will have the following effects:
    - Changing a portion of the river from its natural running water (river, lotic conditions) into a lake-like (stagnant water, lentic condition) water body.
    - Implications on water quality; the importance of this impact will depend, among other parameters, on the quantity of vegetation that will be submerged during impoundment of the reservoir.
- Interruption of the river:
    - Biological impact: a dam will be a barrier for movements of water organisms, and mainly for fish migrations; in low, weir-type structures this can be mitigated by means of fish ladders or similar structures that will allow fish to pass, bun this is not possible in the case of high dams.
    - A large reservoir will retain sediments, influencing in this way sedimentation and erosion dynamics in the downstream area.
- Potential changes in the local water balance (gains from direct precipitation, and losses from evaporation and infiltration).

These are the (theoretical) main changes directly concerning water that will become manifest during the entire operation period of the HPP. In addition to that, impacts caused and risks present specifically during the construction period have to be mentioned. These are mainly the risks of water contamination during construction, as e.g.:

- Increased sediment input due to work in the river itself and in its immediate surroundings, which includes baring of soils, in this was increasing their exposure to erosion.
- Risk of water contamination with concrete waste (increase of water pH), of contamination with fuels and lubricants or other hazardous materials due to accidents or inadequate storage and handling.
- Risk of water contamination with domestic waste water (untreated waste water from workers' accommodations and other facilities.

These risks must be prevented and minimised by developing and implementing the ESMP (including all specific management plans) for the project; see ESIA Vol. 3. Similar precautions (e.g. for minimising the risk of water contamination) have also to be applied in the operation phase, especially during major maintenance or rehabilitation works.

1.2.2 Situation in the Case of Rogun HPP

From the potential impacts mentioned above, the following are relevant in the specific case of Rogun:

- Interruption of the river: Vakhsh River was already interrupted, and any fish migrations that may have taken place there before were completely blocked by the construction of Nurek dam and the smaller dams and weirs of the cascade downstream of it. Rogun dam will be an additional obstacle to fish migrations with may take place between Nurek reservoir and the upstream part of Vakhsh River; see ESIA Vol. 1, Chapter 15, and discussion of the issue in the CIA,
- Creation of a reservoir: the reservoir with a total length of 70 km will change conditions from lotic to lentic, which will affect the type of habitat for aquatic organisms. Effects of this on aspects related to biodiversity are discussed in ESIA Vol. 1, Chapter 15.
- Water quality: the creation of a large reservoir, with a surface of 159 km² and a volume of 13.3 km³, can have impacts on water quality, which in turn can affect the situation in the downstream area; see Section 4.2.
- Losses due to evaporation from the reservoir: the TEAS estimated evaporation from an open water surface in the project area at 805 mm/year, which would lead to a loss, once the reservoir is full, of 0.144 km³ per year or 4.6 m³/s. However, this dis not take into account that without a reservoir there is a loss due to evaporation from soils and evapotranspiration from plants, which was estimated as being in the order of magnitude of 700 to 1000 mm/year, the same order of magnitude (2014 ESIA). This, therefore, is not considered as a relevant loss and is not evaluated any further.
- Peaking operation: this is a possibility, not yet defined, but likely to be applied at least temporarily. The issue is addressed in Section 4.1.4.

- Change in seasonal flow distribution: as every HPP with a high dam and a large storage volume, Rogun has the potential to retain water in the high-flow season to release it during the low-flow season (winter), with the aim of optimising energy generation. This highly relevant topic is addressed in Section 4.1as well as in the CIA.

These potential effects and their implications will have to be addressed.

The most relevant of these potential impacts, in the case of Rogun HPP, is the last one mentioned in the list above, namely, the potential for changing the seasonal flow pattern in the downstream area by shifting water from summer to winter. The importance of this is given by the fact that in the Vakhsh-Amu Dary basin, there are two main, and directly competing, forms of water use, namely, hydropower and irrigation. This is explained shortly here:

- Hydropower uses water for producing electricity. Since river flow is highly seasonal, with high flows in summer and very low flows in winter, and since electricity demand is highest in winter, the aim of HPPs would be to retain the possible maximum of water in summer in order to use it in winter for generating electricity.
- Irrigation needs water during the vegetation period, which under the climatic conditions in the basin is summer (roughly from April to September), while very little if any water is used for this purpose in winter (October to March).

In contrast to irrigation, hydropower is a non-consumptive form of water use: once passed through the turbines, it is available again for any use in the downstream area. However, shifting a large amount of water from summer to winter will cause potentially severe restrictions for irrigation in the downstream area, where a higher flow in winter is not of any practical use. This is a situation of conflicting interests in the Amu Darya basin which is of high economic relevance and, given the fact that several countries share the river basin, has political implications at an international level.

For this reason, the potential effect of Rogun HPP on seasonal flow distribution is the main focal point of the present document. Cumulative and transboundary impacts are dealt with in a separate document, the CIA (Cumulative Impact Assessment).

1.3 Regulatory Framework

The 2025 ESIA is prepared with taking into account the relevant national legislation and standards as well as applicable international standards and guidelines, namely those of the World Bank. These applicable standards are presented in full in **Volume 1, Chapter 2** of the 2025 ESIA. This section summarises the regulatory framework that is relevant to Water.

1.3.1 Tajikistan National Legislation

Water Code of 2000 (as amended in 2020) - The Law governs the use of water and sustainable use of water resources. The Law is based on principles regarding:

- Consideration of the importance of water bodies as the basis of human life and activity;
- Basin management of water resources;
- Stakeholder participation in the preparation and making of decisions about water resources management;
- Protection of water bodies;
- Avoidance of excessive negative impact on waterbodies;
- Regulation of water relations depending on the natural characteristics of waterbodies; and
- Accounting of the economic value of water resources.

1.3.2 International Agreements

Water management among Central Asian States is guided by agreements dating in part back to Soviet times, and additional agreements between the newly independent states reached since then. These instruments include:

- Protocol 566 of September 10, 1987
- October 12, 1991 Declaration
- February 18, 1992 Agreement "On Cooperation in the Field of Joint Water Resources Management and Conservation of Interstate Sources
- By-law of the Basin Water Association "Amu Darya" (6 April 1992, Ashkhabad)
- By-law of the Interstate Commission for Water Coordination of Central Asia (ICWC) (5 December 1992, Tashkent)
- Nukus Declaration of September 20, 1995.

A more complete list of agreements can be accessed on ICWC's website (http://www.icwc-aral.uz/legal_framework.htm).

These agreements form the basis for the current practice of water allocation among the Central Asian states (Kyrgyzstan, Tajikistan, Uzbekistan and Turkmenistan for the Amu Darya basin). The following institutions are in charge of water allocation:

- Two Basin Water Organisations (BWO, Basseynoe Vodnoe Obedinenie) were created still during Soviet times, one for the Amu Darya, and one for the Syr Darya).
- The 1992 agreement led to the foundation of the Interstate Commission for Water Coordination (ICWC).

ICWC is the institution in charge of water allocation; the two BWOs are the operative branches of ICWC.

The most recent of these agreements is the Joint Statement of the Heads of Water Agencies of the Republic of Kazakhstan, the Republic of Tajikistan, Turkmenistan and the Republic of Uzbekistan (27 April 2022, Turkestan), available on http://www.icwc-aral.uz/statute15.htm, cited here ((emphasis in the web document):

> "We, the Heads of water agencies of Kazakhstan, Tajikistan, Turkmenistan, and Uzbekistan, while recognizing the importance of regional water security challenges, express our willingness **to take further coordinated actions** in order to ensure multipurpose and sound use and protection of transboundary water resources.
>
> We believe it important to continue cooperation in the **spirit of collective leadership, solidarity and collective responsibility** as a foundation, on which the regional water cooperation was developed and the Interstate Commission for Water Coordination in Central Asia was created.
>
> We acknowledge our solid commitment to transboundary water management **on the basis of consensus**, to the **benefit of all the riparian states** and in line with **international agreements to which the region's countries are signatories**.
>
> We will continue implementing **integrated water resources management** at all levels as a key tool of green development, adaptation, and water-food-energy-environment nexus.
>
> We will endeavor, within our mandates, to take feasible **measures, with the focus on sound water use and water conservation**, to build trust and enhance cooperation, transparency and sustainability among the Central Asian countries.
>
> We will make efforts to ensure that **qualified personnel, reliable data, advanced knowledge, digitalization and innovative development** of the water sector become the key factors of medium- and long-term economic growth and sustainable development in the region.
>
> We will encourage development and **sharing of knowledge, forecasts and innovations** in order to improve water use management and planning.
>
> Having experienced environmental and socio-economic consequences of unsound water use, we recognize the need for **sustainable use and a reasonable balance** between the needs of people, economies and ecosystems today and in the future.
>
> In this context, we will strengthen coordination of actions for the improvement of **water-related ecosystems**, including glaciers, flow formation zones, river deltas and the exposed Aral Sea bed and for climate mitigation.
>
> We attach particular importance to more active work with **youth** and to **encouraging** the population to value and take care of water."

It is important to highlight that while the set of regional agreements may have some shortcoming, they represent a well-established framework for managing regional water resources. Through the formalization of the institutions (BWOs, and ICWC, mainly) and the mechanisms by which the countries come together to discuss and agree on national water sharing allocations, this has proven to be a very robust framework which has been in place for more than 30 years, and a good system to resolve the water sharing issues among the five countries.

Practical aspects of water regulation in the Amu Darya basin with relevance for Rogun HPP are discussed in Section 3.1.4.

1.3.3 International Lender Requirements

World Bank Environmental and Social Standards

- ESS1: Assessment and Management of Environmental and Social Risks and Impacts;
- ESS3: Resource Efficiency and Pollution prevention and Management;
- ESS4: Community Health and Safety; and
- ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.

Hydropower project development guidance documents:

- The World Bank Group Good Practice Handbook for Environmental Flows for Hydropower Projects (2018); and
- European Investment Bank (EIB) Environmental, Climate and Social Guidelines on Hydropower Development (2019).

2 Approach

2.1 Area of Influence

The area of influence can be defined on different levels as follows:

- **Amu Darya Basin:** Vakhsh River is one of the main tributaries of the Amu Darya, and a main source of water for the Amu Darya basin. The Vakhsh River's average annual flow is 20 km^3, which is about 32% of the Amu Darya River's flow, estimated at 61.5 km^3 per year (as referenced in Protocol 566, Environmental and Social Impact Assessment (ESIA), Volume I, Page 23). The Amu Darya river starts at the confluence of the rivers Vakhsh and Panj (average of 32.7 km^3/year) at the border between Tajikistan and Afghanistan, and soon after receives the waters of the Kafirnigan (average of 5 km^3/year). It will be important to place Rogun and the Vakhsh river in this broader context for its relative importance in the basin, in comparison to the much larger Pyanj river and other tributaries. For this reason, a first and general level is the Amu Darya basin as whole. Potential downstream and transboundary impacts are addressed in the Cumulative Impact Assessment for Rogun HPP.
- **Vakhsh Basin:** since Rogun dam is built on the Vakhsh River, Vakhsh basin has to be taken into consideration, starting from Rogun reservoir and including the hydropower cascade downstream of it. Rogun HPP does not influence water (flow, seasonal distribution, quality) in the area upstream of Rogun reservoir. The risk of backwater effects is not mentioned in the reservoir modelling studies, but it is very low, since peak inflows into the reservoir occur mainly in spring and early summer (snow melt and peak precipitation, see Figure 3-4), when the reservoir is low and easily able to cope with such inflows. This area therefore is not discussed here.
- **Rogun and Nurek Reservoirs:** this is the major part of the area of influence for this assessment, since effects of Rogun, first of all, will be felt here. This part includes the stretch of Vakhsh River between the outlet of Rogun power house and the Nurek reservoir.

The 2014 studies (TEAS and ESIA) demonstrated that the Vakhsh cascade with Rogun HPP added can be operated without changing the water regime, and especially without changing seasonal water distribution, downstream of Nurek HPP. Aligned with this, Tajikistan has agreed to not shift any additional flows from summer to winter, than the 4.2 km^3/year already being shifted by Nurek since its construction, and to not alter the flow regime downstream. For this reason, the AoI for the updated ESIA was defined as covering Rogun reservoir area and a buffer zone, reaching as far down as Nurek dam, this AoI is applied here. As mentioned above, for the purpose of the Cumulative Impact Assessment, which is also a Transboundary Impact Assessment, the AoI had to be extended as to include the entire Amu Darya basin (see in the CIA).

2.2 Receptors

2.2.1 Main Parameters Affected

The following are the main parameters affected, which are the focal points of this Report:

- Hydrology: risk of changes in downstream water flow patterns, and mainly on seasonal distribution of water. Highly sensitive issue, since an additional shift (in addition to what was already caused by Nurek HPP) from summer to winter, in the interest of maximising winter energy generation, would have very negative consequences for water users in the downstream area, mainly concerning irrigation in Uzbekistan and Turkmenistan.
- Water quality: creation of a reservoir, changing the river characteristics accordingly, can have an impact on water quality, which in turn could cause problems for water users downstream of the dam, and could also affect aquatic habitats.
- Sediment transport: retention of sediments in the reservoir leads to changes in sediment-related dynamics downstream of the dam.
- Flood risk: floods can be a major risk for the human population along the river, and for man-made structures in potentially affected areas.

Changes in these parameters will have an impact on the final receptors. An overview is provided in the following Section.

2.2.2 Summary of Impacts on Receptors

The following Table lists the main project effects on relevant parameters, the main receptors affected, the main impacts to be expected, and indicates where these issues are addressed (ESIA Chapters or Annexes, or Sections of the present report).

Table 2-1: Summary of Impacts on Receptors

Parameter	Main effect	Receptor	Impact	Assessment and Mitigation: ESIA
1. Hydrology	1.1: Impoundment: submersion of an area of 159 km².	1.1.1: Terrestrial biodiversity: terrestrial habitats with their fauna and flora.	These habitats (floodplains with riparian vegetation, grassland, forest relicts, with their associated fauna will be lost permanently.	• Vol. 1, Ch. 15: Biodiversity • Vol. 1, Ch. 16: Ecosystem Services • Vol. 2, Ann. 7-1: Baseline • Vol. 2, Ann. 15-1: Critical Habitat Assessment • Vol. 3, A04: Biodiversity MP • Vol. 3, A05: No Net Loss Framework
		1.1.2: Aquatic biodiversity: river within the reservoir area	Change of about 70 river km from lotic (river) to lentic (lake-like) conditions; changes living conditions for fish and other aquatic organisms.	
		1.1.3: Socio-economy, human population	People inhabiting the reservoir area need to be resettled; losses (housing, land, infrastructure, other assets) need to be replaced/compensated.	• Vol. 1, Ch. 06: Stakeholder Engagement • Vol. 1, Ch. 17: Socio-economy • Vol. 1, Ch. 18: Community Health • Vol 1, Ch. 20: Cultural Heritage • Vol. 2, Ann 7-1: Baseline • Vol. 2, Ann. 17-1: Gender • Vol. 3, A06: Cultural Heritage MP • Vol. 3, A08: Community Health and Safety Plan
	1.2 River hydrology	1.2.1: River between Rogun and Nurek.	Effect during reservoir filling: • Flow reduction due water retention • Seasonal change • EFlow Effect during operation:	• Vol. 2, Ann. 13-1: Minimum Environmental Flow • Vol. 2, Ann. 13-3: Water Resource Modelling • Section 4.1 • Section 4.4

		1.2.3: River downstream of Nurek	No change: cascade will be operated in a way as not to change flow pattern in the downstream area.	• Vol. 2, Ann. 13-3: Water Resource Modelling • Section 4.1.4 • CIA
	1.3 Floods	1.3.1: Routing of floods	• Improved flood control • Rogun able to safely route PMF	• Vol. 2, Ann. 13-3: Water Resource Modelling • Section 5.5
2. Water Quality	2.1 Reservoir	2.1.1: Change of water quality in the reservoir	• Thermal stratification • Oxygen depletion	• Vol. 2, Ann. 7-1: Baseline • Vol. 3, B04: Waste Water MP • Section 4.2
		2.1.2: Effect of water quality on downstream area	• Impact on biodiversity	• Vol. 1, Ch. 15: Biodiversity
3. Sediments	3.1 Sediment retention	3.1.1: Sedimentation of Nurek reservoir	• Nurek has reservoir already accumulated a considerable amount of sediment • Sediment retention in Rogun will increase life span of Nurek	• Section 4.3
		3.1.2 Sediment retention in Rogun reservoir	• Sediment will accumulate in Rogun reservoir. • Longer life span for Nurek • No change downstream of Nurek	

3 Baseline Situation

3.1 Amu Darya Basin

3.1.1 The Basin

Rogun HPP includes a high dam that is under construction on the Vakhsh River; this is a major tributary of the Amu Darya, one of the two large Central Asian rivers finally ending in the Aral Sea. Given Rogun's potential for change in the downstream area, the Amu Darya basin has to be considered.

The Amu Darya is the largest river in Central Asia by discharge. Its length is 2'415 km and the size of the catchment area is 534,700 km².

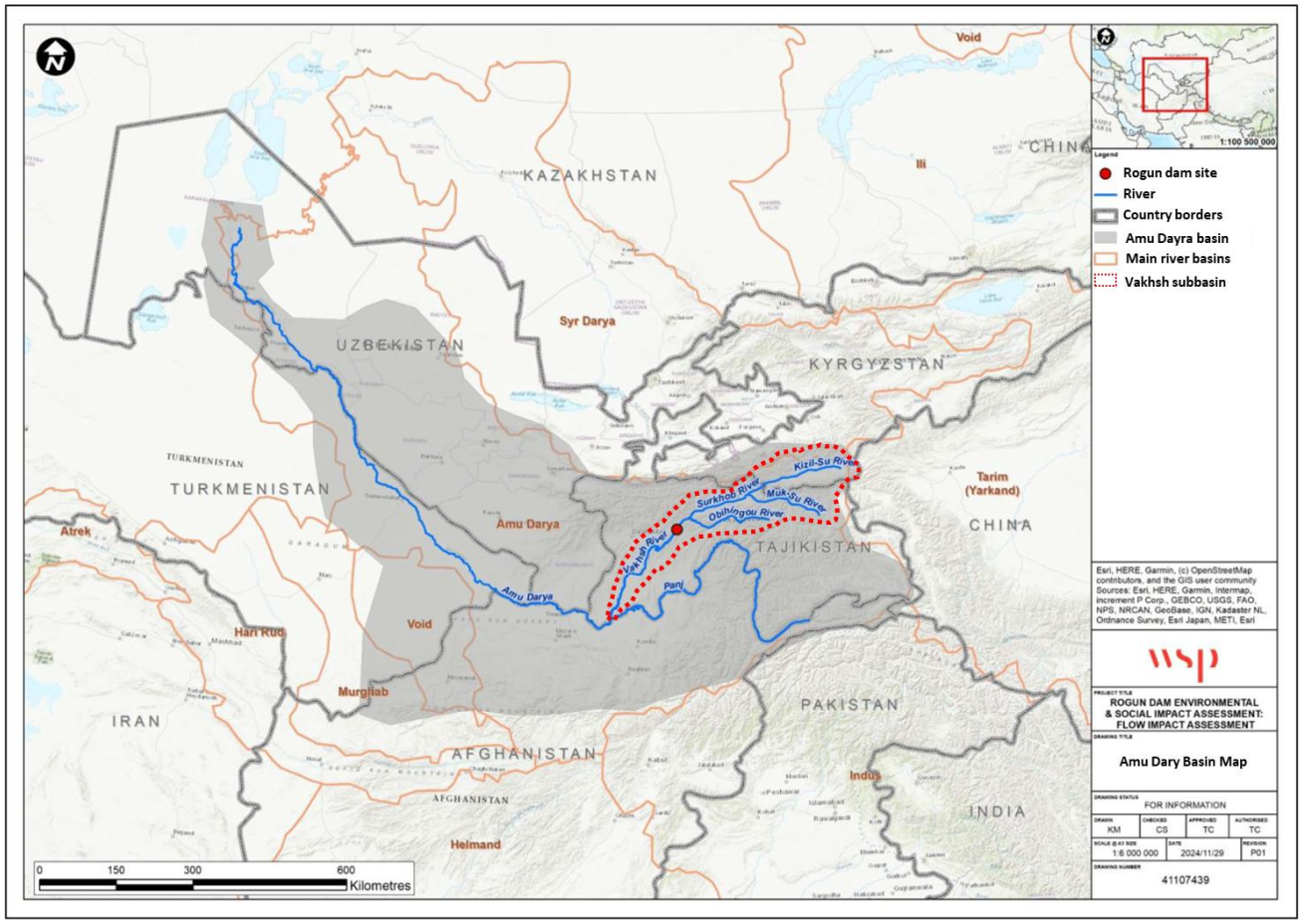


Figure 3-1: Amu Darya river basin

Starting at the confluence of Vakhsh (20 km³/year) with Pyanj (32.7 km³/year), the river is called Amu Darya; Pyanj flows along the border between Tajikistan and Afghanistan. Downstream from this confluence, the Amu Darya is joined by several additional tributaries, the main ones being the Kunduz (from Afghanistan), the Kafirnigan (from Tajikistan), the Sherabad and the Surkhandarya (from Uzbekistan).

The Amu Darya basin is shared by Afghanistan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan and terminates in the Aral Sea. Most of the Amu Darya river flow is formed in the upper part of the catchment area, i.e. in the mountains of Afghanistan and Tajikistan, as shown in the following Table.

Table 3-1: Contribution to Amu Darya annual flow by country

Country	Annual flow generated (km³)	%
Tajikistan	62.90	80.17
Afghanistan	6.18	7.88
Uzbekistan	4.70	5.99
Kyrgyzstan	1.90	2.42
Turkmenistan	2.78	3.58
Total	78.46	100

Source: Main guidelines of water strategy of the Aral Sea basin 1996 (ICWC)

It should be pointed out that the contribution of Vakhsh River to the part of Tajikistan is 20 km³ (in an average year). A large part stems from Pyanj (which includes the major part of water originating in Afghanistan, and there is also the Kafirnigan River, which joins Amu Darya downstream of the confluence of Vakhsh and Pyanj. Downstream of the Kafirnigan-Amu Darya confluence, there are no more major tributaries. On the way to the Aral Sea the river forms the boundary between Afghanistan and Tajikistan as well as between Afghanistan and Uzbekistan, but also crosses the boundaries between Turkmenistan and Uzbekistan.

Table 3-2: Main characteristics of Amu Darya basin, Vakhsh and Pyanj sub-basins

River	Basin area (km²)	Length (km)	Altitude (m asl)		Average flow (km³/yr)	Catchment yield factor (l/s/km²)
			lowest point	highest point		
Amu Darya (entire basin, incl. Vakhsh and Pyanj)	534'700	2'415	28	7'495	78.46	4.6
Vakhsh	39'100	786	326	7'495	20.1	16.3
Pyanj	114'000	921	326	6'974	31.6	8.8

3.1.2 Amu Darya

The origin of the Amu Darya (which has this name only from the point of the confluence of its main tributary, the Pyanj, with Vakhsh, 1445 km upstream of the Aral Sea) is in the Pamir, in Afghanistan, close to the Chinese border, at an altitude of 4900 m asl. The total length of Pyanj-Amu Darya is 2,415 km. The total catchment area is 534'700 km². Most of its water stems from snow and glacier melt. Two major tributaries come from Afghanistan, the Kochka (upstream from Pyanj-Vakhsh confluence) and the Kunduz (between Vakhsh and Kafirnigan), bringing about 7 to 8% of the total flow. Further west, there are no other major tributaries. The Amu Darya has a highly seasonal flow pattern, as shown in the following Figure.

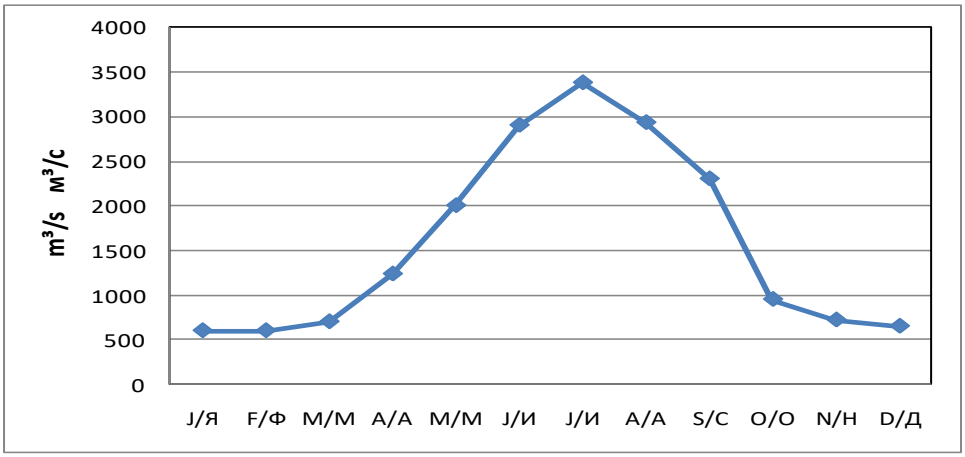


Figure 3-2: Monthly discharge of Amu Darya at Kerki (1959, 50 year average)

Source: 2014 ESIA, based on data from Létolle and Mainguet (1993: 58)
Kerki is located in Turkmenistan, about 250 km downstream from the Tajik-Uzbek border.

The water of Amu Darya has high concentrations of calcium carbonate, and its content in organic matter is very low, due to the low content of humus in the catchment area. Salt content has increased markedly due to drainage water from irrigated areas and waste water inflow from settlements.

3.1.3 The Aral Sea

The Aral Sea is a large lake without outflow, inflows are balanced by evaporation. Around 1960, it had a surface of 66'458 km² and was then the fourth largest lake in the world in terms of surface area. Average depth was 16 m, maximum depth was 68 m in the western and 29 m in the central and eastern part; these two parts were separated by islands which today form an almost complete separation between the two parts.

In historical and prehistorical times, the lake level has known rather important fluctuations, the amount of which is still a matter of debate. However, for a time span of at least two centuries before 1961 it has been very stable, with a variation in the order of magnitude of 1 to 2 m.

The Aral Sea has only two tributaries of importance, the Syr Darya in the North and the Amu Darya in the South, both originating in the high mountain areas to the east of the lake, in Kyrgyzstan, Tajikistan and Afghanistan. Records from the 20th century show that the overall runoff of the Amu Darya at the foothills of the mountains (i.e. in the region of Termiz, a short stretch downstream of the Tajik-Uzbek border) was 78.6 km³/yr, with high year to year fluctuations, however without showing a downward trend. Out of this, originally (i.e. before about 1960) around 60 km³/yr reached the Aral Sea. The fact that in spite of the high annual variation of inflow the lake level remained rather stable might have been due to the mitigating effect of the groundwater reserves in the soils along the river plains and the lake.

After the end of World War II, and especially towards 1960, large irrigation projects were implemented in the Aral basin, along the Amu as well as the Syr Darya. This increased the irrigated area and agricultural productivity mainly in Uzbekistan and Turkmenistan (for the Amu Darya), but it also had the immediate effect of massively increasing water abstraction from Amu Darya, thus reducing inflow to the Aral Sea, leading to a situation where the losses from evaporation were no longer compensated and the Aral Sea started shrinking, and salinity of the water increased. Around 1990, northern and southern parts of the Aral Sea became separated. The northern part, the Small Aral Sea, which receives the inflows from Syr Darya, was then isolated from the southern part (Large Aral Sea) by the construction of the North Aral Dam between the two parts. This lead to a recovery of the Small Aral Sea; salinity there has dropped from around 30 g/l to pre-shrinking values of 10 g/l or less. The southern part, however, continues to shrink and salinity is rising accordingly. Today, there is water only in the former westernmost (deepest) part of the original lake, and, depending on inflow, some water intermittently in the central part, covering less than 10% of the original surface.

3.1.4 Water Use in the Basin

Up until 1987, the allocation of the Amu Darya waters among the four Central Asian republics (Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) was based on the water development master plan for the Amu Darya

basin. In 1987, two important steps were passed: first, based on an analysis of water shortages in 1974–1975, and especially in 1982, two Basin Water Organizations: BWO “Amu Darya” with headquarters in Urgench, and BWO “Syr Darya” in Tashkent were created. Secondly, a water allocation plan named "Protocol No. 566" of the Science and Technological Council of the USSR Water Management Ministry was prepared.

Protocol No. 566, dated September 10, 1987, is still used today as a reference document for discussions on water allocation between the four formerly soviet countries of the Amu Darya basin: Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

Table 3-3: Origin and use of water in the Amu Darya basin

Country	Contribution to total flow of Amu Darya	Water allocation according to Protocol 566	
	%	%	km³**
Kirgizstan	2.42	0.6	0.4
Tajikistan	80.15	15.4	9.5
Turkmenistan	3.58	35.8	22.0
Uzbekistan	5.97	48.2	29.6
Total 1	*92.12*	*100*	*61.5*
Afghanistan*	7.88		2.1
Total 2	**100**		**63.6**

* Afghanistan is not an ICWC member. The quantity of water used by Afghanistan included in the Table is based on empirical values.
** The values in km³ per year reflect the situation in an average year. The actual amount to be used by each country is determined by a semi-annual forecast of expected water quantities based mainly on assessments of the snow cover in the catchment area.
Source: Mr. Daler Abdurazoqzoda, Head of Energy and Water Policy Department (pers. comm. 2024-03-05).

These volumes of water withdrawals from the Amu Darya River were set against the level of full water exhaustion, “proceeding from the existing water use practices, irrigated land in use, and based on estimated unit water use” (Protocol 566). The Master Plans give the following justification of that water distribution criterion: “*According to the USSR water law, for the distribution of limited water resources the priority sectors are: drinking and municipal water supply and industry, as well as fishery that show high water demand in terms of quantity and quality and guarantee. In addition, in arid zone, the most demanding water user is the irrigated agriculture. As a rule,* ***the area of irrigated land is the main guiding factor*** *in setting the volume of water withdrawal*.”

After the end of the Soviet Union, when the Central Asian former soviet republics became independent states, several interstate agreements were reached between them regarding water allocation and use. The International Water Sharing Agreements of 1992 (Almaty Agreements), formalized the establishment of the International Commission on Water Coordination (ICWC), the Basin Water Organizations (BWOs) Amudarya and Syrdarya, and established the main mechanisms through which the countries come together every year to discuss and agree on water sharing allocations. In a meeting held in Nukus, Uzbekistan, on September 20, 1995, the states signed the so-called Nukus Declaration, which defined the policy to be taken for the Aral Sea. The Nukus Declaration does not specifically address water allocation to and distribution among the riparian countries, and it does not refer to Protocol 566 or any other agreement on water resources. It also does not mention the use of water resources for hydropower. However, it confirms that previously signed agreements on water resources would continue to be respected.

This situation was analysed in the 2014 ESIA. The 2014 ESPOE, in its final report, emphasised the concerns about this situation as follows: “*The legal analysis contained in the ESIA (chapter 8) shows that these water sharing instruments are agreements, declarations or practices rather than treaties, that they lack provisions for monitoring and enforcement; and provide no dispute resolution mechanisms. The E&S PoE notes that the legal and technical basis for the BWO and ICWC water quotas to countries lack clarity by not being explicit and that no documented account of the process and rules applied by these bodies for water allocation between states has been provided. Although generally appearing acceptable by the countries involved, current annual water allocation practice thus remains vague and unenforceable and is not amenable to objective resolution in cases of dispute. It is noted that the current practice does not include Afghanistan that in the future may become a*

more important stakeholder. The Rogun project planning is thus proceeding without transparent verifiable agreed rules for allocating water between competing seasonal and annual demands."

While these concerns may be justified from a legal point of view, the practice observed during the last more than 30 years shows that the water management framework arising from Protocol 566 and evolving through the Almaty Agreements (92), Nukus declaration (95) and through the established practices of yearly water allocation agreements at the ICWC with the BWOs, is a robust system that works. In addition, since 2010, BWO Amu Darya makes data on water allocation to and actual water use by the member countries publicly available (http://sic.icwc-aral.uz/reports_e.htm) for each half-yearly period (growing season, April 1 to September 30, and non-growing season, October 1 to March 31). These data are analysed in the Cumulative Impact Assessment as part of the updated ESIA. The data show that the BWO member countries respect the water allocation, and that during the period on record Tajikistan on average used 1.3 km³ less water than its allocated share. The conclusion from that is that in spite of the mentioned shortcomings the system obviously works, and has proven to be a very robust one.

Currently, the countries meet at least four times per year in the context of the ICWC to define the agreed water allocations for the vegetation and non-vegetation seasons and the distribution of flows across the season based mainly on the demand profiles for each country prepared by the BWOs and the forecasted water availability for the season. Article 8 of the Almaty Agreement gives mandate to ICWC to adjust the water withdrawal limits and reservoir operation regimes depending on actual water availability and the current water-related conditions. Once the water withdrawal limits have been agreed upon (with adjustments if needed), the BWOs have the mandate of implementing the water allocations by operating the diversions for the River's main stem, and to do the water accounting. Subsequent meetings during the year are used to make adjustments in the withdrawal limits to correct for deviations between the forecasts (expectations) and the actual flows.

The following Figure summarizes the water availability and water use over time in the Amu Darya basin, showing total actual annual flow and total cumulated use.

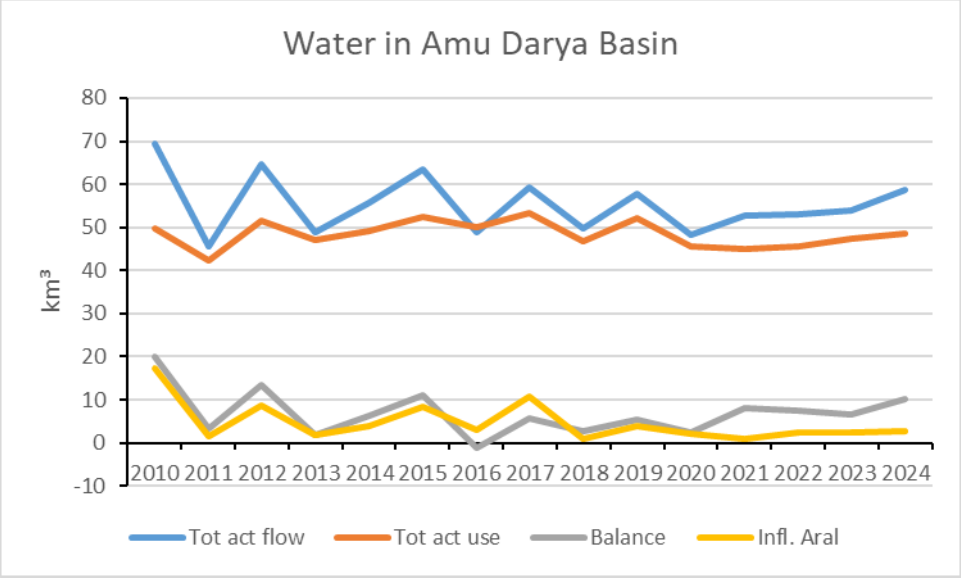


Figure 3-3: Total yearly water flow and use in Amu Darya basin

Data source; http://sic.icwc-aral.uz/reports_e.htm

The Figure also shows something else which is of high relevance in the context with Rogun HPP: while there seems to be some correlation between balance (i.e. water not used) and inflow to the Aral Sea, these two parameters are not directly correlated. It cannot be assumed that the total volume of unused water in the basin would automatically reach the Aral see. This is clearly shown by the data for the last few years, where there was a slight increase of unused water and at the same time a decrease of water reaching the Aral Sea. This also means that it cannot be assumed that any change in water released from Rogun would result in a same effect on inflow to the Aral Sea.

One main concern, for which there is no clear solution yet, is the fact that Afghanistan is still not included in the water sharing agreements. Presently, it has a project under way, the Qosh Tepa canal, which will have the

capacity to divert 5 (potentially up to 15 km³ of water annually from Amu Darya, which would change the basin's water allocation in a rather fundamental way. Phases 1 and 2 of the project, comprising the construction of the canal are almost finalized, and Phase 3 the most complex one is to start soon comprising the land reclamation, administration and the development and organization of the irrigation schemes. See the CIA for a discussion of the topic which also mentions the need to include Afghanistan.

3.2 Vakhsh Basin

Vakhsh basin is a sub-basin of the Amu Darya basin (see Figure 3-1).

One of the Vakhsh River's sources, its tributary Kizil-Su, lies in a very remote area of southern Kyrgyzstan near the Chinese border, where it runs westwards for 262 km; it then flows through Tajikistan for a length of 524 km before joining the Pyanj River to form the Amu Darya at the border of Tajikistan and Afghanistan.

The river gets the name "Vakhsh" at the confluence of Surkhob and Obihingou rivers; the former of these two is formed by the confluence of Muksu and Kizil-Su rivers; Kizil-Su, which is one of the major spring rivers of Vakhsh, originates in Kyrgyzstan. Muksu river, which originates from Fedchenko glacier - the largest glacier of Central Asia - is the main source river of Vakhsh. Vakhsh runoff is approximately 20 km³/yr, to which Muksu contributes 3.53 km³ and Kizil-Su 1.65 km³.

For most of its route, Vakhsh rushes through high mountains, before slowing down in the plains of southern Tajikistan. The river, which is fed mostly by melting snow and glaciers, achieves maximum flow during the summer months of July and August. The river's watershed area is 39'100 km², of which 31'200 km² lie within Tajikistan.

In its upper parts, Vakhsh is a mountain stream with a rather marked gradient, flowing mostly through a rather narrow valley with steep slopes. On a considerable part of this mountain section it flows in a gorge-like valley deeply cut into lateral alluvions. Only on a few sections the valley is wider and almost flat, and here the river has formed extensive floodplains. Two of these, one near Komsomolobod, the other near Novobod, are located within the area of the future reservoir. Likewise, the confluence of Surkhob and Obihingou will also be submerged by the reservoir.

Downstream of Nurek, Vakhsh river flows in a south-westerly direction through a gradually widening plain. In its lowest part it flows in wide meanders in a wide plain; this is the protected wetland area called Tigrovaya Balka. It then reaches the border with Afghanistan, where it meets Pyanj river. These two then form Amu Darya. Downstream of the Pyanj-Vakhsh confluence, only one more river of some importance joins the Amu Darya within the territory of Tajikistan, the Kafirnigan.

Vakhsh river has a seasonal flow pattern, with a discharge maximum in July and a minimum in February, as can be seen from the following Figure. River flow is mainly influenced by snow melt, since a major part of the annual precipitation falls during the winter months, in higher areas as snow.

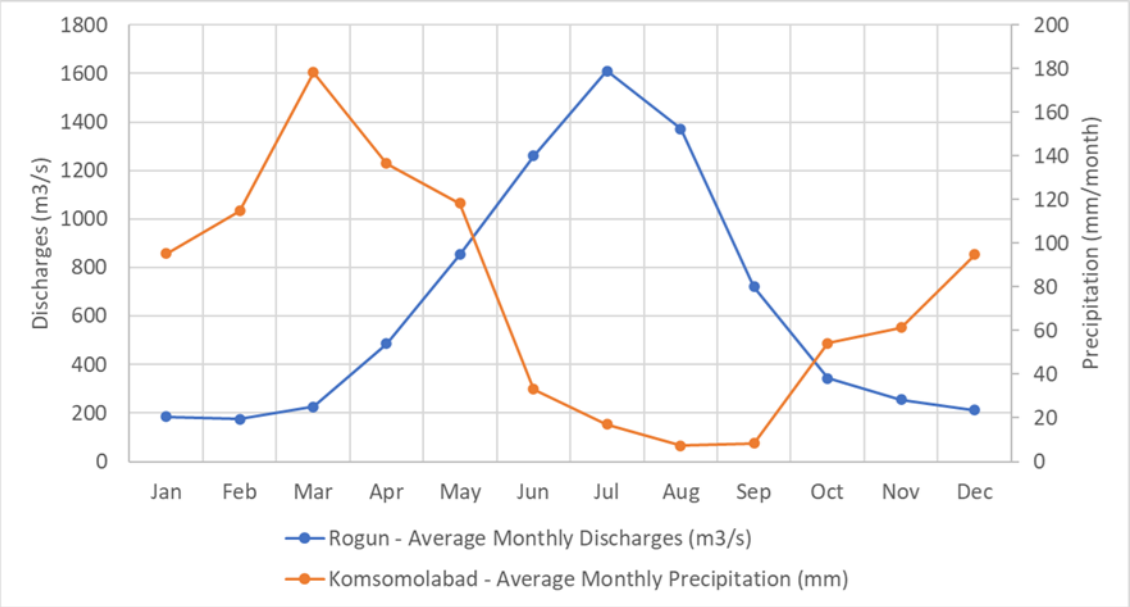


Figure 3-4: Monthly average precipitation and average flow of Vakhsh River

(2025 ESIA Vol. 2, Annex 7-1, Baseline Conditions).

Figure 3-4 presents the average monthly flow pattern at Rogun dam (from a combined flow dataset from Pöyry (2014) and the World Bank (2023)) and the average monthly precipitation measured at Mehrobod (then known as Komsomolobod or Komsomolabad) (data obtained from Pöyry (2014)). The graph illustrates that the flows are not correlated with precipitation but are correlated with seasonal temperature change.

A monthly flow record covering the period January 1932 to December 2022 for the Rogun Dam is available. The flows are driven by snow melt starting in April with the flows increasing during the summer months. The monthly flow pattern and the range of monthly flows are shown in the box and whisker plot in Figure 3-5.

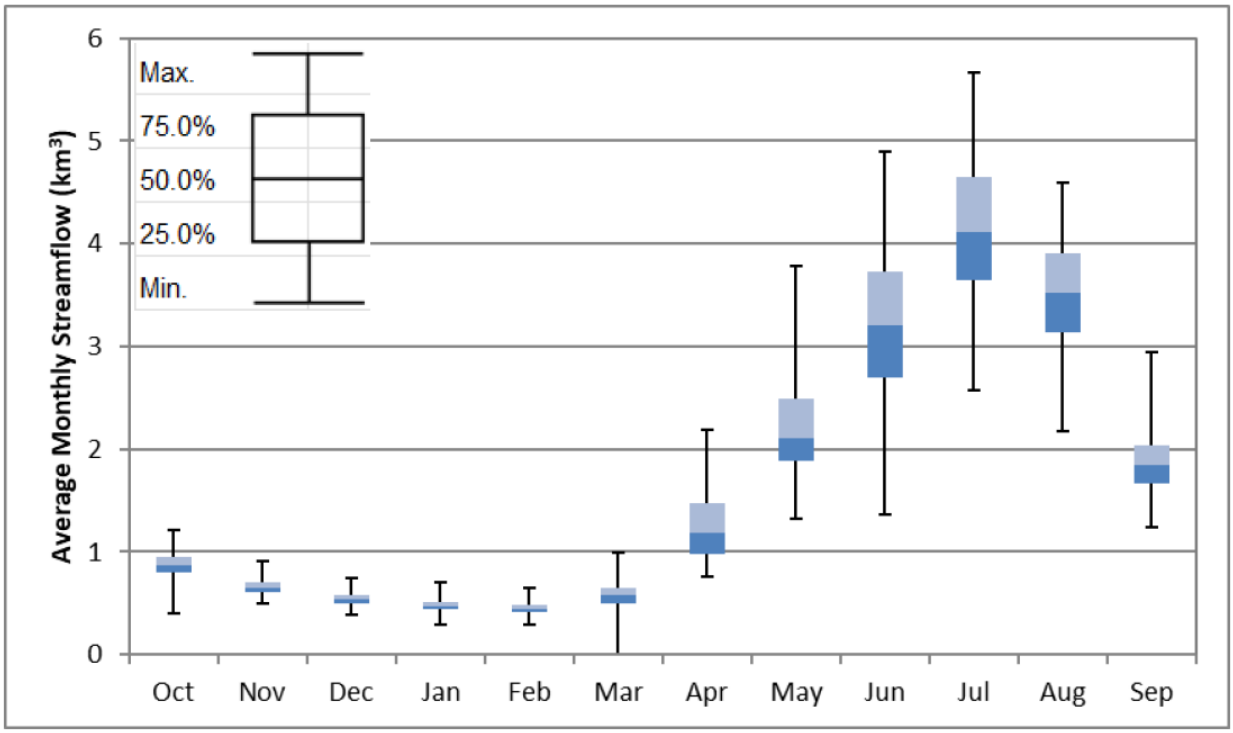


Figure 3-5: Box and Whisker plot of monthly streamflow record at Rogun HPP

Source: 2025 ESIA, Vol. 2, Annex 13-3, Water Resource Modelling

The average annual flow is 20 km³, with year-to-year variations between a maximum of 27.3 km³ and a minimum of 14.2 km³ (Figure 3-6).

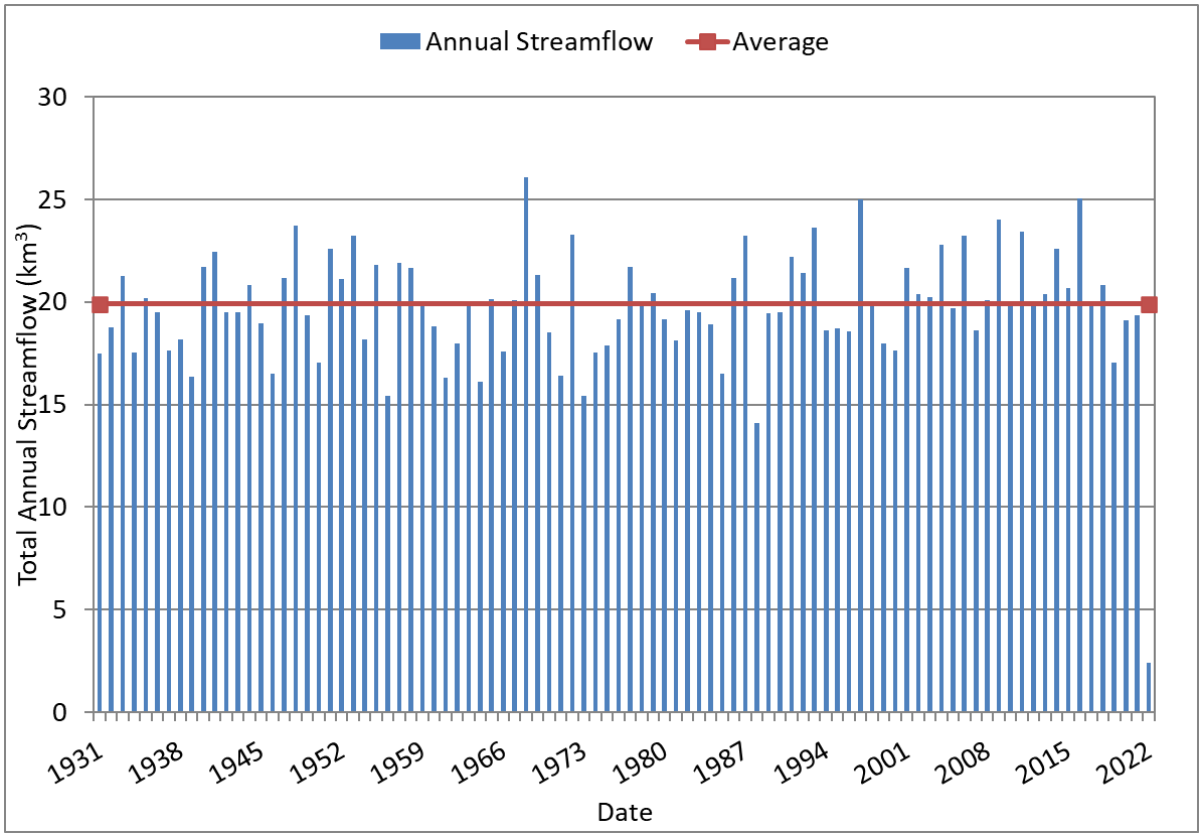


Figure 3-6: Annual flows of Vakhsh River at Rogun HPP

Source: 2025 ESIA, Vol. 2, Annex 13-3, Water Resource Modelling

3.3 Vakhsh Cascade

Nurek HPP was commissioned in 1972. It is the largest HPP, and the second largest regulation reservoir in Amu Darya river basin (after Tyuyamuyun reservoir in Uzbekistan). Until now, it provided around 80% of the electricity available in Tajikistan. So far, Nurek is the only reservoir in upper Amu Darya basin (i.e. in Kafirnigan, Vakhsh and Pyanj basins) with an interannual regulation capacity. The other HPPs in the Vakhsh cascade have a maximum of a weekly (Baipaza) or daily (for peak production) regulation capacity (see Table 3-4).

Figure 3-7 shows the schematic layout of Vakhsh cascade as it was used for modelling Rogun and Nurek reservoir operation in TEAS (2014) and in the updated ESIA (Vol. 2, Annex 13-3, Water Resource Modelling). Shurob HPP, which still is a project at the conceptual stage, was not included in the model. In any case, since it will be a ROR structure, it will not influence seasonal water distribution in any way. Irrigation 1, indicated between Nurek and Shurob, stands for the irrigation water which is derived from Nurek reservoir.

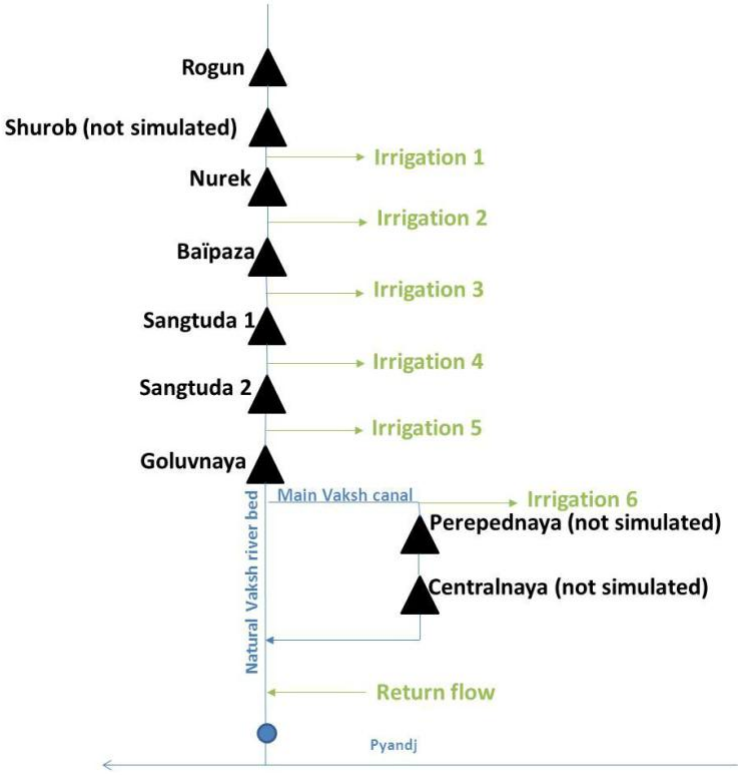


Figure 3-7: Vakhsh cascade

Source: TEAS 2014: Phase II - Vol. 3 – Chap.5 – Reservoir operation study.
Rogun HPP is under construction, while Shurob is in an early planning stage.

As can be seen from this schematic layout, water is taken from Nurek reservoir and from the downstream part of Vakhsh River for irrigation within Tajikistan.

Table 3-4: Characteristics of existing Vakhsh River cascade HPPs

HPP	Regulation capacity	Reservoir			Installed capacity, (MW(	Head, (m)
		Total volume (hm^3)	Active storage (hm^3)	Surface (km^2)		
Nurek	annual	10,500	4,536.8	98	3,000	265
Baipaza	weekly/daily	97	80	8.04	600	60
Sangtuda-1	daily	258	12	9,75	670	64.4
Sangtuda-2	daily	66.5	3.53	-	220	22
Golovnaya	daily	94.5	18	7.5	210	23.3
Perepadnaya	daily	-	-	-	29.9	-
Centralnaya	daily	-	-	-	15.1	-

The construction of Nurek from 1961 to 1980, the creation of the 10.5 km^3 reservoir and the commissioning of the hydroelectric station from 1972 to 1979 have resulted in a modification of the Vakhsh River flow pattern to the following extent:

- The filling of the reservoir from 1972 to 1980 resulted in a reduction of downstream flows equal to the volume of water stored in the reservoir of 10.5 km^3, which over the nine years filling duration, on average, meant a flow reduction of 1.16 km^3 per year, corresponding to 6.8 % of the Vakhsh River flow or 1.5 % of the entire Amu Darya flow.

- The increase of evaporation due to the creation of the reservoir is estimated by HPI (2009) to be 0.052 km³/yr, i.e. 0.3% of the Vakhsh River flow.
- Modification of the seasonal distribution of Vakhsh river discharge is a result of the reservoir operation. As can be seen from the following Figure, Nurek had a regulating effect on Vakhsh discharge downstream of the dam, with a marked shift, with a total of 4.2 km³, from high flow season to low flow season.

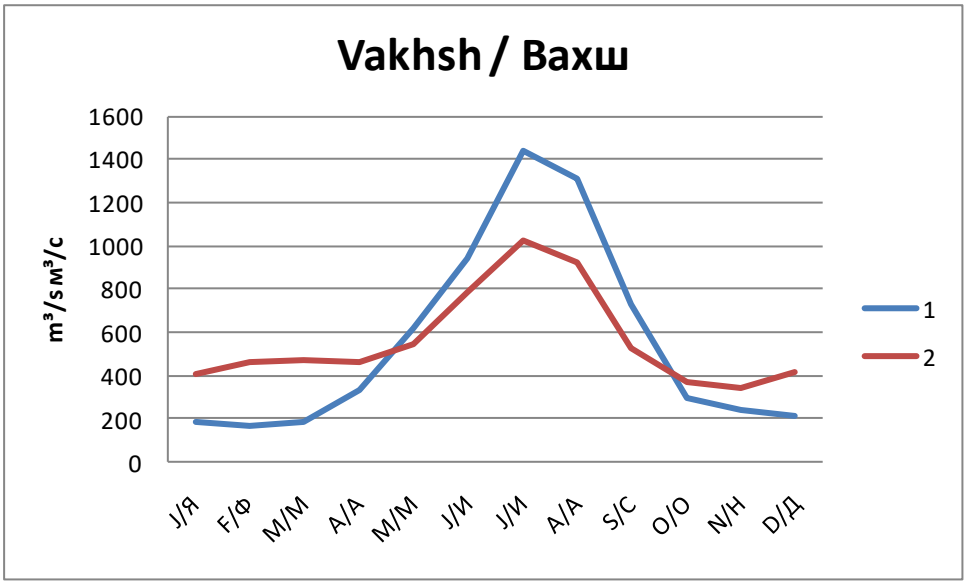


Figure 3-8: Effect of Nurek dam on Vakhsh discharge

Values for Vakhsh-Tigrovaya Balka station:
1 = without Nurek (1960-1962)
2 = with Nurek (1984-1990)
Source: 2014 ESIA

This shift from summer to winter is also shown in Figure 3-9.

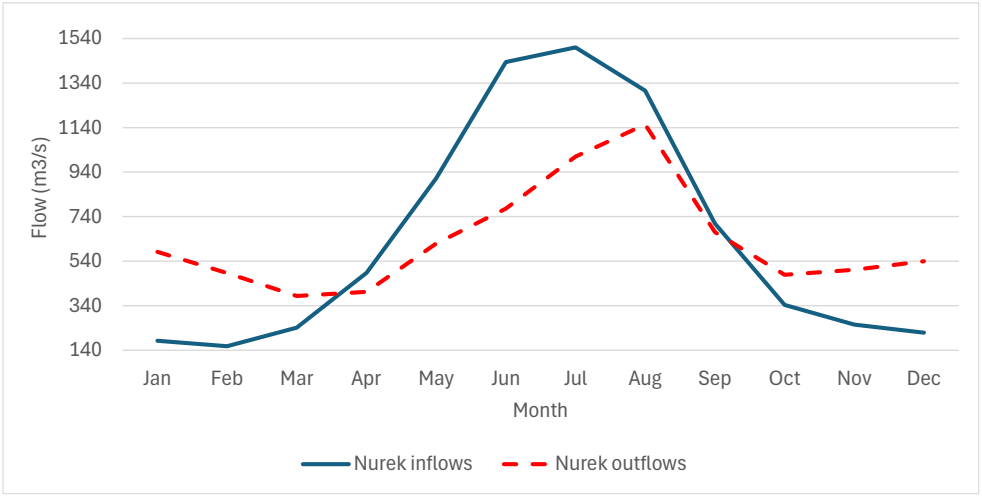


Figure 3-9: Average monthly inflows and releases from Nurek HPP for current operation

Source: 2025 ESIA, Vol. 2, Annex 13-3, Water Resource Modelling

The main effect of Nurek HPP was the permanent shift of 4.2 km³ of water from summer to winter. The increased winter flow is used for generating electricity in winter, when demand is highest and natural flow in rivers is lowest.

This shift is maintained, and BWO water allocation is based on this changed pattern of Vakhsh discharge. Overall seasonal flow in the Amu Darya was changed accordingly by this shift.

3.4 Main Characteristics of Rogun HPP

The construction of Rogun Dam started in the 1970s and has been through a number of stop/start cycles with the project implementation resuming in 2008. As of May 2025, the dam has reached an elevation of 1100 m asl, and water is impounded to an elevation of 1 075 m asl, and electricity is being generated through the two preliminary turbines already installed in the power house. Discharges from the reservoir are currently made through the turbines and bypass tunnels. A further 4 turbines and an upgrade of the two preliminary ones is planned as the dam embankment will raise and the construction of the associated infrastructure will be completed. The concurrent installation of the turbines while constructing the dam will allow for the generation of electricity as the dam is constructed. The construction of the dam to its crest elevation of 1300 m asl is planned for completion by November 2033.

Table 3-5: Main characteristics of Rogun HPP

Main part	Item	Unit	Dimension
1. Dam	Height	m	335
	Crest elevation	m asl	1300
2. Reservoir	Overall length	km	70
	Area at FSL	km²	159
	Elevation at FSL	m asl	1290
	Total volume	km³	13.3
	Drawdown 1: Minimum operation level (MOL 1) Maximum drawdown Live storage 1 Area at MOL 1	 m asl m km³ km²	 1185 105 10.3 51
	Drawdown 2: Minimum operation level (MOL 2) Maximum drawdown Live storage 2 Area at MOL 2	 m asl m km³ km²	 1260 30 4.2 (Nurek: 4.2) 125*
3. Hydrology	Catchment area (Komsomolobod)	km²	29,500
	Average inflow yearly monthly maximum (July) monthly minimum (February)	 m³/s m³/s m³/s	 631 1,600 73
	Total annual inflow	km³	20.1
	Floods: 2 years 10 years 100 years PMF	 m³/s m³/s m³/s m³/s	 2,360 3,070 4,030 7,800
4. Power Plant	Total installed capacity	MW	3780
	Number of units (630 MW each)	N	6
	Discharge from turbines maximum per unit maximum (all 6 units)	 m³/s m³/s	 271 1,626
	Yearly power production	GWh	14,400 (17,000)

* Estimated value, determined by interpolation.

Dam type: rockfill with central impervious core.

Construction stage situation (May 2025):

- dam crest 1,110 m asl, height 143 m (upstream cofferdam)
- reservoir level 1,075 m asl
- Reservoir area 12 km², volume 0.5 km³
- 2 units @ 200 MW each under operation.

Some additional relevant information on Rogun HPP:

- Rogun dam is the second large dam constructed on Vakhsh River, about 70 km upstream of the existing Nurek dam.
- Its main purpose is the production of electricity, a large part of which shall be exported, mainly to Pakistan and Afghanistan, via the 500 kV transmission lines built under the CASA 1000 project.
- Filling of the reservoir (13.3 km²) will be done under strict observation of the water allocation rules, which means that on average annually not more than 1.2 km² of water will be retained, which corresponds to the quantity allocated to Tajikistan under Protocol 566 but so far not used by Tajikistan. The plan is to gradually fill the reservoir over the period from 2019 to approximately 2037; see detailed discussion of this topic in Section 4.1.3.
- The expected life span of Rogun HPP is 115-130 years; the main limiting factor is sedimentation of the reservoir.

The 2014 TEAS and ESIA concluded that the Vakhsh cascade, with Rogun HPP in place, can be operated in a way as not to change the present river flow pattern in the downstream area, and especially not to change the seasonal distribution of flows. Tajikistan intends to operate the cascade in this way. This means that building and operating Rogun HPP will not reduce water availability for irrigation by downstream riparians, considering that Tajikistan intends to use its full water share in any case. This is discussed in detail in Section 4.

4 Impact Assessment and Mitigation

4.1 Seasonal Water Distribution

4.1.1 Main Aim: No Change in the Downstream Area

Tajikistan committed itself to respect the two conditions outlined at the end of the previous Section, and by doing so continue to adhere at all times with the regional water allocation agreements by not using more water than allocated to it during the filling phase, and by not shifting additional water from summer to winter. This would mean that there will be no change in seasonal water availability in the downstream area in comparison to the situation without Rogun, with the only exception that from now on Tajikistan will use the full share of the water allocated to it. This, however, is something that Tajikistan plans to do in any case, first for filling Rogun reservoir and then for increasing its irrigation.

In the following Sections, these conditions are analysed in some more detail.

4.1.2 Modelling of Rogun

For the 2014 TEAS, a modelling of Rogun reservoir operation was carried out (Coyne et Bellier et al., 2013: Reservoir Operation Simulation Studies). This was rechecked and updated as part of the 2025 ESIA (2025 ESIA, Volume2, Annex 13-3: Water Resource Modelling). The following Sections are based on these two modelling studies.

4.1.3 Filling of Rogun Reservoir

The guiding principle for the impoundment of Rogun reservoir is that the Government of Tajikistan will impound the flows that are otherwise not used from its annual water share allocation, as per the water allocations to countries regionally agreed each year at ICWC meetings. Tajikistan will respect at all times the regional water sharing agreements during the impoundment of Rogun reservoir, and will not go beyond its allocated water share.

As outlined in Section 3.1.4, water allocation among the riparian states Kirgizstan, Tajikistan, Turkmenistan and Uzbekistan is agreed by member states in the context of the ICWC meetings and with the assistance of the BWO. Based on the forecast on expected water quantity in the following vegetation period derived from observations of snow cover in the upper reaches of the Amu Darya basin, each country is allocated a certain amount of water. Figures on this allocation as well as on actual consumption are provided in a BWO home page (http://sic.icwc-aral.uz/reports_e.htm). The following Table shows the present use of this water in Tajikistan for the period 2010 to 2023, the period for which data are available on the internet site mentioned above. The Table shows the following parameters:

- allocated km³: this is the total yearly volume defined by BWO, based on the two forecasts (one growing season, summer, and one non-growing season, winter), which Tajikistan is allowed to use;
- used km³: shows the water volume that was actually used by the country during this year;
- used %: indicates the percentage of BWO allocated water which was used;
- balance km³: the volume of BWO allocated water which was not used (- xx) or which was used in excess of the allocated volume (+ xx); the Table shows that this latter never occurred during the 15 years on record.

Table 4-1: Yearly water use by Tajikistan

Year	allocated km³	used km³	used %	balance km³
2010	9.63	7.48	77.67	-2.15
2011	9.67	8.05	83.25	-1.62
2012	9.75	8.23	84.44	-1.52
2013	9.72	7.67	78.91	-2.05

2014	9.75	7.79	79.90	-1.96
2015	9.82	8.41	85.64	-1.41
2016	9.88	7.91	80.06	-1.97
2017	9.77	9.03	92.43	-0.74
2018	9.67	8.80	91.00	-0.87
2019	9.88	8.80	89.07	-1.08
2020	9.88	8.46	85.63	-1.42
2021	9.88	8.69	87.96	-1.19
2022	9.86	9.09	92.19	-0.77
2023	9.78	9.46	96.73	-0.32
2024	9.94	8.63	86.82	-1.31
Water not used (average)				-1.36

Source of data: http://sic.icwc-aral.uz/reports_e.htm
Values for winter 2012-2013 are not available; in order to simulate a complete year, the average value of the 14 winters on record were inserted.

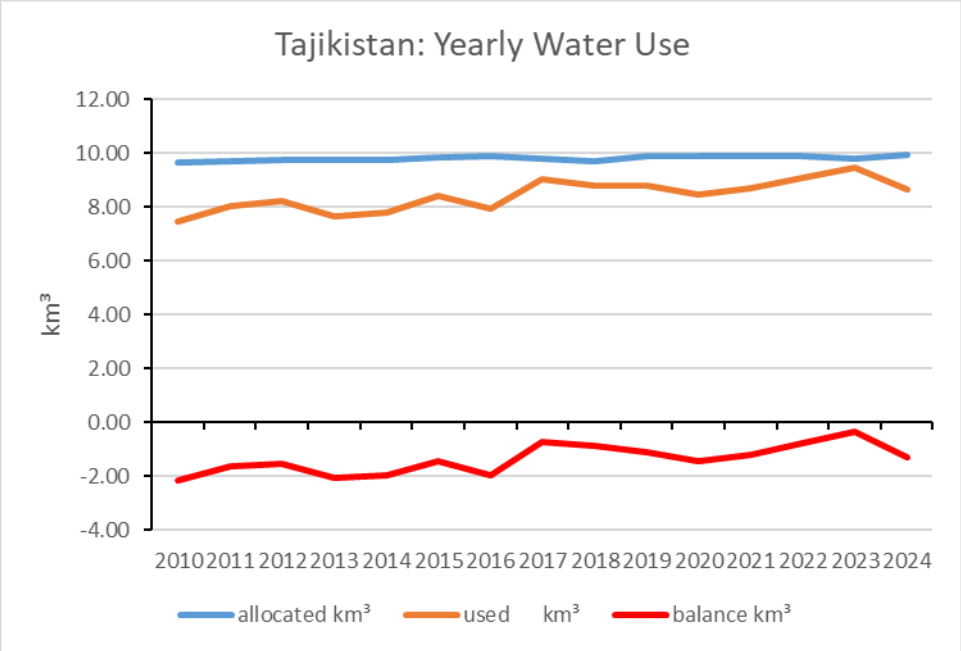


Figure 4-1: Yearly water use by Tajikistan

The same data are shown graphically in Figure 4-1. The graph seems to indicate a trend towards using an increased share of allocated water, especially in the years 2020 to 2023; according to information received from the Energy and Water Policy Department (oral communication), this was due to a number of dryer than average years and the fact that additional water was used for eliminating salts that had been accumulating in irrigated areas. The latest year on record, 2024 (which includes the first quarter of 2025) shows a portion of unused water close to the long-range average.

As Table 4-1 shows, during the 15 years on record on average 1.36 km³ of the water allocated to Tajikistan was not used. In the reservoir simulation study, TEAS (2014) had determined an average volume of 1.211 km³ of yearly unused water. In the following discussion this value (1.211 km³ per year, corresponding, as a yearly average, to 38 m³/s) is used, because this is a more conservative assumption than the 1.36 km³, and the TEAS value is based on a longer time series and therefore less likely to be affected by short-terms fluctuations. This is the amount of water that is, in an average year, available for filling Rogun reservoir. This corresponds to about 6% of the mean annual Vakhsh runoff (inflow to Rogun reservoir, see Figure 3-6) of 20 km³/year. It is understood

that the actual difference will depend on what is agreed in the ICWC meetings of each year, being the difference between volumes allocated annually and expected use in that year (the point being that the volume of water available for filling Rogun will vary from year to year, with less water available in dry years and potentially more in wet years). It is expected that in ICWC negotiations each year, Tajikistan will likely get a greater allocation during above-average years (water abundant years) and the unused water share will exceed the historical average; and conversely, during drought years, the unused allocation may be smaller than the historical average. For this reason, the impoundment of Rogun reservoir will depend mainly on the volume of inflows from the Vakhsh River during impoundment years. Given the need to respect the regional water sharing agreements at all times, an exact, fixed impoundment plan is difficult to produce.

It is important to highlight two points here: First, as Tajikistan has not used its full allocation, the ICWC-agreed allocation has been constant in time, without any increases during wet years. This is subject to change in future yearly ICWC meeting negotiations given the need to impound Rogun. The basis for making this assumption is two-fold: (i) Protocol 566 stated: "*If water availability in the Amudarya River is above the estimated one, excess water, i.e. above the established quantities of water withdrawal, must be primarily accumulated by reservoirs"*. This would obviously benefit Tajikistan in the impoundment of Rogun; and (ii) Article 8 of the Almaty Agreement gives mandate to ICWC to adjust the water withdrawal limits and reservoir operation regimes depending on actual water availability and the current water-related conditions. This gives room for negotiations if the countries agree at ICWC. Tajikistan never had an incentive to negotiate for more water during wet years as it never used its full allocation, but now the incentive is clear and backed by Protocol 566.

Second, it is well known that a significant part of the flows diverted into canals in Tajikistan return back to the river, and the actual use of the water share is overestimated. Two simple examples are as follows: (i) in winter, the irrigation canals downstream of the cascade (such as the Vakhsh Main Canal) are used for several HPPs existing along the canals but there is no consumptive use and the totality of the water diverted returns to the river; (ii) the conveyance and irrigation efficiency in Tajikistan is low, with numerous return flows to the river. The Ministry of Energy and Water Resources of Tajikistan is making steps to install hydroposts to measure these unaccounted return flows to the river, which are significant.

Thus, the above two points indicate that Rogun could potentially be impounded at a slightly faster rate than anticipated, with the accounting of return flows to the river, and if a few wet years were to occur, specially after year 2030 (see Table 4-2) when the reservoir construction increases storage capacity at a much faster rate than 1.2 km^3/year.

Presently (May 2025) the dam has reached an elevation of 1100 m asl, the water level is at 1075 m asl and reservoir volume is about 0.5 km^3. This volume, which was retained during the last 3 to 4 years, is much less than the annual available volume, but its retention has possibly contributed to the higher than average water consumption of Tajikistan illustrated in Figure 4-1. Still, it is not possible, based on the data on water use, to actually see when how much water was retained. This is also shown by the fact that the water level in the reservoir was raised by 5 m (from 1070 to 1075 m asl) in August-September 2024, while in that year the amount of unused water by Tajikistan rose by 1 km^3 in comparison with the year before (Table 4-1). At the present still low water level in the reservoir and the comparatively small surface of only 7 km^2 the increase in volume by a rise by 5 m will be in the order of magnitude of 0.035 Km^3.

Reservoir capacity, i.e. the volume available for storage, increases as the construction of the dam progresses (see details in ESIA Vol. 2, Annex 13-3, Water Resource Modelling). However, due to the restriction in water retention to 1.211 km^3 per year, the increase in actual water volume retained is slower, as shown in Table 4-2, the reservoir will reach its full capacity in 2033, when the dam crest will have reached its final level of 1300 m asl, while the filling of the reservoir will not be finalised before 2037. As mentioned, the figures presented in the Table are based on the assumption that the average volume of 1.211 km^3 will be available every year. In case a series of dryer than average years should occur during this period, filling of the reservoir could even take longer. This slow filling of the reservoir certainly comes at a cost, since increase in electricity generation would be more rapid with a faster filling regime. However, this process reduces impacts on downstream water users and is therefore much more favourable than what usually is the case in large storage projects.

Table 4-2: Increase of reservoir capacity and water volume stored

Date	Reservoir capacity (km^3)	Water Volume (km^3)
1 Jan 2025	0.86	0.440
1 Jan 2026	1.317	1.317
1 Jan 2027	2.053	2.053

1 Jan 2028	3.240	3.240
1 Jan 2029	4.713	4.450
1 Jan 2030	6.883	5.660
1 Jan 2031	9.402	6.870
1 Jan 2032	13.300	8.080
1 Jan 2033	13.300	9.290
1 Jan 2034	13.300	10.500
1 Jan 2035	13.300	11.710
1 Jan 2036	13.300	12.920
1 Jan 2037	13.300	13.300

Table 4-3 shows the relation of reservoir volume and area with increasing reservoir level. At the elevation of 970 m (river elevation, no dam) reservoir volume and area are 0, reaching their maximum once the reservoir will have reached FSL. This is shown also in the storage-area curve in Figure 4-2.

Table 4-3: Rogun reservoir elevation-volume-area development

Elevation (m asl)	Volume (km^3)	Area (km^2)
970	0	0
1 020	0.2	2
1 070	0.5	7
1 120	1.1	18
1 170	2.4	39
1 220	5.2	76
1 270	10.0	132
1 290	13.3	159

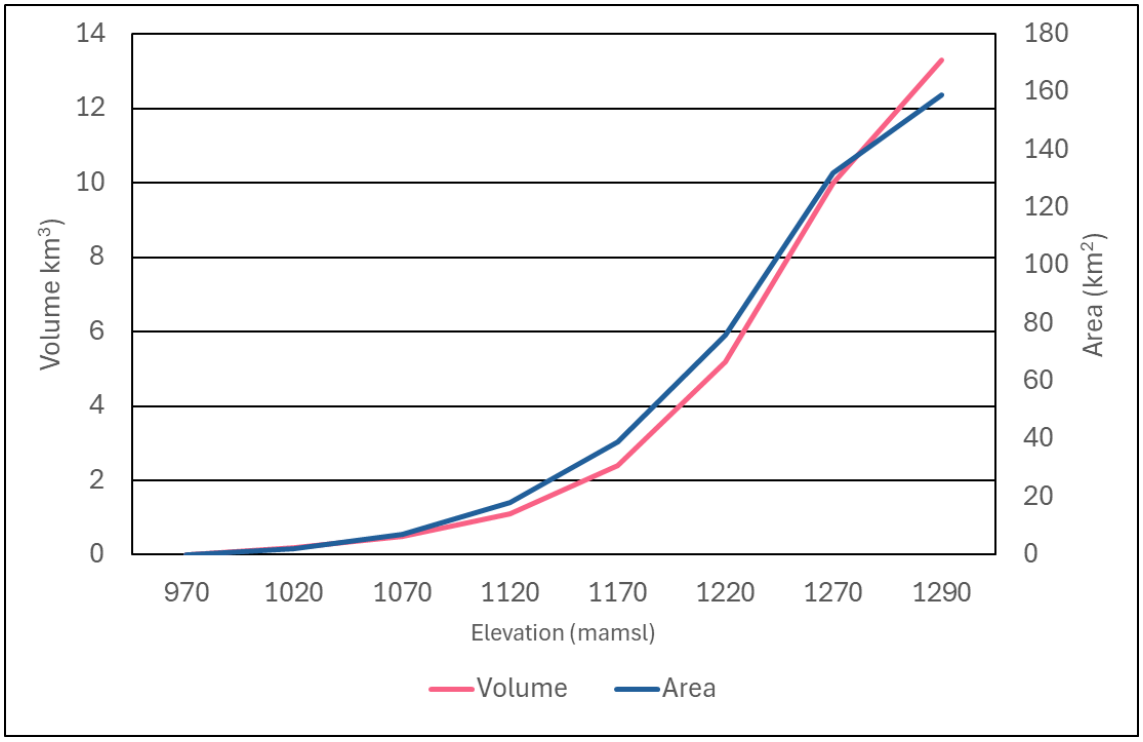


Figure 4-2: Rogun reservoir storage-area curve

Source: ESIA Vol. 2, Annex 13-3, Water Resource Modelling

With increasing dam height and reservoir volume, electricity generation will also gradually increase. Presently, two units with a reduced capacity (200 MW each) are installed and operational at Rogun HPP. The runners of these two turbines will be replaced at a later stage (planned to be done by end of 2025), for them to reach the final capacity of 630 MW, and the 4 remaining turbines will gradually be installed, bringing the total installed capacity up to its final value of 3,780 MW. In parallel to this development the operation pattern will gradually change in the following way:

- In the situation without Rogun, seasonal regulation is done entirely by Nurek, whose reservoir oscillates between the FSL of 910 m asl and the MOL of 857 m asl, controlling a live storage volume of 4.2 km³.
- With increasing dam height and installation of additional generating units, Rogun will gradually take over regulation, fluctuating between a spring low and an autumn high.
- In parallel to that, reservoir fluctuation at Nurek will gradually decrease.
- Once Rogun reservoir will have reached its FSL of 1290 m asl, flow regulation will be done entirely at Rogun, the reservoir fluctuating between FSL and the MOL of 1260 m asl and a regulating volume of 4.2 km³.
- Nurek reservoir will then be operating as a near-ROR structure; its reservoir level will be kept more or less stable at FSL or a little bit below; small fluctuations in reservoir level will be used for balancing out fluctuations resulting from Rogun operation (e.g. by peaking) or to provide some storage space in case of a flood.

This will then be the standard operation pattern for the Rogun-Nurek cascade. This development was modelled by TEAS (2014), and is shown in Figure 4-3. This graph should not be interpreted as precisely reflecting the development of all parameters illustrated, but it is a useful visualisation of the overall development, whereby j-16 in the graph would correspond approximately to the year 2037 of the present time scale.

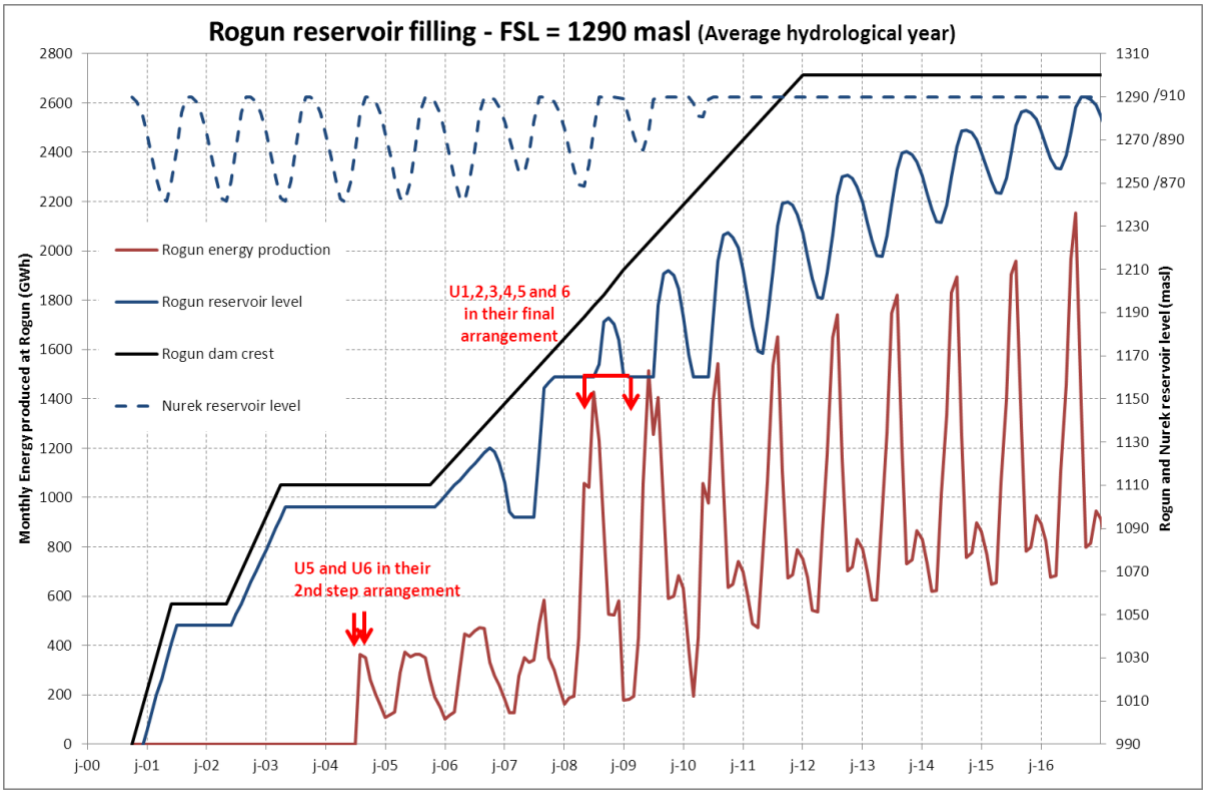


Figure 4-3: Process of Rogun reservoir filling

Source: TEAS 2014 (2013 Reservoir Operation Simulation)

4.1.4 Cascade Operation with Rogun

4.1.4.1 Basic Operation Characteristics

When discussing Rogun HPP and cascade operation (the latter including Rogun and Nurek HPPs, taking into account that the smaller HPPs downstream of Nurek will continue to operate as ROR structures), two patterns have to be distinguished, namely:

- Seasonal: this covers the annual pattern of retaining water in summer for using it for electricity generation in winter, which leads to a seasonal fluctuation in reservoir level. As illustrated in Figure 4-1, this is presently done in Nurek reservoir, to be gradually taken over by Rogun reservoir until such a time when Rogun will assume this role completely, transforming Nurek into a close to ROR structure. It is important to point out that the total regulated volume, which is now 4.2 km³ stored in summer and released in winter will not change in this process.
- Short term, e.g. daily: as a general rule, storage hydropower plants, in addition to seasonal regulation, are also very suitable for short-term (daily) regulation. This means that they can closely follow short-term variations in demand.

In Tajikistan, electricity demand is highest in winter. Therefore seasonal water storage in reservoirs is essential for meeting this demand pattern, and this causes the reservoir drawdown illustrated in Figure 4-3. However, there is also a distinct daily pattern, as shown in Figure 4-4.

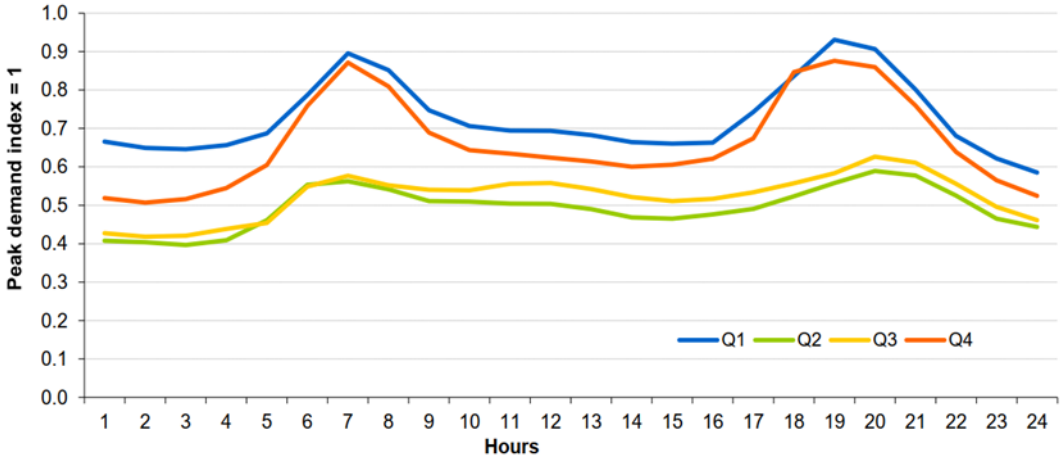


Figure 4-4: Average daily electricity demand pattern

TEAS 2014: Economic Analysis, Fig. 18, p. 33

In addition to the fact that electricity demand in winter (Q1, January to March, and Q4, October to December) is higher than in summer, the Figure also clearly shows that there are two daily peaks, one in the morning and one in the evening. Peaking production is now done by Nurek (and to some degree by the downstream HPPs of the cascade). Once Rogun fully operating, Nurek will still be able to perform in this way, but some of the short-term regulation is likely to be assumed by Rogun as well. It has to be pointed out that there is no firm and well-defined regime for the short-term operation of the cascade, since this will be – as Nurek is now – largely demand-driven. A description of possible and probable patterns is provided in the following Sections.

4.1.4.2 Operation of Nurek HPP

Presently, Nurek provides a large part of the total electricity presently produced and used in Tajikistan. It is operated in three ways, whereby these three modes are overlapping:

- Baseload: 2 to 3 out of the 9 units are always in operation (not including maintenance or emergency shutdowns), and water output of each of the units, when working at full capacity, is between 150 to 163 m³/s.
- Seasonal storage: during the high-flow season the reservoir is filled to its FSL of 910 m asl, and during winter, when inflow into the reservoir is lowest and electricity demand is highest, it is drawn down to its MOL of 857 m asl, in this way using its live storage of 4.2 km³ (2014 ESIA, p. A).
- Daily peaking: daily variation in electricity demand has to be met by corresponding short-term changes in production. Such a peaking regime means that turbines are turned on and off frequently, which in turn leads to important variations of water output from the power plant. Presently, peaking demand is met by Nurek and the cascade downstream of it.

Typical daily patterns are shown in Figure 4-5.

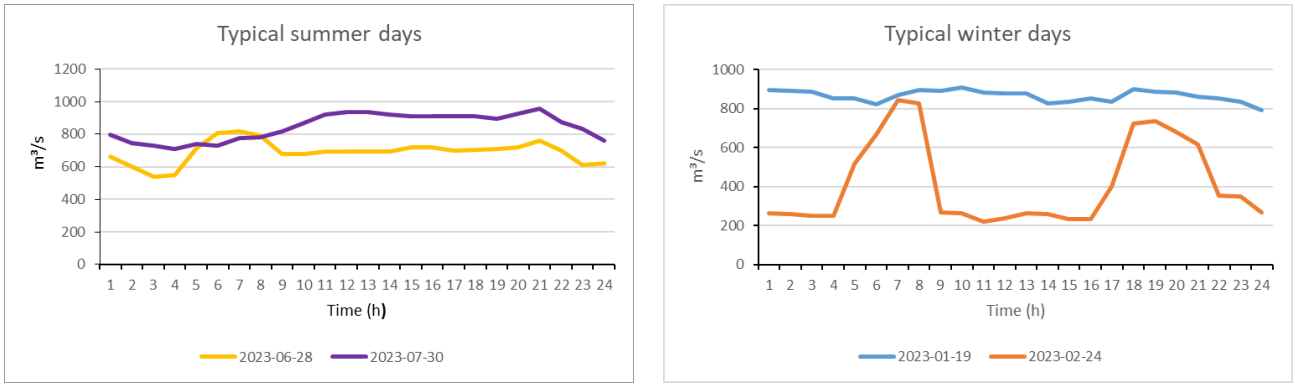


Figure 4-5: Turbining pattern in Nurek HPP

Source; Barki Tojik Dispatch Center, data received 2024-05-08

The theoretical water output from Nurek, with all 9 units operating at full capacity, would be between 1,350 m³/s (with the reservoir at FSL) and 1,467 m³/s (with the reservoir at MOL). The Figure shows that during the days illustrated this maximum was never reached. This can be due to the demand level at that time, but also, especially in winter, due to limited water availability. It also shows that production (and with it use of water) is not constant during the day. In summer, the hourly differences are rather small, a small peak in the morning is visible in one curve and one in the evening in both of them. In winter, the situation can be very different. While one of the curves shows a day with almost constant 24 h output, the other one illustrates a day with a marked peaking pattern. In the morning, water use raises within 3 h from 250 to 842 m³/s, to drop then from 827 to 266 m³/s within one hour; it should be noted that the available data are average hourly discharges, the actual change may be within a much shorter time. The values of roughly 250 m³/s during the day and in the night would mean that at this time probably only two units were operating at reduced capacity.

This clearly illustrates the fact that in a peaking power plant, the daily pattern can vary greatly from one day to the next, and that during the day very marked short-term variations are possible.

4.1.4.3 Operation of Rogun HPP During Filling

The general filling process of Rogun reservoir was discussed in Section 4.1.3. Here, operation during the filling process is discussed. In order to understand this, some information on relevant structures is required. At the present stage of construction (May 2025), in addition to the dam with a crest elevation of 1100 m asl the following structures of relevance for this process are in place:

- Diversion tunnels: there are three diversion tunnels (DT 1 to 3) in operation, a fourth (DT 4) is under construction. when the reservoir will reach a level of about 1110 m asl, sedimentation in the reservoir is expected to reach a level that will block DT 1 and 2, which by then will be replaced by DT 4. Capacity of the DTs depends on reservoir water level; at al level of 1100 m asl, the four DTs will be able to pass a total of about 7,000 m³/s.
- Two units are installed already in the power house, with a maximum installed capacity of 200 MW. Each of them is able to turbine water at a maximum of 192 m³/s, at the present reservoir level about 156 m³/s each; it is planned to upgrade them to the full capacity of 630 MW each, the process foreseen to start be the end of 2025.

The following Figure shows the operation pattern of Rogun HPP for the years 2019 to 2023.

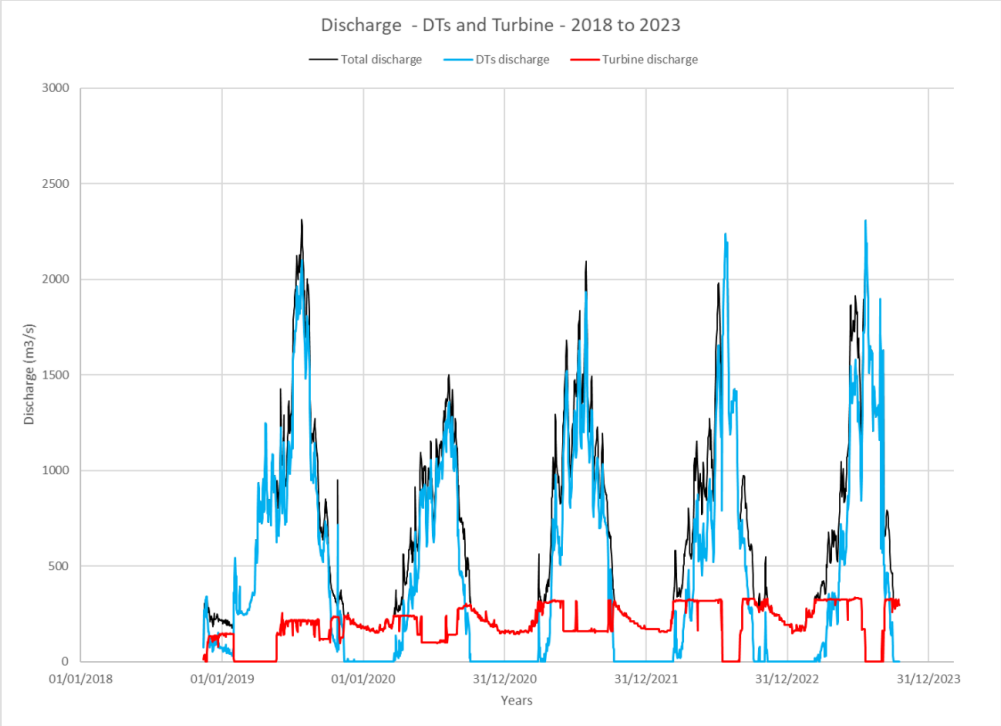


Figure 4-6: Operation of Rogun HPP during the construction period

Source: IADT Report 2025

The Figure shows the following main characteristics:

- By far the largest quantity of water passes through the DTs, with a very clear seasonal pattern.
- The two turbines already installed are operating with a maximum combined discharge of about 300 m³/s.
- During the high-flow season, the turbines are shut down at times, during the low-flow season they operate continuously, although with a reduced output; this presumably reflects water availability (i.e. inflow, since the aim is to keep the reservoir elevation stable).
- During the low-flow season, no water flows through the DTs for extended periods of time. The only discharge during that time is the one passing though the turbines.

Some additional information is provided in the next Figure. This shows details of DT operation in 2020, which was the dryest year of the ones shown in the previous Figure.

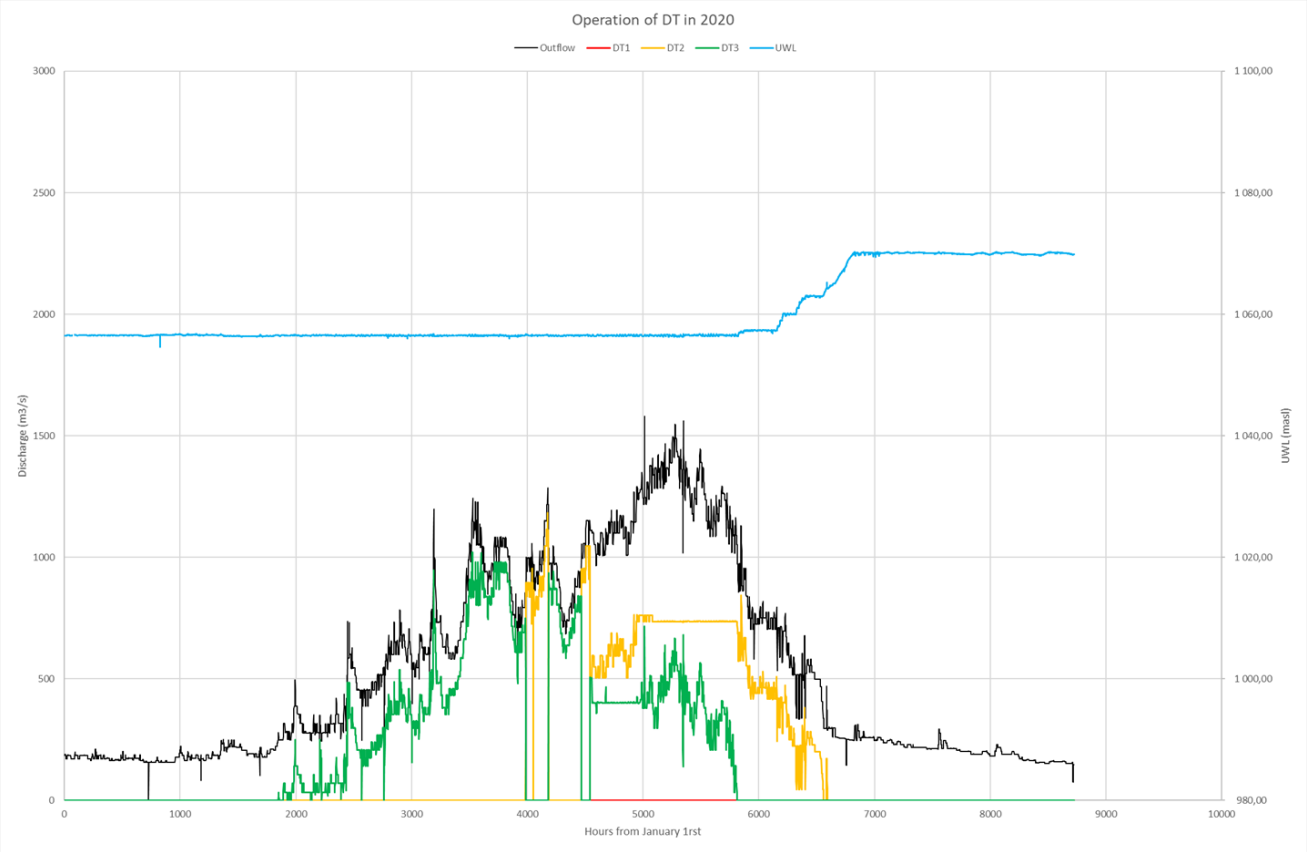


Figure 4-7: Rogun filling phase operation

Source: IADT Report 2025
DT = Diversion Tunnel (tunnels 1-3). UWL = upstream water level (= reservoir water level)
Curves legend : --- Total Outlfow, --- DT1, --- DT2, --- DT3, --- UWL

Main elements:

- Till about July, the plant was operated in a way as to keep the reservoir level constant at about 1058 m asl, meaning that inflow was equal to outflow..
- In August/early September, the reservoir level was risen to 1070 m asl, by which time the total reservoir volume reached about 0.44 km³. Note that the amount of water retained here was far below the theoretically available 1.2 km³; a reservoir level rise by 12 m, at a reservoir surface of about 7 km², corresponds to a volume increase of about 0.08 km³.

- In the beginning as well as in the end of the year, all DTs were closed completely; discharge during this period must represent turbine output (of about 150 – 200 m³/s).

4.1.4.4 Operation of Rogun HPP

Rogun HPP will be operated in the way indicated above, meaning that the annually available volume of water shifted from summer to winter will be retained there, seasonal cascade regulation to be guided by Rogun and no longer by Nurek. Figure 4-8 shows the change this will cause: summer flows (= unregulated flow of Vakhsh River, inflow to Rogun reservoir) will decrease in the section between Rogun and Nurek, while winter flows (regulated outflow from Rogun reservoir) will increase.

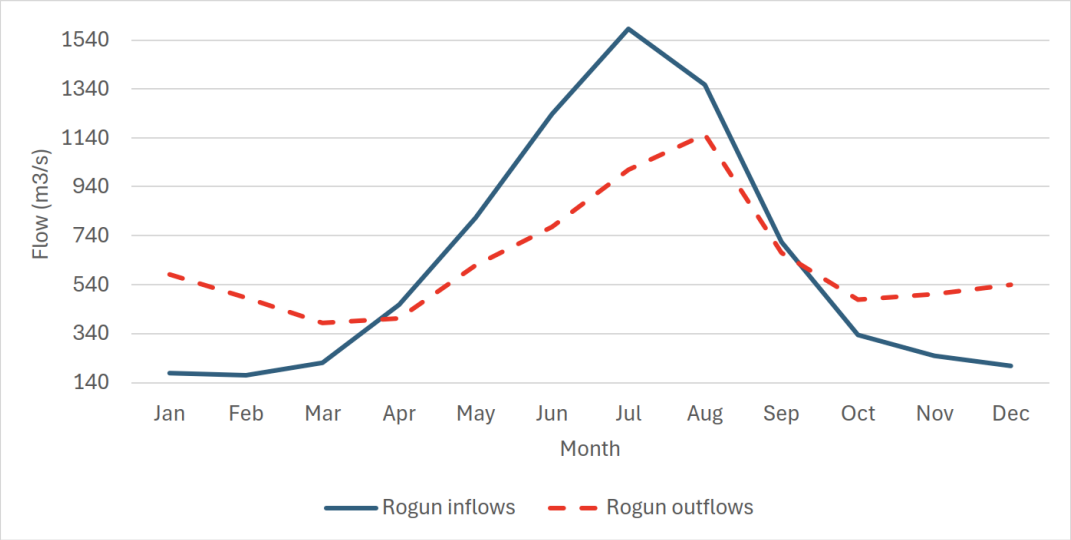


Figure 4-8: Inflow to and release from Rogun during operation

Source: WSP 2025 ESIA: Vol. 1 Annex 13-3: Water Resource Modelling, Figure 9-1

This general operation pattern does not say anything about the short-term (e.g. daily) operation of the power plant. With all 6 units in operation, the power plant can turbine 1,626 m³/s in total. Assuming a year-round operation at full capacity, this would result in a total water volume of 51 km³ per year, 2.5 times the available water. This makes it clear that operation will have to be guided by water availability and power demand. The most probable scenario is that at least one turbine will be running all the time, the remaining according to demand, with maximum capacity being reached only during peak hours. The result of this is a at times highly irregular flow release, with the potential to change between 271 m³/s (one turbine operating) to 1,626 m³/s (power plant operating at full capacity). Such changes can occur frequently and abruptly.

4.1.4.5 Combined Operation of Rogun and Nurek

As mentioned previously, the guiding principle of the operation of the combined Rogun and Nurek reservoirs is that there will be no difference in the seasonal flow pattern below Nurek when comparing the situation without and with Rogun. Simulation results show that this is possible and Tajikistan has made a commitment to not shift more than 4.2 km³/year from summer to winter. This is the amount historically shifted by Nurek operations (emptying itself in winter, and being refilled in summer, by the amount of 4.2 km³/year). This commitment from Tajikistan is reflected in the minutes of riparian consultations as well as in the financing agreement as per the obligation to comply at all times with the water sharing agreements (which include the national water allocations and the seasonally agreed deliveries) and avoiding significant harm downstream. Thus, after impoundment, the presence and operation of Rogun should be invisible to downstream countries, given that the flow regime downstream of Nurek will not change from the historical period.

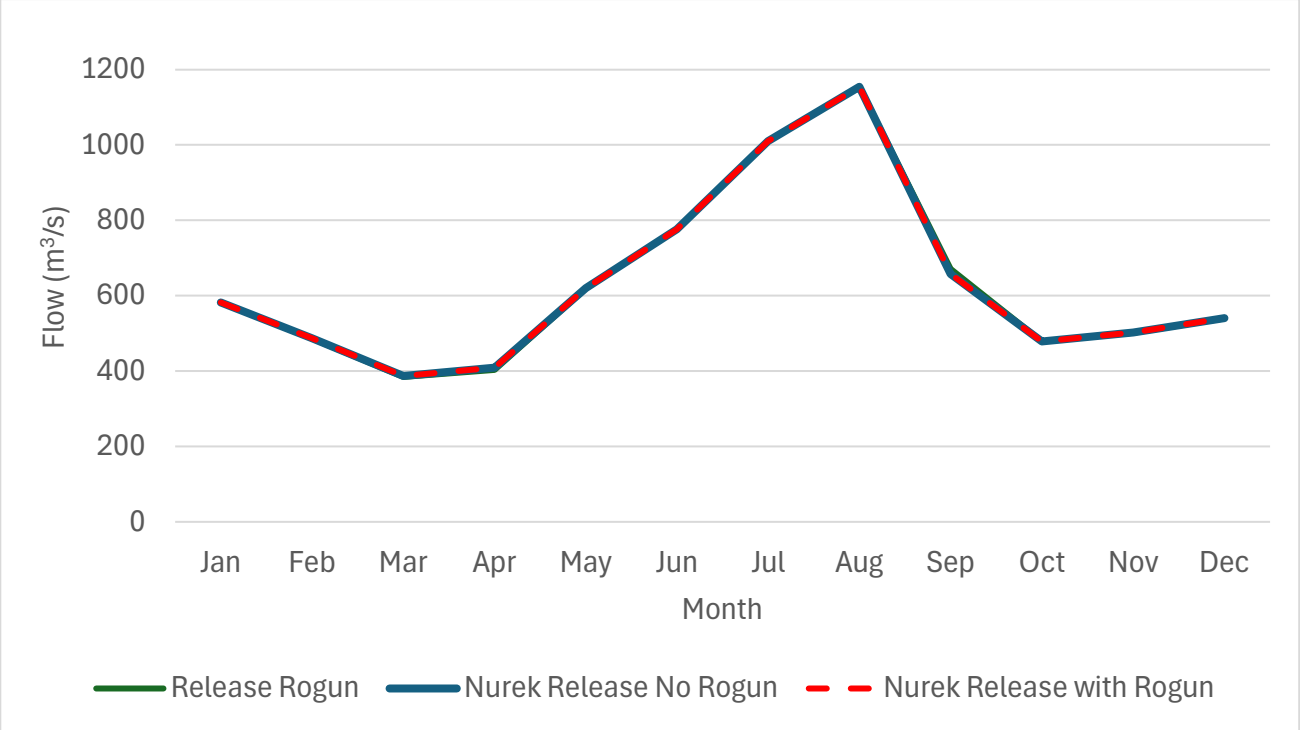


Figure 4-9: Simulated releases from Nurek Reservoir with and without Rogun

Source: WSP 2025 ESIA: Vol. 1 Annex 13-3: Water Resource Modelling, Figure 9-2

The Figure shows that, with Rogun operating, the release from Nurek will be the same as it is now, without Rogun. The pattern is determined by releases from Rogun (Figure 4-8, Rogun outflows), and this pattern is not changed by Nurek since this will then be operated as a "near ROR" structure. It should be noted that the cascade downstream of Nurek only has the capacity to modify the pattern on a daily, or at the most on a weekly basis, since the storage volume of these ROR schemes is too small for having any major influence (see Table 3-4). The same will be the case for Shurob HPP, which is planned to be built between Rogun outlet and Nurek reservoir, this however not before Rogun will be finalised and operating.

As mentioned before, the cascade, in addition to seasonal storage and regulation, will also have to respond to short-term (daily and shorter) fluctuations. The pattern to follow, driven by demand, is illustrated in Figure 4-5; these short-term fluctuations will be taken over, to some degree, by Rogun HPP. Still, as mentioned, Nurek will continue to do some of that (whence the precision that it will be operated as a "near-ROR structure", i.e. without seasonal, but still with short-term regulation). Nurek will also have to be operated as a re-regulation structure for Rogun: while Rogun HPP, when at FSL and operating at full capacity, has a total water output of 1626 m³/s, the maximum output of Nurek is at 1350 m³/s. This means that Rogun cannot operate at full capacity when Nurek reservoir is at FSL. For this reason, Nurek reservoir will mostly be somewhat below FSL in order to be able to cope with the output from Rogun. To some extent, daily fluctuations in outflow can also be moderated by the HPPs downstream of Nurek, which have daily (or in the case of Baipaza) weekly storage.

4.2 Water Quality

The creation of a reservoir with the hydrological changes this brings about, can have an influence on water quality, and this in turn can cause impacts in the downstream area.

4.2.1 Situation

Some data on water quality are provided in Table 4-4.

Table 4-4: Water quality of Vakhsh and Amu Darya rivers

Parameter	Unit	1 Vakhsh Nurobod 1998-2010 average	2 Amu Darya Termez 1996-2001 average	3 Amu Darya Samanbay 1996-2001 average	4 Vakhsh WSP 2023 range	Tajikistan requirement for surface water
O_2	mg/l		10.5	10.8	8.9 – 9.9	4.0 in winter 6.0 in summer
	%sat		99.7	98.7		
BOD	mg/l	-	0.8	1.4	-	3.0
COD	mg/l	0.6	4.5	15.1	-	
TDS	mg/l		551.4	1170.0	132.4 – 606.4	
pH		7.6	7.6	7.6	7.0 – 8.1	
PO_4^{3-}	mg/l	0.06	0.75	0.60	-	
NO_3^-	mg/l	1.6	0.6	0.5	-	40
HCO_3^-	mg/l	105.4	131.1	142.9		
Cl-	mg/l	85.4	73.3	213.9	-	300
SO_4^{2-}	mg/l	169.6	176.6	433.6	-	100
Temp.	°C	7.6	16.7	13.6	10.6 – 15.9	

Source: 1-3: Pöyry, 2014
4: WSP, 2025 ESIA (range of 9 samplings in 2023)

Water quality in Vakhsh River is generally good, mainly since there are no major sources of contamination. The data also show that Amu Darya shows an increased load of items linked with salinity (carbonate, chloride, sulphate). A description of the baseline water quality situation is provided in the updated ESIA, Vol. 2, Annex 7-1, Table 7-10.

4.2.2 Impacts

Changes of water quality, in the context of a dam project, are mainly the result of the transition from a lotic (river) environment to lentic (lake-like), with stagnant, deep water.

4.2.2.1 Reservoir Stratification

Under the climatic conditions prevailing in the project area (with hot summers and cold winters) the large and deep Rogun reservoir will develop a thermal stratification with two yearly circulations. A stable thermal stratification with warmer water at the surface and cooler water in the deeper layers during summer can have impacts on water temperature in the downstream area. Since the water intake for the turbines is located at greater depth, i.e. below MOL, colder water will flow through the turbines, to be delivered to the river downstream of the dam. This can have negative impacts on the river, and mainly on organisms (fish and organisms serving as food for fish). In the case of Rogun, this impact will be negligible, since the water will flow into Nurek reservoir a short stretch downstream, and since the river section between these two reservoirs has very little if any biological importance. Colder water flowing into Nurek reservoir will insert itself into the lower water layers of the reservoir, without causing any major change in the thermal stratification of Nurek reservoir. Downstream of Nurek, no change from the present situation will result.

4.2.2.2 Oxygen Content

Reservoir stratification is also important with respect to oxygen content of the water. During a stable thermal stratification in summer, oxygen in deeper layers can be depleted if large amounts of organic matter have to be broken down. In the case of a reservoir, this can be the case under two conditions, namely:

- after first filling, if large amounts of biomass (vegetation) were submerged and are now being broken down, and

- in cases where eutrophication of the reservoir happens, i.e. when large amounts of nutrients are being brought into the reservoir, which lead to a high plant (algae) productivity close to the surface, where there is enough light for photosynthesis.

The second condition is not considered as a risk in the case of Rogun. Nurek reservoir, after over 40 years of existence, is still an oligotrophic water body, i.e. with low concentrations of nutrients, and the same can be expected for Rogun

The first condition (submergence of biomass) can lead to anoxic conditions in the reservoir, and this in turn will lead to methane (CH_4) production; methane is a very powerful greenhouse gas (GHG). This is the case mainly in tropical reservoirs, where often very large amounts of biomass are submerged. This is not the case for Rogun, where the vegetation mostly consists of grassland, with very small amounts of forest. In the following calculation, based on results from other areas with similar (grassland) vegetation, a biomass amount of 10 t/ha is assumed; in grasslands, the amount of biomass is usually between 0.4 and 8 t/ha, which means that 10 t is a conservative assumption. In moist tropical forests, this value can reach an amount of 150 to over 200 t/ha, taking into account only soft, i.e. easily degradable biomass (leaves, herbs etc.), leaving away hard biomass (wood), since this latter decays very slowly and is not really of relevance for water quality deterioration (Zwahlen, 2022:406). Table 4-5 summarises the situation as it will likely evolve in the case of Rogun HPP.

Table 4-5: Consumption of oxygen during Rogun reservoir filling

1	2	3	4	5	6	7	8	9	10	11	12
Year	Reser-voir level	Reser-voir volume	Annual volume retained	Reser-voir surface	Annual surface increase	Annual total inflow	Total O_2 in annual inflow	Submerged biomass	O_2 to break down biomass	O_2 balance	O_2 used of annual inflow
	m asl	km³	km³	km²	km²	km³	t	t	t	t	%
2025	1070	0.5	1.2	7	7	20	160,000	7,000	7,490	152,510	4.7
2026	1120	1.7	1.2	18	11	20	160,000	11,000	11,770	148,230	7.4
2027	1170	2.9	1.2	39	21	20	160,000	21,000	22,470	137,530	14.0
2028	1200	4.1	1.2	55	16	20	160,000	16,000	17,120	142,880	10.7
2029	1220	5.3	1.2	76	21	20	160,000	21,000	22,470	137,530	14.0
2030	1230	6.5	1.2	85	9	20	160,000	9,000	9,630	150,370	6.0
2031	1240	7.7	1.2	90	5	20	160,000	5,000	5,350	154,650	3.3
2032	1250	8.9	1.2	100	10	20	160,000	10,000	10,700	149,300	6.7
2033	1260	10.1	1.2	110	10	20	160,000	10,000	10,700	149,300	6.7
2034	1270	11.3	1.2	132	22	20	160,000	22,000	23,540	136,460	14.7
2035	1280	12.5	0.8	145	13	20	160,000	13,000	13,910	146,090	8.7
2036	1290	13.3		159	14	20	160,000	14,000	14,980	145,020	9.4

The calculations provided in Table 4-5 are based on and show the following:

1. Starting point is 2025, i.e. the present (May 2025) situation, with the dam crest at 1100 m asl, the reservoir level at 1070 m asl and a reservoir volume of 0.5 km³.
2. Reservoir level will gradually increase till reaching FSL of 1290 m asl (note that FSL represents the stage when the reservoir is full; as Figure 4-3 shows, there will be a seasonal fluctuation between FSL and MOL).
3. The volume of retained water will gradually increase for finally reaching full storage volume of 13.3 km³ (with a seasonal fluctuation as indicated for reservoir level) .
4. Gradual filling of the reservoir (columns 2 and 3) will be done by retaining the water that is allocated to Tajikistan, but was not used so far. It is assumed here that this will be done by retaining 1.2 km³ per year, which corresponds to the average amount available for this purpose; this would allow for filling the reservoir till 2037. The amount actually retained per year will depend on weather conditions, it could be more in wet years and less in dry years.

5. With rising water level, reservoir surface will increase. Surface of the reservoir depending on reservoir volume and level is derived from the storage-area curve shown in Figure 4-2.
6. An additional land surface will be submerged every year, and the biomass on this additional surface will have to be broken down.
7. The total annual inflow to the reservoir will be the total flow of Vakhsh River, which is 20 km³ on average.
8. The total oxygen content in the yearly inflow will be the amount of oxygen available for breaking down the newly submerged biomass. The amount indicated here is based on the assumption that average oxygen content in the inflowing water is 8 mg/l; this is a conservative approach, actual content is more likely to be around 10 mg/l.
9. A certain quantity of biomass is submerged yearly; the estimate here is that the average amount of biomass is 1,000 t/km².
10. The amount of oxygen required for breaking down the newly submerged biomass is calculated on the assumption that 1.07 t of oxygen is required per t of biomass.
11. Oxygen balance indicates the amount of oxygen per year that would still be in the water after all the submerged biomass would have been broken down.
12. Indicates the percentage of oxygen consumed for braking down all newly submerged biomass.

The calculation shows that there will be a huge surplus of oxygen, even under these somewhat pessimistic assumptions (to be on the safe side, an oxygen content of 8 mg/l was assumed, althoug given the generally low wate temperature in the river it is likely to be 10 or more mg/l, and a high estimate for the amount of biomass was included). The conclusion from this is that there is no risk of anoxic conditions forming in the deeper layers of the reservoir. One specific condition helps in this respect, namely the fact that the reservoir will be filled over such a long period, which means a gradual, slow increase in reservoir surface and therefore in submerged biomass, and a very high turnover rate of the water given the fact that only 6% of the water flowing into the reservoir will be retained.

Since no anoxic conditions will develop in Rogun reservoir, there is also no risk of oxygen-free water being released to Nurek reservoir.

Concerning the overall GHG emissions from Rogun HPP see 2025 ESIA Vol. 1, Ch. 9, GHG.

4.2.3 Conclusion

No negative impacts on water quality are expected to result from building and operating Rogun HPP, under the condition that water contamination during construction is strictly controlled and prevented. Still, precautions are required during the construction period, which presents a risk of water contamination (e.g. due to accidents with or inappropriate handling of hazardous material; the measures outlined in the ESMP (2025 ESIA, Vol. 3, B04, Waste Water Management Plan, and B05, Hazardous Material Management Plan) need to be implemented. Water quality management is required (see Section 5.5).

Due to the marked seasonal fluctuation, Rogun reservoir is not expected to develop into a good habitat for fish species; on the other hand, that Nurek will not show such fluctuations any longer, it can be expected that there conditions for fish species which are adapted to lake conditions will find a better situation (see 2025 ESIA, Vol. 1, Ch. 15, Biodiversity).

4.3 Sediments

4.3.1 Situation

4.3.1.1 Sediment Retention in Nurek Reservoir

Vakhsh river is characterized by a high sediment load. The concentration of suspended solids fluctuates during the year and reaches its maximum during the high flow season. TEAS (Phase II: Project Definition Options – Volume 2: Basic Data – Chapter 6: Sedimentation, March 2014) has determined the annual sediment supply into the reservoir to be in the order of magnitude of 62 to 100 hm³. As a conservative approach, the value of 100 hm³/yr has been considered as a representative assumption of sediment solid runoff.

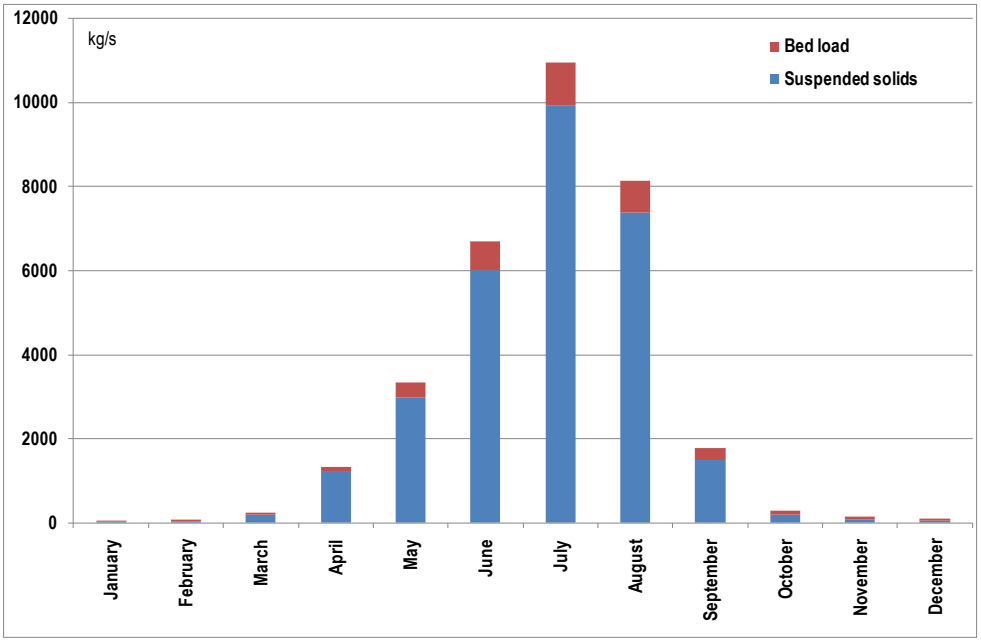


Figure 4-10: Suspended solids and bed load in Vakhsh river at Rogun (2010)

Since the construction of Nurek HPP, the sediments of the upper Vakhsh catchment no longer reach the lower catchment but instead are deposited in the reservoir of Nurek. To what degree sediment is retained in Nurek reservoir is shown by the following Figure. The suspended solid still reaching Tigrovaya Balka stems mostly or completely from the intermediate catchment, as good as no sediments will pass Nurek reservoir.

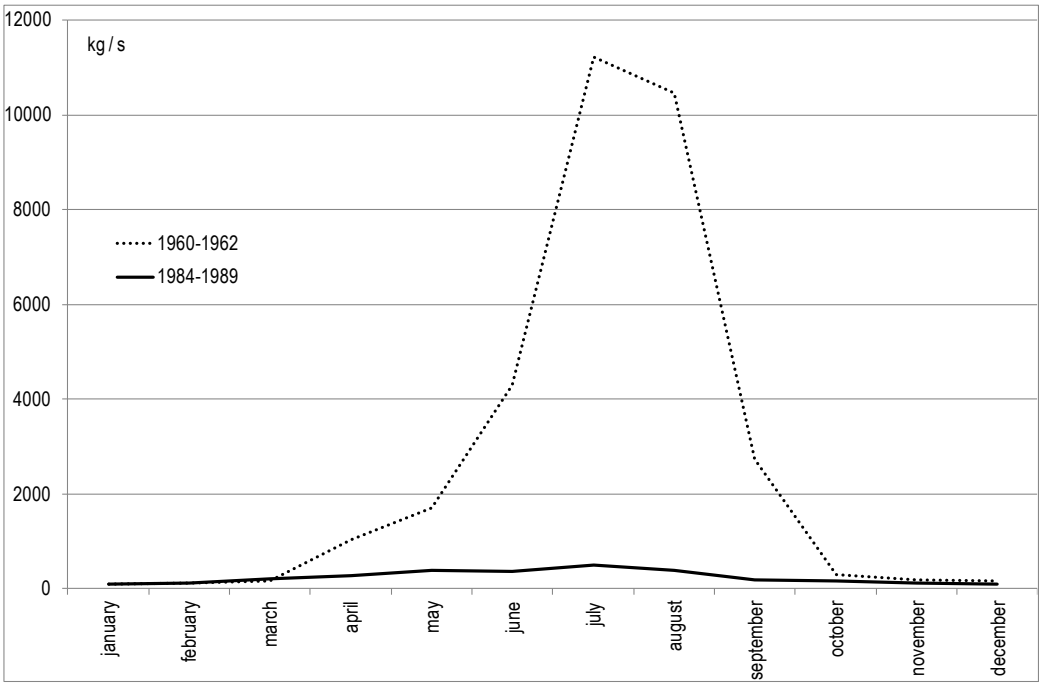


Figure 4-11: Suspended solids - Tigrovaya Balka, Vakhsh, before and after Nurek HPP commissioning

Nurek reservoir has already lost a part of its capacity due to sediment accumulation. While most of the sediment is deposited below MOL, i.e. in the dead storage, some of it in the upper parts of the reservoir also accumulates above MOL (see Figure 4-12). The loss of active storage is estimated at 10 * 106 m³ per year in the situation without Rogun (HR Wallingford, 2016).

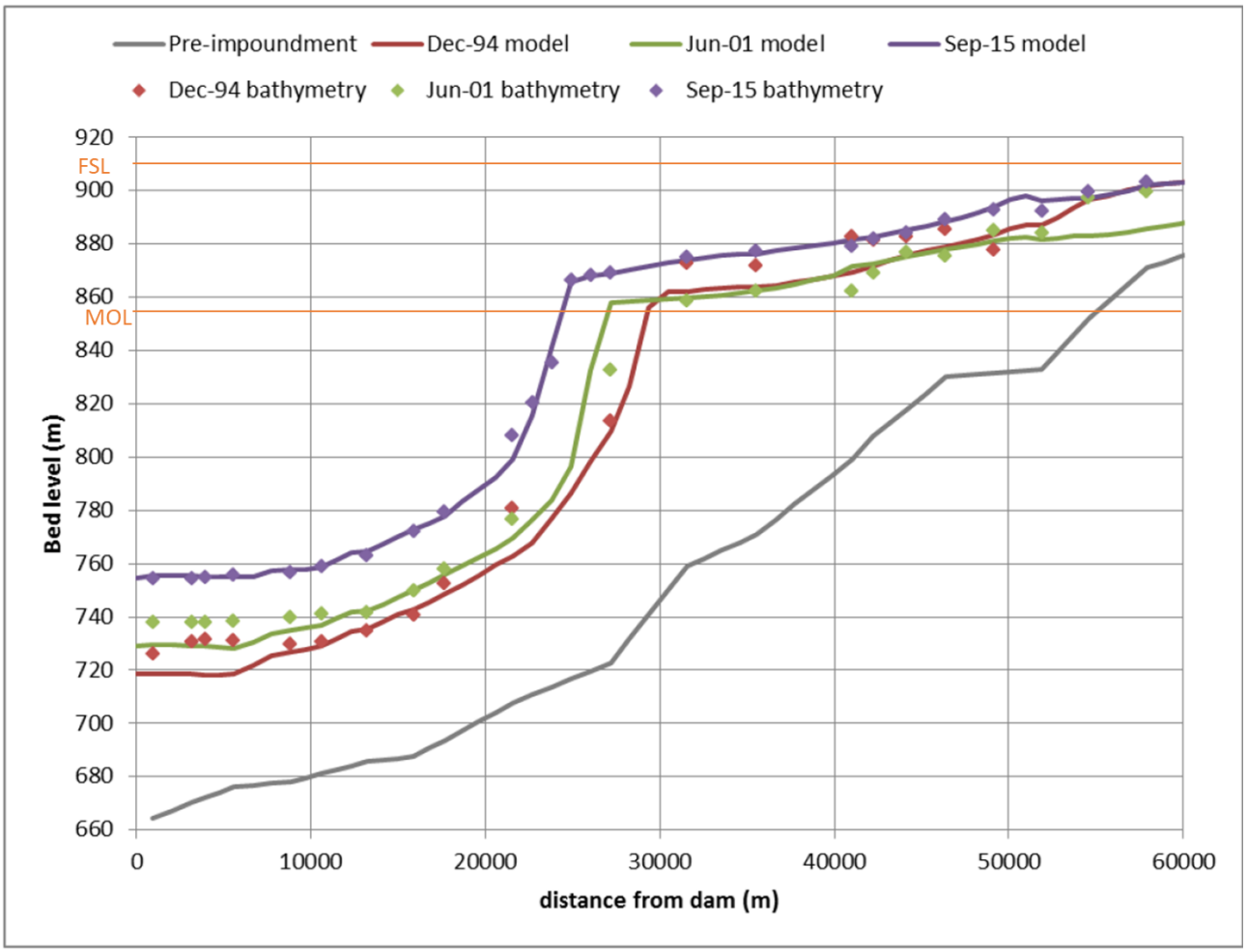


Figure 4-12: Sedimentation of Nurek reservoir

Source: HR Wallingford, 2016

The study concludes that without Rogun, the dead storage of Nurek will be filled by about 2075, the loss of active storage continuing as indicated above.

4.3.1.2 River between Rogun and Nurek

About 15 km of Vakhsh river remain between Rogun dam and Nurek reservoir. The river there flows in a narrow valley, with steep mountain slopes on both sides. A number of small creeks with intermittent flow join the river on this stretch, but the only tributary, with a catchment area of 52 km² and probably permanent flow (for which however no data are available) joins Vakhsh River on the left side immediately downstream of the dam. This stream had already in earlier studies been identified as a potential risk for Rogun HPP, since a mudflow from this small lateral valley could block Vakhsh just downstream of the dam. For this reason, a check dam was built there, with the aim of retaining such sediments (2014 ESIA). This check dam was finalised in 2016.

On May 16, 2024, heavy rainfall caused a flash flood in Obishur which triggered a large mudflow. By this time, the reservoir behind the Obishur check dam had had already been filled to about half its capacity with sediments. The massive mudflow filled the reservoir almost completely, and a large amount of sediment, including large boulders, was flushed through the openings at the top of the check dam. This material was then carried downstream to the Obishur confluence with Vakhsh, were it was deposited and blocked Diversion Tunnels 1 and 2 (see Figure 4-13). Fortunately, DT3 was not blocked.



Figure 4-13: Situation of mudflow from Obishur blocking Vakhsh, May 2024

Source: WeBuild, 2024-05-30

The total amount of debris and sediment which was flushed from Obishur to Vakhsh was estimated at about 900,000 m³, 550,000 of which were deposited in the river bed of Vakhsh, while 350,000 m³ were swept into DT 1 and 2. This led to a backwater effect which first resulted in an automatic shutdown of the units 5 and 5 (the two turbines installed and operating), and finally to flooding of the power house. Over the following few days, the sediment from the DTs and from Vakhsh bed at the food of the dam could be flushed out. The reservoir level, which was at 1070 m asl at that time, was lowered to 1062 m in anticipation of the flood that would arrive in the reservoir due to the rain event (see Figure 4-14).

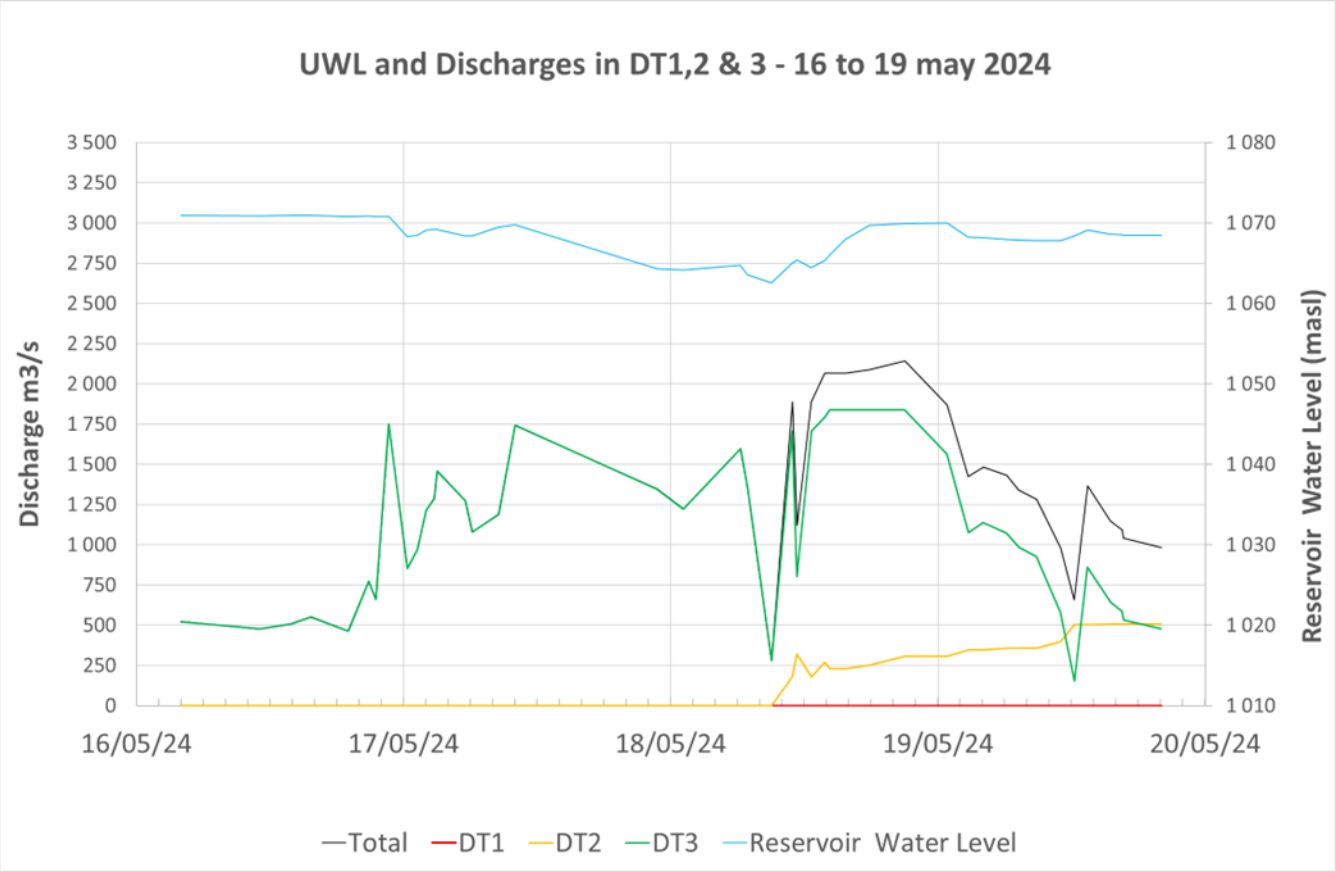


Figure 4-14: Reservoir level and flood evacuation through DTs.

Source; Tractebel 2025 (UWL = upstream water level, reservolr level)

As can be seen in this Figure, first only DT3 was available. Gradual opening of the gate of DT1 then allowed flushing out the sediment which had blocked it.

The flood and mudflow has seriously damaged the left abutment of the check dam. DSPOE (2025) commented on these events, emphasising the risk of other such incidents in the future, and criticising the unsafe way in which material that needed to be removed from the plunge pool was disposed of, blocking Obishur River, and asking for the following measures to be taken immediately:

- Stabilize the compromised left abutment of the Obishur Dam.
- Remove the deposited material obstructing the confluence of the Obishur and Vakhsh Rivers.

This is an issue that will need continuous attention

4.3.2 Impacts

Once Rogun dam in place, sediments will be retained there, they will no longer reach Nurek reservoir. The situation downstream of Nurek will not change. TEAS (2024) predicts a sedimentation progress similar to the one that was observed in Nurek (see Figure 4-12), with fine sediments settling down in the deeper parts of the reservoir, while coarse material will be deposited at the upper end, forming a delta at the inflow of Vakhsh River. This would also lead to a gradual loss of regulation volume, i.e. of live storage, which will continue over the life span of the project. This will considerably increase the life span of Nurek. No sediment flushing is foreseen at Rogun.

The situation of Obishur remains critical and needs to be surveyed on a continuous basis.

4.3.3 Conclusions

The fact that sediment will be retained in Rogun reservoir will have the following effects:

- Rogun reservoir will be filled gradually. Under the somewhat pessimistic assumptions used in the TEAS study, it was estimated that the lifetime of Rogun HPP, i.e. the time till the reservoir will be filled, would be 115 years. Updated estimates based on more detailed evaluation of sediment inflow estimate this time to be 130 years or more. This might be further influenced by a later construction of additional dams upstream of Rogun, which might slow down siltation of Rogun reservoir (see CIA). Once the reservoir filled, Rogun HPP can still be operated as a ROR structure.
- The life span of Nurek will be extended by the retention of sediments in Rogun. This is important, since Nurek there is no provision for safely operating Nurek once the reservoir is full, and in that stage it will not be possible to operate it as ROR plant. Adding Rogun to the cascade, therefore, has two positive effects:
    - Increasing the active life span, and with it the duration of electricity generation, of Nurek HPP.
    - Providing more time (approximately the life span of Rogun HPP) for finding a solution for operating Nurek when its reservoir will be filled.
- The existence of Rogun will allow the construction of Shurob HPP, an additional power plant foreseen to be built at the upper end of Nurek reservoir, with an FSL that will reach the level of the water outlet at Rogun HPP. Since, as mentioned, the part of the river between Rogun and Nurek, a stretch of approximately 15 km, has very little if any ecological value, this would be a minimum impact addition to the Vakhsh cascade. It is a ROR structure which can only be built with Rogun in place, since otherwise the small reservoir would be filled with sediment very rapidly. This is a positive impact of Rogun in terms of energy production.
- Since under present conditions, without Rogun, sediment is already retained in Nurek reservoir, no change concerning sediment load downstream of Nurek will occur.

4.4 EFlow

4.4.1 Definition

A residual flow (ecological or minimum flow, EFlow) is defined as the minimum amount of water which needs to be kept flowing at all times in order to guarantee a minimum of water in the river on a permanent basis.

The main purpose of defining and maintaining a minimum flow is usually one or both of the two following:

- to maintain the affected part of the river as a habitat, mainly for fish, but also for other aquatic life; and/or
- to guarantee water availability on a permanent basis for water users along the affected stretch of river; this concerns mainly water needs for irrigation or drinking water supply, for maintaining a sufficient dilution of waste water being discharged into the river, and/or to maintain the use of the river for boat traffic.

4.4.2 Standards and Guidelines

Relevant guidelines are summarised in the 2025 ESIA for Rogun, Vol. 2, Annex 13-1: Minimum Environmental Flow. Of special importance:

- The Good Practice Handbook for Environmental Flows for Hydropower Projects, published by the World Bank Group, provides guidance to practitioners on selecting an appropriate environmental lows assessment level for hydropower project developments, as well as guidance on taking rigorous and consistent approaches to assess and manage hydropower project impacts on downstream river ecosystems and people, through the assessment and provision of E-Flow (World Bank, 2018). The Handbook defines E-Flow as," the quantity, frequency, timing and quality of water and sediment flow necessary to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depends on these ecosystems."
- Chapter 3 of the European Investment Bank (EIB), Environmental, Climate and Social Guidelines on Hydropower Development, October 2019, deals with environmental issues and impacts. Specific reference is made to the EIB requirements/recommendations for Downstream Hydrology and Limnology.

4.4.3 Importance of EFlow

In the case of hydropower projects, an EFlow will have to be defined when there is a risk of temporary or permanent dewatering of a section of a river. This will be the case under the following conditions:

- Peaking power plant: when an HPP is used mainly or exclusively for peaking power production; this means that it will often or regularly be stopped during non-peak hours. No water will be delivered via the turbines during these off-times. EFlow is then needed for preventing the river bed of falling completely dry.
- Deviation power plant: water from a reservoir can be deviated from the river bed by headrace structures (canals, tunnels and penstock) for being turbined in a power house at some distance (up to several km) downstream of the dam, in order to gain head for power production. This could mean that the river between dam and power house tailrace outlet, or at least till the next tributary, would remain without water in the absence of an EFlow.
- An extreme case of a deviation power plant is the case where the power house is located on another river, e.g. in a neighbouring valley (transbasin project). In such a case, the entire river downstream of the dam to the confluence with another (major) river would be affected by this permanent reduction in flow.

Additional issues in the case of a peaking operation pattern are often the large amplitude between peaking operation and EFlow, but also the usually very abrupt increase in water volume when the turbines start operating; the increase from EFlow to maximum turbine outflow may take as little as a few seconds, and this can happen several times per day. The surge wave resulting from such an operation pattern will literally flush out the river, and it may present a risk for people along the stretch of river affected in this way.

Rogun HPP is not a deviation power plant, since the power house is located directly at the foot of the dam, therefore there is no constantly dewatered part of the river which would require an EFlow. However, as Figure 4-6 shows, in the low flow season during the process of reservoir filling, there are times when the DTs are closed, water only passing through the turbines. If during such a period the turbines would shut down, no water would be released. Such a situation will be the normal case under standard operation, i.e. after the reservoir filling phase. With the exception of spilling (presumably rather rare and limited to the season of maximum flow), the only water flowing downstream of Rogun will be the volume passing through the turbines. EFlow will have to be released when all turbines are closed down.

4.4.4 EFlow Modelling

The only part of the river where the flow regime will be directly influenced by Rogun HPP is the stretch of Vakhsh River between Rogun HPP outlet and the upper end of Nurek reservoir, a river section of about 15 km. For this, an EFlow modelling was carried out (2025 ESIA, Vol. 2, Annex 13-1, Minimum Environmental Flow). It determined the minimum flow required based on the natural seasonal distribution of water in the stretch of the river in question. The results of this modelling are shown in Figure 4-15.

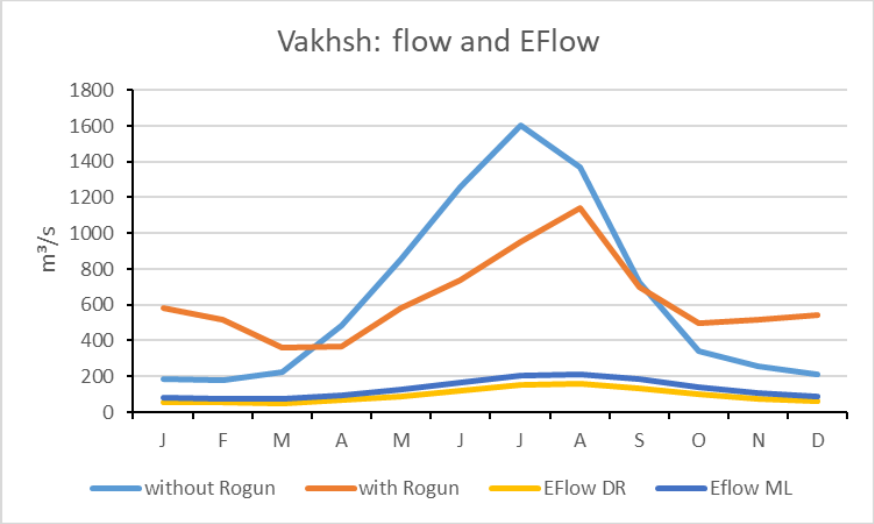


Figure 4-15: EFlow in Vakhsh River in comparison to actual flows

Two values were determined for the EFlow, namely DR (the minimum flow required during especially dry conditions) and ML (maintenance low flow, minimum required during normal conditions). For both values, seasonal variation was included for mimicking the natural seasonal flow variations. The actual flow conditions in Vakhsh River are shown without Rogun (natural conditions) and with Rogun (release from Rogun reservoir; these values are also shown in Figure 4-8.

4.4.5 Prevailing Situation at Rogun HPP Site

In the case of Rogun, a certain number of specific conditions has to be considered, namely:

- The affected stretch of river, where discharge could temporarily be reduced to zero, is very short, it is only between Rogun dam and the upper end of Nurek reservoir at FSL, a total of approximately 15 km. Further downstream, river discharge is regulated by Nurek, Rogun has no direct effect on that.
- There are no settlements, i.e. no water users, along this affected part of the river.
- The importance of this river stretch for fish is very limited (2014 ESIA, Chapter **Error! Reference source not found.**; 2025 ESIA, 2025 ESIA, Vol 2, Annex 7-1, Baselines Conditions). In any case, even if there were fish migrations from Nurek reservoir upstream, these would be blocked by Rogun dam. In addition to that, the only tributary with permanent flow, which joins Vakhsh on the left bank immediately downstream of Rogun dam, the Obishur, was blocked by the construction of a dam serving for retaining sediments stemming from it, since there is a risk that such sediments could block the powerhouse outlet of Rogun (see 4.3.1.2). Therefore, this small stream is no longer accessible for fish; there is no information on whether it ever did play a role as fish habitat.
- The river between Rogun dam and Nurek reservoir is a steep and narrow channel. With the exception of Obishur, a small stream reaching Vakhsh immediately downstream of the dam, and which was blocked by a check dam for retaining sediments (see Section 4.3.1.2), there are no permanent affluents on this part of the river.
- There is a plan for an additional HPP, Shurob, between Rogun dam and Nurek reservoir. Its dam will be 93 m high, in this way using the total difference in elevation between the two large reservoirs. It will be a ROR structure, its reservoir reaching the powerhouse outlet of Rogun.

4.4.6 Situation with Rogun HPP in Place

Construction of Rogun HPP is under way. Presently, the dam crest has reached an elevation of 1100 m asl; this is the height of the upstream coffer dam, which will be integrated into the main dam as dam construction progresses. The reservoir is presently kept at an elevation of 1075 m asl; its level will gradually increase as construction goes on (see Section 4.1.3).

The relevant question concerning EFlow concerns the situation in the river, i.e. quantity and distribution of water flowing in the section between Rogun dam and Nurek reservoir. Three different stages have to be considered, namely, original (natural) situation, construction period, and operation.

Original situation:

- Before the start of the construction of Rogun dam, river flow in the river section in question was the natural flow of Vakhsh River, the inflow into Nurek Reservoir.
- This flow was characterised by its seasonal pattern, with high flows in summer and low flows in winter, with a minimum monthly average flow of about 190 m³/s in February. (see Figure 3-4).

Construction period:

- The first decisive part of this period was the construction of the diversion tunnels (or rather, their rehabilitation: they had been excavated already during Soviet times and were then blocked during a flood event) and the coffer dams were swept away.
- Since these structures (DTs) are in place, the river flows through these tunnels (see Figure 4-6 and Figure 4-7). Amount of water and its seasonal distribution downstream of the dam remained unchanged.
- Once the coffer dams had reached a certain elevation, a first step of reservoir impoundment started; presently, the reservoir has reached a level of 1075 m asl, and has a volume of 0.44 km³. This means that over the last several years this amount of water was retained in the reservoir which, had this been

done in one average year, with a total flow in Vakhsh River of 20 km³, would have meant a reduction in flow of 2.2%.

- Presently, in Rogun HPP two turbines with reduced capacity (200 MW each) are installed and operating, presently turbining about 156 m³/s each, with a maximum of 192 m³/s each.
- The plan is to fill Rogun reservoir gradually, to reach its FSL of 1290 m asl in 2037, by retaining, on average, 1.2 km³ of water per year (see Section 4.1.3 for a detailed description).
- With an average yearly flow of 20 km³ in Vakhsh River, this means that retention for reservoir filling will reduce the flow in the river downstream of Rogun dam, and with this inflow to Nurek reservoir, by 6%; seasonal distribution will not change, since the remaining quantity of 18.8 km³ (in an average year) will flow to the downstream area via turbines and spillways.
- As the dam height increases, four more turbines will be installed, and the first two ones will be upgraded for all to reach the capacity of 630 MW each, being able to pass 271 m³/s; Rogun HPP will have a total capacity of 3,780 MW, maximum water output 1,626 m³/s.
- During this period, with the increasing water level in the reservoir and the gradual commissioning of the turbines, there will be a transition in operation of the two main power plants of the Vakhsh cascade, Rogun and Nurek: Rogun will gradually be taking over the regulatory role, with Nurek being kept at a more or less stable level (see Section 4.1.4).
- For the river stretch between Rogun and Nurek, this will mean that the seasonal distribution in flow will change, summer high flows being reduced while winter flows will be increased (by the, on average, seasonal shift of 4.2 km³ of water from summer to winter, see Figure 4-8).
- During the filling period, as mentioned, most of the water passes through the DTs. During the low-flow season, when inflow is less than the volume that can pass through the turbines, the DTs are closed completely. As shown in Figure 4-7, in order to keep the reservoir level stable, the volume turbined is restricted to the amount flowing in, which can be less than turbine capacity and reaches about 150 m³/s: EFlow determined as required for this period (low flow season) would be about 50 to 75 m²/s. If at such a time the turbined would need to be shut down, EFlow release would be required.

Rogun HPP operation:

- Once all 6 turbines commissioned and the reservoir at its FSL of 1290 m asl, the operational pattern not only of Rogun, but of the combined Rogun-Nurek cascade as shown in Figure 4-3 will be implemented.
- No sediment will be brought from Rogun reservoir to this part of the river, the sediment there (with potential input form Obishur) will be regularly flushed out.
- Rogun HPP will take over the regulating function in the cascade (which, without Rogun in place, was done by Nurek), meaning that Rogun reservoir will be filled up to FSL (1290 m asl) in summer and will be drawn down to MOL (1260 m asl) in winter, while Nurek will be operated as a type or ROR structure, meaning that the fluctuations in water level will be comparatively very small. There is no more detailed operation regime for Rogun HPP available as yet; however, it is assumed that one or two turbines in Rogun HPP will always be operating, while some peaking will be done according to net requirements.
- Under normal operation, at least one, but presumably more than one turbine will be running continuously. This means that below Rogun HPP, there will be water flowing all the time, while there will also be some short-term fluctuations due to peaking. The only time where EFlow would actually have to be released would be in cases when all turbines would be shut down. It has to be taken into account that this, if at all, is most likely to happen in winter, when electricity demand is highest, and where therefore every effort will be made to have the HPP in good operating conditions.

4.4.7 Conclusions

Concerning EFlow between Rogun HPP and Nurek reservoir, the following conclusion can be reached:

- The biological value of this part of the river was low already without Rogun dam in place; it will be further reduced with Rogun, at least in part due to peaking, but the impact is considered as minor (not significant) for the construction period and as negligible to minor (not significant) for the operation priod (2025 ESIA, Vol. 1, Chapter 15, Biodiversity.
- There is no human use of the river and river wate along this stretch of the river, therefore no negative socio-economic impact.

- As Figure 4-15 shows, also with Rogun HPP operating the average monthly flow will always be higher than the required EFlow.
- Given the fact that during operation at least one turbine will be operating all the time, there will always be a minimum of 271 m³/s flowing, which is higher than the EFlow requitement calculated in the modelling study, the highest ML flow determined for August being 213 m³/s.
- EFlow will only be required in the rare cases where, for whatever reason, all turbines at Rogun HPP will be shut down.

EFlow is an important mitigation measure in many cases of hydropower projects, since with this a minimal ecological functioning of an affected river can be maintained. However, in the case of Rogun HPP, as discussed above, there is very little probability that it will ever have to be applied.

4.5 Floods

With respect to flood risks, large storage dams present two main aspects:

- Reduction of flood risk: flooding occurs when large amounts of water reach a river in a very short period, like e.g. exceptionally strong rains falling in a small area, or strong rain combined with snow melt, which can lead to a momentaneous river discharge which cannot be conveyed further downstream within the river bed and which therefore leads to flooding of the surrounding area. Large storage dams usually have a certain capacity for retaining additional water during such events, which may be sufficient for lowering the momentaneous peak flow and in this way can prevent or at least reduce a flooding event downstream of the dam. There is also a possibility, if a risk for flooding is recognised early enough, to lower the reservoir on beforehand in order to create more space for retaining the flood peak. In this way, dams can contribute to flood protection of e.g. inhabited areas.
- Risk of dam break: the most serious dam-related accident that can happen is a dam break, which has the potential to cause very serios flooding in the area downstream of the dam. The higher the dam and the larger the volume of the reservoir, the larger the potential damage such an event could cause. Three main measures are usually taken to minimise this risk:
    - Construction of the dam according to best practice; this, e.g. means that a dam will be built in a way that it is able to withstand the strongest earthquake that could happen in this area. Rogun dam is designed according to international standards taking into account geological and seismic risks (including Maximum Credible Earthquake, MCE).
    - Resisting flood: a dam and its structures, in this context mainly the structures serving for flood discharge, must be conceived and built for being able to handle an extreme flood event without being damaged. The assumption on which the layout of the structures are dimensioned is the Probable Maximum Flood (PMF), which is calculated based on local conditions and potential hazards including rain storms, snow melt etc. TEAS (2014) determined the following magnitudes of flood events in Vakhsh River:
        - 2-year flood event: 2,360 m³/s
        - 5-year flood event: 2,780 m³/s
        - 10-year flood event: 3,070 m³/s
        - 20-year flood event: 3,360 m³/s
        - 100-year flood event: 4,030 m³/s
        - 1’000-year flood event: 4,950 m³/s
        - 10’000-year flood event: 5,970 m³/s
        - PMF (day): 7,800 m³/s
        - PMF (instantaneous peak) 8,160 m³/s

      The Probable Maximum Flood (PMF) is the theoretical maximum flood that poses extremely serious threats to the flood control of a given project in a design watershed and could plausibly occur under current meteorological conditions.
    - Dam Failure Analysis: in spite of all safety measures taken, one component of a complete dam study is a Dam Failure Analysis or a Dam Break Study; this analyses what would happen if the

dam in question would break, determining e.g. the time span until the flood wave would reach a certain point, e.g. the nearest inhabited area downstream of the dam, the area that would be flooded, the height the water would reach, and the duration of the flood. Based on this, an Emergency Preparedness Plan (EPP) can then be developed, which defines the measures to be taken in the case of such an accident (early warning system, evacuation plans including the identification of safe muster points, required information, awareness raising and training of the potentially affected population, etc. A dam break analysis was undertaken in for the Stage 1 dam height of 1100 m asl (Gruner, 2018), which showed that a failure of Rogun dam at this stage would not lead to an overtopping of Nurek dam. A further dam break analysis will be prepared for the final dam height of 1300 m asl. These risks are further considered in 2025 ESIA Volume 1, Chapter 23: Major Accidents and Disasters. DSPOE, in all their reports, has pointed out the necessity for this final EPP, insisting that it will have to be in line with the current EPP study for the Vakhsh cascade.

The Vakhsh cascade as presently operating, including Nurek dam, is not designed to handle a Probable Maximum Flood (PMF). Nurek's surface spillway capacity is only of 2020 m3/s, not able to handle the PMF peak of 8,160 m³/s. Rogun has been designed with a surface spillway able to operate and safely ensure PMF evacuation. Appropriate operation of Rogun's spillway facilities will provide protection of Nurek and the downstream areas, in this way reducing flood risks to a considerable extent. This is a positive impact of Rogun HPP.

5 Conclusions

In this Section, the impacts caused on the key receptors listed in Section 2.2 are summarised and discussed.

5.1 Hydrology

- **Risk:** Change in seasonal water availability in the downstream area, which would have a serious negative impact on water users especially for irrigation.
- **Situation:** Two stages need to be distinguished:
    - Reservoir filling: for filling the reservoir, a total of 13.3 km³ will be retained, and this water will not be available in the downstream area. This has a negative impact on irrigation in the downstream riparian countries. However, in order to minimise this impact, the following conditions will be met:
        - Tajikistan will continue to respect regional water allocations agreed yearly at the ICWC (which according to Protocol 566 amount in average to 15.4% of the water flowing in Amu Darya basin as the share of Tajikistan).
        - So far, Tajikistan has not used this share completely, leaving a surplus of 1.2 km³ per year on average. This unused part will be used for filling Rogun reservoir; this corresponds to approximately 6% of the flow of Vakhsh river. The exact amount is likely to vary each year depending on the flows of each year and the exact water allocation for Tajikistan agreed each year.
        - This restriction means that it will take approximately untill about 2037 for filling Rogun reservoir completely, with the caveat that it could occur faster if some wet years take place during the impoundment period, but could also take longer in the case of a number of dry years.
        - Overall, water availability in the downstream area will be reduced by the amount retained. However, this is according to regional agreements, and Tajikistan will use this water in any case (for irrigation once Rogun reservoir will be filled). For this reason, this cannot be considered as a negative impact of Rogun.
    - Operation: Rogun HPP adds a very considerable storage volume to the Vakhsh cascade, increasing the potential for influencing seasonal flow distribution in the river. However, Rogun can and will be operated in a way as not to change the seasonal flow pattern downstream of Nurek. The combined operation of Nurek and Rogun will not shift any additional flows from summer to winter over the amount of 4.2 km^3/year already shifted by Nurek operations during the historical period, resulting in no negative impact from Rogun.
- **Measures:** Additional mitigation measures to the ones adopted and described (slow reservoir filling, no additional shift of water from summer to winter), are not required. However, it is recommended to pay attention also to the following points:
    - Strict adherence to ICWC annual agreements and BWO water accounting as described.
    - Close monitoring of water use in the Vakhsh cascade, with direct sharing with BWO headquarters, and making the relevant data publicly available (as agreed in the financing agreement) in the website of the MEWR.
    - Continuing stakeholder involvement, also by means of public hearings/workshops in the riparian countries.
    - Rogun would also have the possibility of making additional water available for irrigation in especially dry years. This, however, is possible only if specific measures are foreseen to compensate the releases of additional water and to refill the reservoir after such an event. Since multi-year storage and water use between upstream and downstream countries is not clearly defined in the existing legal frameworks or in the experience of current practices, special negotiations each year, and potential agreements among the riparian countries addressing this will be required. It is recommended that the countries develop a dialogue towards finding viable win-win scenarios around this topic.

5.2 Water Quality

- **Risk:** Two phases again:
    - Construction: a large construction site presents the risk of contaminating the water, by increasing sediment input, suspended sediment load, or (accidentally) contaminating it with hazardous substances (fuel, oil, lubricants etc.). Negative impact of potentially important dimensions.
    - Operation: the formation of a reservoir can change water quality.
- **Situation:**
    - Construction: given the very large construction site, the risk for water contamination is real. Even if there are no water users directly downstream of Rogun, this risk must be minimised.
    - Operation: Under the conditions of Rogun HPP, there is no risk of deteriorating water quality due to submerged biomass or of an eutrophication of the reservoir. Thermal stratification will occur, but since the water from Rogun is directly transferred to the reservoir of Nurek via a short stretch of river (and at a later stage via an additional small reservoir) releasing cold water downstream of the dam will not have any negative consequences.
- **Measures:**
    - Construction: identified and known risks must be met by precautionary measures (pollution prevention, waste water treatment, storage and handling of hazardous material) and by measures ensuring preparedness in case of an accident. The required measures are described in the ESMP.
    - Operation: pollution prevention measures will also have to be applied in the operation of the HPP. It would also be advisable to have waste water treatment plants in the settlements located in the catchment of the reservoir; this, however, is not the responsibility of the Project. As mentioned, the risk of wate quality degradation due to submerged vegetation is very small; as an additional precautionary measure it is recommended to fell all trees before submersion, and to burn the biomass not used. This would also ensure that wood, a valuable resource in the project area, can be used.

5.3 Sediment

- **Risk:** retention of sediment in the reservoir, causing changes in sediment dynamics in the downstream area.
- **Situation:** presently, all sediment from the upper Vakhsh catchment is retained in Nurek reservoir. There is a risk of an increased sediment load in the rived due to the construction of Rogun dam. The 2016 Wallingford Sedimentation Study shows that from 1970 (impoundment) to 2015, the total storage volume of Nurek reservoir decreased from 10 km³ to about 6.2 km³; most of this loss was dead storage, active storage was reduced from 4.2 to about 4 km³. Without any further measure the dead storage of Nurek would be completely filled be 2075, and by then active storage would be reduced to 3 km³.
- **Development:** Once the filling of Rogun reservoir starts, sediment will be increasingly retained there. Since sedimentation threatens negatively affect the operation of Nurek HPP, this sediment retention will increase the life span of Nurek, which is a positive impact of Rogun. With Rogun dam in place, inflow of sediments to Nurek will be reduced by 97%, the remaining 3% being the sediment originating from the intermediate catchment between Rogun and Nurek. The modelling shows that in that case there would be no relevant reduction in total storage volume till 2115 (end of modelling period). The study concludes that it would take 130 years for filling Rogun reservoir with sediments to a level where regulation in Rogun is no longer possible. The TEAS (2014) estimate for total life span of Rogun was 115 years.
- **Measures:** additional sediment input to Vakhsh River due to the construction of Rogun dam must be minimised by applying measures to limit erosions, as described in the ESMP (ESIA Vol. 3 B08, Erosion Management Plan). During operation, a monitoring program providing a follow-up on reservoir siltation (Rogun as well as Nurek) is recommended. It will also be necessary to develop a plan that will allow for Nurek to continue to be operated safely once it will be filled with sediment.

The currently accepted sedimentation scenarios are from TEAS (RP 43 rev. C). The project has been designed and is being constructed according to these scenarios. Sediment inflow calculations during TEAS have been

largely confirmed by the extensive sediment sampling programme that is run by the Lot-2 Contractor. However, the DSPoE judged that the updated Hydrology and Climate Change Study under execution should also examine sediment transport into the reservoir, particularly under climate change conditions. The first draft results are expected in August 2025.

Furthermore, the DSPoE requested the execution of a detailed modelling study for the prediction of the patterns of sediment deposition within the reservoir, under different sediment management measures. This study is about to be awarded. Results should be expected in the Summer of 2026.

5.4 Floods

- **Risk:** storage reservoirs present a potential for reducing flood peaks, in this way minimising the risk of floods in the downstream area. On the other hand, they also present a risk of a dam break, which would lead to major flooding in the downstream area.
- **Situation:** Nurek is not designed for safely handling the Probable Maximum Flood (PMF). Rogun is designed in a way as being able to do so, which is a major positive impact on Nurek, the downstream cascade and the wider downstream area. Rogun is also built for maximum dam safety, e.g. for being able to resist the Maximum Credible Earthquake (MCE).
- **Measures:** in addition to the adopted design criteria for dam safety, it is also important that the Dam Break Study for the final dam crest elevation of 1300 m asl will be prepared, along with the corresponding EPP, and that this plan will be implemented.

5.5 Monitoring

Close and continued monitoring will be required for these four main issues directly related to water. This is outlined here shortly.

5.5.1 Hydrology

This is the central subject for operating a hydropower plant or a cascade of such plants. The following parameters have to be monitored on a continuous basis:

- Construction and reservoir filling phase:
    - Inflow to Rogun reservoir.
    - Outflow (separately through turbines and diversion tunnels).
    - Reservoir level and volume.
    - Amount of water retained, including time/duration of water retention.
- Operation phase:
    - Inflow: inflow to Rogun reservoir as well as inflow to Nurek reservoir (possibly derived based on outflow data from Rogun dam and HPP).
    - Outflow/release, including amount turbined, spilling and releases through any other ways (bottom or mid-elevation outlets) that may be available; to be done for all dams/HPPs in the cascade.
    - Development of any fluctuations in water level and associated water volume in the two main reservoirs Rogun and Nurek.

These are data required for the operation of the cascade and the individual power plants and are presently recorded already. This monitoring program will be continued and adapted to the evolving situation as required. In addition to their importance for cascade operation, these data are also required for monitoring compliance with agreed-upon rules for water use in accordance with BWO / Protocol 566.

5.5.2 Water Quality

Here as well, monitoring will be required during the construction and during the operation period, as outlined below:

- Construction period:
    - The most basic and important water quality monitoring program, to be carried out at least monthly during the entire construction period, would be a systematic sampling at two sites, one upstream of the construction site (the best location in this case probably being just a short stretch downstream of the confluence of Surkhob and Obihingou) and one downstream of the construction site, if feasible downstream of the diversion tunnels. The most important parameters to be measured would be temperature, DO (dissolved oxygen, in mg/l and % saturation), pH, suspended solids, total dissolved solids, oil and grease, and coliform bacteria. Any major difference between the upstream and the downstream values would then indicate a potential negative effect caused by the construction site and construction site activities.
    - Waste water treatment on the construction site: three potential sources of waste water need to be monitored:
        - Domestic waste water from workers' camps etc. These waste waters need to be treated in a suitably dimensioned wastewater treatment plant before being released to the river. Compliance with legal requirements needs to be checked by regular monitoring, and corrective action must be taken in case of non-compliance (see ESIA Vol. 3 B04, WWMP (outline wastewater management plan).
        - Runoff water from workshops, fuel storage ares etc. Such sites need to be equipped with a proper drainage and oil separators, which need to be maintained; runoff to be monitored.
        - Drainage and washing water from crushing plants, batching plants and washing sites for lorries transporting concrete. This water is likely to have a very high pH, and an abrupt raise in pH of the river water can be toxic for fish. Therefore, it needs to be drained though sedimentation ponds before being released to the river, the sediment from these ponds needs to be removed and stored properly, in a way that it will not reach the river.
- Reservoir filling: as mentioned in Section 4.2.2, it is expected that Rogun reservoir will develop a seasonal thermal stratification, without however developing a layer of anoxic water in the deeper parts of the reservoir. In order survey this situation, is is recommended to develop a monitoring program which will measure temperature and oxygen content in the water column from reservoir surface to bottom. Ideally, this is done four times a year (January, April, July and October) at two sites in the reservoir, one being located just upstream of the dam (fixed point to be maintained throughout the filling phase, but not in proximity of diversion tunnel or power intakes), and one in the centre of the reservoir (this point gradually moving upstream with the increasing impoundment). This monitoring should be continued into the operation phase, until a steady pattern will have been established. The main question here is whether there is any risk of anoxic water being delivered to the downstream area.
- Operation: a water quality program will have to be prepared and implemented during the initial part of the normal operation phase, i.e. once reservoir filling will be completed, for controlling the development of water quality in the reservoir.

5.5.3 Sediment

As mentioned in Section 5.3, Rogun dam will reduce sediment input into Nurek reservoir by about 97%, leading to no relevant sedimentation in Nurek till at least 2115, while filling of Rogun reservoir with sediments will take about 130 years. An ongoing monitoring of sedimentation in Rogun as well as in Nurek is recommended.

5.5.4 Floods

As mentioned in Section 5.4, adding Rogun HPP to the Vakhsh cascade will considerably reduce the flood risk in the downstream area since Rogun will be able to safely rout the Probable Maximum Flood (PMF).

A Dam Break Study was carried out for Rogun Dam at elevation 1100 m asl, which showed that such an event would not overtop Nurek dam and would therefore not have any negative impact on the downstream area. A study, including an Emergency Preparedness Plan (EPP) for the full dam crest elevation at 1300 m is under preparation.

Annex: List of References

DSPOE, 2025-03-19: Memorandum (on mudflow event in Obishur of May 2024).

Gruner, 2024: Main Dam at 1110 m asl: Emergency Preparedness and Action Plans. Webuild, Doc. No. S-0214-A-GE-B-GE-TR-003-A0

HR Wallingford, 2016: Nurek Reservoir Sedimentation Study. Deliverable 6: Sediment Transport Modelling.

TEAS, 2014: Techno-Economic Assessment Study For Rogun Hydroelectric Construction Project, Phase Ii: Project Definition Options. Volume 2: Basic Data, Chapter 6: Sedimentation.

Tractebel et al., 2025: Independent Assessment of Diversion Tunnels DT1, DT2 and DT3, and Management of Construction Floods (IADT). ROGUN-IADT-P1-06-C.

Tractebel., 2025-06-06: ROGUN HPP Power house flooding on May 16, 2024 and subsequent event

WB 2014: CASA-1000: Central Asia South Asia Electricity Transmission and Trade Project. Regional Environmental Assessment (REA). https://www.casa-1000.org/Docs/0104/CASA-1000%20REA%20Main%20February-14%20Final.pdf

WB, 2016: World Bank Environmental and Social Framework. World Bank, Washington D.C., 106 pp.

WeBuild, 2024-05-30: Obi-Shur debris flows, May 2024, Damages on the Obi-Shur dam.

WeBuild, 2024-11-28: Obishur River – Highly hazardous working practices by the Employer / Employer's other contractor.

DSPOE, 2025-03-19: Memorandum (on mudflow event in Obishur of May 2024).

Ziganshina, D. (2022) Chapter 18: Transboundary water allocation in the Amudarya Basin of Central Asia (2022). In Book: Water Resources Allocation and Agriculture: Transitioning from Open to Regulated Access, IWA Publishing, DOI: https://doi.org/10.2166/9781789062786 (https://iwaponline.com/ebooks/book/857/chapter/2992997/Transboundary-water-allocation-in-the-Amudarya)

WeBuild, 2024-11-28: Obishur River – Highly hazardous working practices by the Employer / Employer's other contractor.

Ziganshina, D. (2022) Chapter 18: Transboundary water allocation in the Amudarya Basin of Central Asia (2022). In Book: Water Resources Allocation and Agriculture: Transitioning from Open to Regulated Access, IWA Publishing, DOI: https://doi.org/10.2166/9781789062786 (https://iwaponline.com/ebooks/book/857/chapter/2992997/Transboundary-water-allocation-in-the-Amudarya)

Zwahlen, R., 2022: Assessing the Environmental Impacts of Hydropower Projects. Environmental Earth Sciences Series. Springer Nature Switzerland; xxx + 622 pp. https://doi.org/10.1007/978-3-030-91185-0

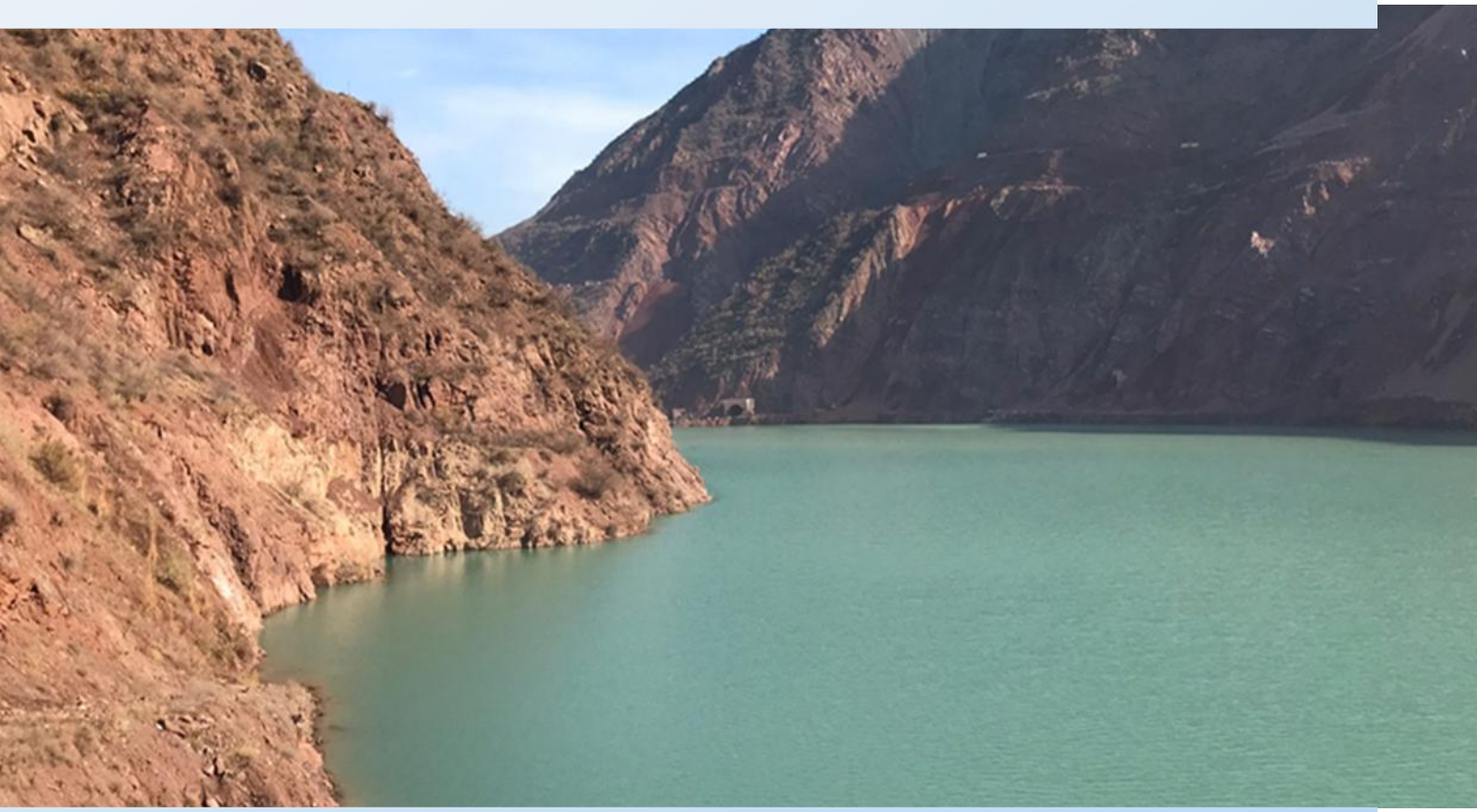
JSC “Rogun HPP”

State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT - UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Volume 1, Chapter 14: Landscape and Visual



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QUALITY CONTROL

LIST OF ACRONYMS AND ABBREVIATIONS

Term	Definition
ADB	Asian Development Bank
AIIB	Asian Infrastructure Investment Bank
ALARP	As Low As Reasonably Practicable
AMSL	Above Mean Sea Level
AoI	Area of Influence
ATPZ	Atypical Zone
CASA	Central Asia-South Asia project
CBD	UN Convention on Biological Diversity
CBRN	Chemical, Biological, Radiological and Nuclear (CBRN)
CEMP	Construction Environmental Management Plan
CEP	Committee for Environment Protection
CFP	Chance Find Procedure
CFRD	Concrete Face Rockfill dam
CHSSP	Community Health, Safety and Security Plan
CIA	Cumulative Impact Assessment
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CoC	Code of Conduct
CME	Coronal Mass Ejections
CRC	Convention on the Right of the Child
db	Decibels
DFZ	Directorate of Flooding Zone of Rogun HPP
DLEO	District Livelihood & Engagement Officer
DNSH	'Do No Significant Harm' (DNSH)

Term	Definition
DSPoE	Dam Safety Panel of Experts
E&SPoE	Environmental and Social Panel of Experts
ECoW.	Ecological Clerk of Works
ECS	Environmental, Climate and Social
EDB	Eurasian Development Bank
EFLOW	Environmental Flows
EFTA	EU and European Free Trade Area
EHS	Environmental, Health and Safety Guidelines
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EMZ	Electromagnetic Zone
EPC	Engineering, Procurement and Construction
ERP	Emergency Response Plan
ESCP	Environmental and Social Commitment Plan
ESF	Environmental and Social Framework
ESG	Environmental, Social and Governance
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESP	Environmental and Social Policy
ESPOE	Environmental and Social Panel of Experts
ESHS	Environmental, Social, Health and Safety
ESS	Environmental and Social Standards
ESSF	Environmental and Social Sustainability Framework
EU	European Union
FSL	Full Supply Level
GAP	Gender Action Plan

Term	Definition
GBVH	Gender-Based Violence and Harassment
GDP	Gross Domestic Product
GIIP	Good International Industry Practice
GBD	Global Burden of Disease
GRM	Grievance Redress Mechanism
GW	Gigawatts
GWh	Gigawatt-Hour
GWP	Global Warming Potential
GWSP	Global Water Security and Sanitation Partnership
HESG	Hydropower Sustainability ESG Gap Analysis Tool
HH	Household
HPP	Hydropower Project
HSAP	The Hydropower Sustainability Assessment Protocol
HWSD	Harmonised World Soil Database
ICWC	Inter-State Commission for Water Coordination of Central Asia
IED	Industrial Emissions Directive
IFAS	International Fund for the Aral Sea
IHA	International Hydropower Association
ILO	International Labor Organization
IPCC	Intergovernmental Panel on Climate Change
IPPC	International Plant Protection Convention
IsDB	Islamic Development Bank
IUCN	International Union for the Conservation of Nature
JSC	Joint Stock Company
KFAED	Kuwait Fund for Arab Economic Development
KfW	Kreditanstalt für Wiederaufbau

Term	Definition
LFPR	Labor Force Participation Rate
LNAPL	Light Non-Aqueous Phase Liquids
LRP	Livelihood Restoration Plan
MCE	Maximum Credible Earthquake
MW	Megawatt
NGO	Non-Governmental Organization
NTS	Non-Technical Summary
O&M	Operation and Maintenance
OHL	Overhead Lines
PAPs	Project Affected Persons
PIC	Rotterdam Convention on Prior Informed Consent
PIU	Project Implementation Unit
PMF	Probable Maximum Flood
PMG	Project Management Group
PO	Project Owner
PPE	Personal Protective Equipment
RAP	Resettlement Action Plan
RCC	Gravity Roller Compacted Concrete Dam
RPF	Resettlement Policy Framework
RTS	Remote Tunnel Spillways
RTS	Reservoir triggered seismicity (RTS)
SDG	Sustainable Development Goals
SEA	Sexual Exploitation and Abuse
SECO	Swiss State Secretariat for Economic Affairs
SEE	State Ecological Expertise
SEP	Stakeholder Engagement Plan

Term	Definition
SFD	Saudi Fund Development
SGM	DFZ Senior Grievance Manager
SH	Sexual Harassment
SPS	Safeguard Policy Statement
TA	Technical Assistance
TEAS	Techno-Economic Assessment Studies
TGEM	TajikHydroElectroMontazh
TMP	Traffic Management Plan
ToR	Terms of Reference
TSC	Total System Costs
UN	United Nations
UN CCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNICEF	United Nations International Children's Emergency Fund
US	United States
UXO	Unexploded Ordnance
VC	Valued Components
WB	World Bank
WBG	World Bank Group
WB SPDs	World Bank Standard Procurement Documents
WFD	Water Framework Directive
WHO	World Health Organization
WWTP	Wastewater Treatment Plant

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14 LANDSCAPE AND VISUAL

14.1.1. This chapter identifies the potential impacts of the Project on landscape (landscape character) and visual (visual amenity) receptors in line with UK and EU best practice approaches and uses international guidelines to support the approach.

14.1.2. The full landscape and visual baseline is presented in **Volume 2, Annex 7.1 (Baseline Conditions)** and a summary is provided in **Volume 1, Chapter 7 (Baseline)** of this ESIA. An assessment of the potential Project impacts on the landscape character and visual amenity baseline is presented in Section 14.4. Where necessary, requirements and/or recommendations for the avoidance of impact, impact minimisation and/or long-term management, are incorporated.

14.1.3. For the purpose of this assessment the likely effects of the Project upon the two separate (but linked) topics of landscape character and visual amenity are considered. These encompass:

- Landscapes: are an important component of the distinctiveness of any local area; they take their character from a combination of elements, including landform, land use and pattern, land cover/vegetation, open space and cultural heritage influences; and
- Visual amenity: a view, its components and context can have a great effect on the quality of peoples' lives.

SUPPORTING INFORMATION

This chapter should be read in conjunction with the following associated documents in this ESIA, where other aspects of the landscape are discussed in:

- Volume 1, Chapter 12 (Soils and Geology);
- Volume 1, Chapter 15 (Biodiversity);
- Volume 1, Chapter 17 (Socio-economics); and
- Volume 1, Chapter 20 (Cultural Heritage).

14.2 LEGISLATIVE FRAMEWORK, POLICY AND GUIDANCE

14.2.1. This section assesses the relevant legislation, policy and guidance which includes applicable national and international conventions and treaties, international guidance and World Bank Environmental and Social Standards (ESS). Refer to **Volume 1, Chapter 2 (Legislation and Standards)** of this ESIA.

14.2.2. This assessment follows international standards (and associated guidance), in particular the World Bank Environmental and Social Framework. Whilst none of the ESS standards specifically cover landscape or visual amenity, the following documents were considered to help inform this chapter:

- World Bank (2017). Environmental and Social Standard 1 (ESS1): Assessment and Management of Environmental and Social Risks and Impacts.
- World Bank (2017). Environmental and Social Standard 6 (ESS6): Biodiversity Conservation and Sustainable Management of Living Natural Resources.
- World Bank (2017). Environmental and Social Standard 8 (ESS8): Cultural Heritage.
- Asian Development Bank Environmental Assessment Guidelines (2003).
- European Investment Bank Environmental and Social Standards (2022).

14.2.3. The National Environmental Action Plan of Tajikistan, 2006 does not reference landscape and visual effects specifically but some aspects of the document are related, including the sections on land degradation and biological diversity.

14.2.4. In the absence of any existing guidance in Tajikistan specifically relating to landscape and visual impact assessment (LVIA), this chapter has been undertaken broadly in accordance with the following industry accepted best practice guidance in the UK and Europe and in accordance with EU requirements:

- 'Guidelines for Landscape and Visual Impact Assessment' (GLVIA), third edition, 2013, published by the Landscape Institute and Institute of Environmental Management and Assessment;
- 'An Approach to Landscape Character Assessment' 2014 published by Natural England;
- World Business Council for Sustainable Development, Guidelines for Environmental and Social Impact Assessment, 2016;
- Landscape Institute: Assessing Landscape Value – A Technical Guidance Note, 02/21; and
- Landscape Institute and Institute of Environmental Management and Assessment, Guidelines for Landscape and Visual Impact Assessment, 3rd Edition, 2013.

14.2.5. Other international guidelines that have provided points of reference to the approach and method for assessing risk and impacts include the United States Department of the Interior, Visual Resource Inventory and Visual Resource Contrast Rating Manual.

14.3 ASSESSMENT METHODOLOGY

AREA OF INFLUENCE

14.3.1. The Area of Influence (AoI) includes the footprint of the Project and associated components, including:

- The Rogun HPP dam and associated construction areas;
- The reservoir area at full supply level (FSL) – extending around 60km upstream of the dam site;
- Access roads, ancillary facilities and other core infrastructure:
  - extending c3km downstream (quarry, stockpiles, batching plant, loam plant)
  - extending c 6.5km upstream (crushing plants, Webuild camp & offices, batching plant, asphalt plant, stockpiles)
- All retained villages and settlements within 1 km of the FSL.

14.3.2. The Area of Influence (AoI) for the purpose of this assessment is considered to be the maximum potential area over which impacts from the Project are likely to be experienced. For this landscape and visual impact assessment (LVIA), the AoI extends to 1 km from the Full Supply Level (FSL) of the reservoir (1,290 m above mean sea level (m asl)) and 5km downstream (i.e. 1km beyond the main working area south of the dam site).

14.3.3. The majority of construction activity occurs at the dam site and within c6.5km upstream and 3km downstream. The influence of the heavy machinery, construction, processing plants and similar therefore reduces the further upstream or downstream you go. Beyond 6.5km upstream, the main activity is an increase in water level as the reservoir fills, with consequent relocation of villages. Therefore, from around 6.5 km upstream of the dam site, impacts will typically only result from rising water levels, with minimal changes downstream.

14.3.4. Topographical containment is provided by the steep valley sides and mountainous landscape surrounding the Project site, which helps to limit the area of influence. As such, a 2km buffer from the FSL and from the downstream river channel should be sufficient to identity landscape and visual receptors most likely to be affected by the Project. This is based on previous professional experience, the 2014 ESIA for the Project, the visual containment of the Project site, and professional judgement.

14.3.5. The current, partially completed, dam is considered to represent the existing baseline, therefore the assessment of impacts that have already occurred (prior to 2023) are not considered within this Chapter. It does, however, result in there being considerable construction activity already present in the baseline conditions.

14.3.6. This Chapter considers Project impacts up until about 2039, when the full inundation level (1,290 m asl) is due to be reached.

LANDSCAPE AND VISUAL RECEPTORS

14.3.7. To enable an analysis of potential Project-related impacts on landscape and visual receptors, the following receptors have been identified:

- Landscape Receptors:
  - Landscape Character Area (LCA) 1: Disturbed/ industrial landscape - the Project Site;
  - LCA 2: Enclosed River Corridor / Riverine villages;
  - LCA 3: Broader alluvial landscape; and
  - LCA 4: Larger settlements – Rogun City.
- Visual Receptors:
  - Residential receptors:
    - Residents in Rogun City (west of the river);
    - Residents in retained villages alongside the river within 6.5 km upstream of the dam site; and
    - Residents in retained villages alongside the river beyond 6.5 km upstream of the dam site.
  - Recreational receptors:
    - Users / visitors to gardens, parks, tourist attractions and outdoor recreational sites on the edge of Rogun City;
    - Users / visitors to gardens, parks, tourist attractions and outdoor recreational sites in retained villages within 6.5 km upstream and 3km downstream of the dam site; and
    - Users / visitors to Vodoyem and Izba outdoor hiking areas (south west of dam site).
  - Commercial receptors:
    - Workers in Rogun City;
    - Workers in retained villages within 6.5 km upstream of the dam site; and
    - Workers at the existing construction compounds.
  - Transport receptors:
    - Users of the M41 highway; and
    - Users of surrounding roads (including unpaved routes)

QUALITATIVE ASSESSMENT

14.3.8. Conclusions about the sensitivity of receptors, the magnitude of impacts and the significance of effects are based on professional judgement through review of qualitative baseline data and photography from site work.

RECEPTOR SENSITIVITY

Landscape

14.3.9. The assessment of landscape effects relates to the existing physical features of the landscape, including patterns of land use, land cover and its aesthetic and perceptual qualities.

14.3.10. Assessing landscape sensitivity is determined through consideration of each landscape receptor's value and its susceptibility to change.

- Indicators of landscape value include any designations attached to the landscape, its condition, evidence of recreational activity, and cultural association.
- Landscape susceptibility refers to the ability of the landscape to accommodate the Project without undue negative consequences to its baseline. Landscape susceptibility relates to the ability of a particular landscape to accommodate the Project.

14.3.11. Overall landscape sensitivity is then determined by employing professional judgment to combine and analyse the identified landscape value and susceptibility to determine the overall landscape receptor sensitivity.

The categories of relative sensitivity and their typical characteristics are described in **Table 14-1.**

Table 14-1 - Criteria for Landscape Receptor Sensitivity

Sensitivity	Typical landscape characteristics – Susceptibility to change	Typical landscape characteristics - Value
High	An open landscape with limited screening. Distinctive undeveloped skylines. Higher value, characteristic landcover and elements that cannot be easily reinstated or replaced. Landscape with numerous environmental and technical constraints and fewer potential environmental measures. Perceptual qualities associated with particular scenic qualities, wildness or tranquillity. Adjacent landscape character context connected by borrowed character and views. Fragile landscape vulnerable and lacking the ability to accommodate change. No or limited scope for substitution or positive enhancement.	Areas of landscape character that are highly valued for their scenic quality (including most statutorily designated landscapes); Evidence that the landscape / element is valued or used substantially for recreational activity Mature landscape features or vegetation such as ancient woodland or mature parkland trees which are characteristic, contribute to a sense of place, illustrates time-depth in a landscape, and if replaceable, could not be replaced other than in the long term. Elements/features that could be described as unique or are nationally scarce. Aesthetic/scenic aspects of designated wildlife, ecological or cultural heritage features that contribute to landscape character. Landscape with strong cultural associations that contribute to scenic quality.

Sensitivity	Typical landscape characteristics – Susceptibility to change	Typical landscape characteristics - Value
		Landscape with perceptual qualities of wildness, remoteness or tranquillity.
Medium	Areas that have a positive landscape character but include some areas of alteration, degradation or erosion of features. A reasonably attractive landscape with a mix of attractive features and intrusive elements. Pleasant but unremarkable. Some scope for substitution or positive enhancement.	Features / elements that are locally commonplace; unusual locally but in moderate / poor condition. Mature vegetation that is in moderate condition or could be replicated in the short to medium term. Perceptual / aesthetic aspects have some vulnerability to unsympathetic development. Landscape with evidence of cultural associations and recreational activity.
Low	Presence of numerous detracting features such as obtrusive man-made artefacts (e.g. power lines, large scale developments). An enclosed landscape with screening or a large-scale landscape able to accommodate the Proposed Development without undue loss or adverse effects to features. Lower value, non-characteristic landcover and elements capable of rapid reinstatement or replacement. Developed, nondistinctive skylines. Contemporary, cultivated/settled or developed landscapes are likely to have a lower susceptibility.	Landscapes without formal designation. Despoiled, damaged, degraded or substantially modified landscape with few characteristic features of value. Detracting or intrusive features / landscapes/ elements that detract from its inherent attributes. Widespread or 'common' landscape character types, features or elements. Limited wildlife, ecological or cultural heritage features, or limited contribution to landscape character. Limited or no evidence that the landscape is used for recreational activity. Landscape with few cultural associations.

Source: Adapted from Guidelines for Landscape and Visual Impact Assessment (GLVIA), 3rd Edition (2013).

14.3.12. The sensitivity of each landscape character receptor, based on the above criteria, is summarised in **Table 14-2** -. These have been determined by evaluating aerial photography and maps, secondary data sets, and site survey information to ascertain key landscape features and LCAs.

Table 14-2 - Sensitivity of Landscape Receptors

Receptor	Susceptibility - Description	Value- Description	Overall Sensitivity
LCA 1: Disturbed/ industrial landscape - the Project Site	Presence of numerous detracting features due to existing construction activity associated with the Rogun dam, including the dam site and operational turbines, construction worker compounds, artificial landforms, stockpiles, movement from people, vehicles,	The industrial activity of theLCA has largely removed cultural associations of historic value, although the presence of HPP on this river are characteristic of the wider area. The	**Low**

Receptor	Susceptibility - Description	Value- Description	Overall Sensitivity
	plant, conveyors, workshops and processing plants. Vegetation within this LCA includes common-place sparse floodplain vegetation and regenerating scrub on land-slipped soils. The susceptibility of Character Area 1 to this type of project is considered to be **Low**.	vegetation is commonplace within the landscape and of limited, though distinctive, aesthetic value. No evidence of recreational value. The degraded and damaged landscape is considered to be of **Low Value**.	
LCA 2: Enclosed River Corridor / Riverine villages	A meandering watercourse through steep sided valleys, challenging terrain, containing a mixture of grass/scrub on steep mountain sides and more fertile floodplain, generally in good condition. Linear residential settlements alongside watercourses. Many characteristic features of a rural landscape, albeit some relatively commonplace. Residential properties typically low-rise (1-2 story) detached dwellings, with adjoining land plots and small-scale agricultural farmsteads and trees alongside the fertile river corridor. Rural largely undeveloped character. The susceptibility of the enclosed river corridor to the Project is considered to be **Medium**.	There are no landscape designations associated with this LCA, but it contains evidence of recreational activity and numerous cultural heritage artefacts and associations in the area. The landscape is in moderate condition and represents the rural cultural heritage of the region. It also illustrates time-depth in the landscape, having been carved and developed slowly over generations Overall, this LCA is of **Medium value**.	**Medium**
LCA 3: Broader alluvial landscape	Braided river channel, sandbars and a wider meandering watercourse with larger, flat floodplains and hills/ mountains set back. Less challenging terrain, but still rural. Settlements within the floodplain containing low-rise (1-2 story) detached dwellings surrounded by trees, gardens and agricultural plots. Agricultural land is relatively common in the local landscape alongside watercourses, but remains characteristic and distinctive. The susceptibility of the broader alluvial landscape to this type of project is considered to be **Medium**.	There are no landscape designations associated with this LCA but evidence of recreational activity and numerous cultural heritage artefacts and associations in the area. The landscape appears to be in reasonable condition, containing some mature vegetation / features. It represents the rural cultural heritage of the region. It also illustrates time-depth in the landscape, having been carved and developed slowly over generations. Overall, this LCAis of **Medium value**.	**Medium**

Receptor	Susceptibility - Description	Value- Description	Overall Sensitivity
LCA 4: Larger settlements – Rogun City	Established larger settlements and built-up areas surrounded by agricultural plots and backdropped by mountains and hills. Developed/ settled areas of low and medium-rise apartments and buildings and containing infrastructure such as schools, transport routes, electricity, shops, commerce/ retail outlets, cultural and community facilities, and recreational facilities. Settlements typically contain many trees and shrubs to give a vegetated and more intimate character and provide some screening. The susceptibility of settlements to this type of project is considered to be **Low**.	The larger settlements contain cultural facilities and associations, being in generally good condition, but with potentially fewer long-standing cultural heritage associations due to resettlements into the town. Some mature vegetation present within gardens and streets. The value of this LCAis considered to be of **Low value**.	**Low**

Visual

14.3.13. The visual assessment relates to potential changes to existing views from identified receptors (people), e.g., residents, recreational routes, or motorists, as a result of the addition or loss of features in the existing view.

14.3.14. Visual receptors are also assessed in terms of the value of the view and susceptibility to change, in order to determine their overall sensitivity to the Project.

- Indicators of visual value include whether the view is recognised, e.g. via a planning designation or within guidebooks, or is a recognised view in art or literature.
- Visual susceptibility relates to the occupation of those experiencing the view and the extent to which their attention or interest is focused on the view.

14.3.15. Overall visual sensitivity is then determined by employing professional judgment to combine and analyse the identified visual value and susceptibility to determine the overall visual receptor sensitivity.

14.3.16. The categories of relative sensitivity and their typical characteristics are summarised in **Table 14-3.**

Table 14-3 – Criteria for Visual Receptor Sensitivity

Sensitivity	Typical visual characteristics – Susceptibility	Typical visual characteristics - Value
High	A view or overall visual amenity which is an important reason for receptors being there, such as residents, walkers (users of long-distance trails) or tourists to visitor attractions, whose main attention and interest is likely to be on their surroundings. Residents that gain static, long-term views of the development in their principal outlook.	Specific viewpoint identified on maps and/or tourist information and signage. Facilities provided at viewpoint to aid the enjoyment of the view. View afforded protection in planning policy.

Sensitivity	Typical visual characteristics – Susceptibility	Typical visual characteristics - Value
	A view that is focused in a specific directional vista, with notable features of interest in a particular part of the view. A well-balanced view containing attractive features and notable for its scenic quality. A view which is experienced by a large number of people including static viewpoints such as residential property.	View is within or overlooks a designated landscape, which implies a higher value to the visible landscape. View has informal recognition and well-known at a local level, as having particular scenic qualities. View or viewpoint is recognised through references in art or literature. View has high scenic qualities relating to the content and composition of the visible landscape.
Medium	A view or overall visual amenity which plays a relatively small part in the reason why a receptor would be there e.g. users of outdoor sports facilities, visitors to / workers in retail areas, offices or outdoor workers in medium to high quality landscapes. An otherwise attractive view that includes noticeable discordant features or overall visual amenity where there are noticeable visual detractors. Several viewers, or longer transient views such as from public open space and recreational areas. Mobile viewers whose views are transient and dynamic but with typically lower speeds than found on main arterial transport routes, e.g. users of scenic roads or tourist routes, local railways or waterways	Viewpoint may be identified on a limited number of maps, tourist information or signage. Limited facilities provided at viewpoint to aid enjoyment of the view. View unlikely to be afforded protection in planning policy. View is not within a designated landscape. View has limited identified scenic qualities relating to the content and composition of the visible landscape. View or viewpoint may be recognised in limited references in art or literature.
Low	A view or overall visual amenity which is unlikely to be part of the receptor's experience or reasons for being there e.g. people at work in medium quality landscape, Indoor workers, users of sports facilities Mobile viewers whose views are transient and dynamic (e.g. travelling on main arterial routes in cars or trains with glimpsed views). Open views with no specific point of interest. An unattractive view or overall visual amenity where there are many visual detractors Few viewers, or longer transient views such as from public open space and recreational areas.	Viewpoint not identified on maps, tourist information or signage. No facilities provided at viewpoint to aid enjoyment of the view. View is not afforded protection in planning policy. View is not within, nor does it overlook, a designated landscape. View is not known as having any particular scenic qualities relating to the content and composition of the visible landscape. View or viewpoint is not recognised in references in art or literature.

Source: Adapted from Guidelines for Landscape and Visual Impact Assessment (GLVIA), 3rd Edition (2013).

14.3.17. The sensitivity of each visual receptor, based on the above criteria, is summarised in **Table 14-4.**

Table 14-4 - Sensitivity of Visual Receptors

Receptor	Susceptibility	Value	Overall Sensitivity
Residential Residents in Rogun City (west of the river)	Residential views are typically static but key views look towards the town or surrounding mountains rather than onto the Project site. The town contains many residents, including some looking towards the Project site, but most views are screened by intervening properties, topography and trees. Many views are also focussed into the town rather than the wider landscape. Where views look towards the Project site, the existing construction activities are a discordant feature in the view. Susceptibility is Low.	The town is identified on maps, although there are no particular views or vistas identified or protected in planning policy. Value of the view is Low.	Low
Residential Residents in retained villages alongside the river within 6.5 km upstream of the dam site	Views are from a static location in close proximity to the Project site and with clear views across the wider scenic landscape from much of the low-rise village. Whilst the existing Project site creates large, discordant features in the view, there are clear views towards the surrounding attractive, scenic landscape. Susceptibility is Medium.	Views are static, focussed on the landscape and often with long-standing traditions and connections to the landscape. The river corridor and mountain backdrop are scenic features. Views look across the Sarykhosorsky Nature Refuge area, and towards wider mountains. Value of the view is Medium.	Medium
Residential Residents in retained villages alongside the river beyond 6.5 km upstream of the dam site	Views are from a static location in close proximity to the increased water levels but distant from the main dam site. There are limited detracting features in the view. Susceptibility is High.	Views are static, focussed on the landscape and often with long-standing traditions and connections to the landscape. The river corridor and mountain backdrop are scenic features. Value of the view is Medium.	High
Recreational Users/ visitors to gardens, parks, tourist attractions and outdoor recreational sites on the edge of Rogun City	Users are focussed on the local landscape (including the town) as well as the surrounding mountain and river corridor scenery. Views include longer transient views. The existing Project site creates visual detractions in the existing view. Susceptibility is Low.	Users of outdoor attractions focussed on the local landscape but with an awareness of the surrounding hills and valleys. No specific views identified on maps or covered in planning policy. Value of the view is Low.	Low
Recreational	Users focussed on the local rural landscape as well as the	Users of outdoor attractions focussed on the local landscape	Low

Receptor	Susceptibility	Value	Overall Sensitivity
Users/ visitors to gardens, parks, tourist attractions and outdoor recreational sites in retained villages within 6.5km upstream of the dam site	surrounding mountain and river corridor scenery. Views include longer transient views. The existing Project site creates visual detractions in the existing view. Susceptibility is Low.	but with an awareness of the surrounding hills and valleys. No specific views identified on maps or covered in planning policy. Value of the view is Low.	
Recreational Users/ visitors to Vodoyem and Izba outdoor hiking/ park areas (southwest of dam site)	Users focussed on the landscape, which is an important reason for being there, and contributes to the enjoyment of the activity. The main attention and interest of users is likely to be on their surroundings. Susceptibility is High.	Vodoyem and Izba outdoor hiking/ park areas are identified on maps, although no particular facilities are provided. There are, however, numerous well-defined tracks across the scenic landscape. Value of the view is High.	High
Commercial Workers in Rogun City	Numerous views from workers but focussed on work-related activities rather than the landscape. Susceptibility is Low.	Views not identified on maps and no facilities provided for enjoyment of the view. Value of the view is Low.	Low
Commercial Workers in retained villages within 6.5 km upstream of the dam site	Views from workers whose focus is on work-related activities rather than the landscape. Susceptibility is Low.	Views not identified on maps and no facilities provided for enjoyment of the view, although some scenic quality within a rural village setting. Value of the view is Low.	Low
Commercial Workers at the existing construction camps	Outdoor workers in close proximity to the Project site and focussed on work-related activities. Numerous detracting features in the view. Susceptibility is Low.	Transient workers, views not identified on maps and no facilities provided for enjoyment of the view. Value of the view is Low.	Low
Transport: Users of the M41 highway	Views are transient and typically from faster moving vehicles. Susceptibility is Low.	Views are from faster moving vehicles and less focussed on the landscape. Value of the view is Low	Low
Transport: Users of surrounding roads	Views are transient but typically slower moving and more focussed on the landscape. Susceptibility is Medium.	Views more likely to be associated with access to family-owned land plots, spiritual or cultural sites. Value of the view is Medium.	Medium

ASSESSMENT OF IMPACT SIGNIFICANCE

14.3.18. Project impacts have been assessed against the baseline landscape and visual conditions.

14.3.19. The significance of the effects is the outcome of the interaction of the receptor sensitivity and the impact magnitude and indicates the requirements for mitigation. The post-mitigation outcome has also been assessed to determine the significance of the residual effect.

14.3.20. The landscape assessment has taken account of direct and indirect changes to existing landscape elements, features and key characteristics and evaluates the extent to which these would be lost or modified, in the context of their importance in determining the existing baseline character.

14.3.21. The visual assessment has taken account of the likely changes to visual composition, including the extent to which new features would distract or screen existing elements in the view or disrupt the scale, structure, or focus of the existing view.

14.3.22. The descriptions in **Table 14-5** summarize the categories used to assess the magnitude of the impact in relation to landscape and visual**.**

Table 14-5 – Impact Magnitude Categories

Magnitude	Description of Landscape impact	Description of Visual impact
Large Adverse	Considerable change (total loss, large scale change, or addition of new but uncharacteristic conspicuous features and elements) over an extensive area of a highly sensitive landscape, fundamentally affecting the key characteristics and the overall impression of its character.	The project, or a part of it, would become the prominent feature or focal point of the view. A clearly noticeable change to a highly sensitive and well composed existing view.
Medium Adverse	Partial loss or noticeable change to a highly sensitive landscape or distinctive components; or more intensive change to a landscape of medium or low sensitivity. Change affecting some key characteristics or distinctive components; and/or the addition of new but uncharacteristic noticeable components, resulting in a change to the overall impression of its character.	The development would be a noticeable feature or a somewhat discordant feature / element in the view and be readily apparent to the receptor. A noticeable change to a highly sensitive and well composed existing view; or a prominent change within a less well composed and less sensitivity view.
Small Adverse	Slight loss or change to existing character or components, and/or the addition of new but uncharacteristic components. Small change to a limited area of landscape of high or medium sensitivity or a more widespread area of a less sensitive landscape. The changes do not alter the overall impression of its character.	The development would be a visible but not particularly noticeable feature, or a slightly discordant feature in the view. A small change to a highly sensitive and well composed existing view or a noticeable change within a less well composed and less sensitive view. The project, or a part of it, would be perceptible but would not alter the overall balance of components that comprise the existing view.
Very Small Adverse	No discernible loss or change to the existing landscape character or components.	Very limited or no part of the project, or work or activity associated with it, is discernible in the view.

Magnitude	Description of Landscape impact	Description of Visual impact
Neutral	Changes to the character of the landscape that are different to the baseline but neither adverse nor beneficial.	Changes to visual amenity (views) that are different to the baseline but neither adverse nor beneficial.
Beneficial	Improvement of character by the restoration of existing components; the removal of uncharacteristic components; or the addition of new characteristic components.	Improvement of the view through removal or improvement of disrupting or incongruent features, resulting in enhanced quality of the view, or improved perception of the components in the view.

14.3.23. The receptor sensitivity categories in **Table 14-3** and **Table 14-5** and the impact magnitude category in **Table 14-7** combine to provide a qualitative assessment of the resulting landscape and visual impacts respectively.

14.3.24. The matrix for assessing significant of effects is shown in **Volume 1 Chapter 5 (ESIA Methodology)** of this ESIA, and effects that are classified as moderate or major are considered to be significant effects. Effects classified as minor or negligible are considered to be not significant.

14.4 POTENTIAL IMPACTS

14.4.1. Impacts on landscape character and visual amenity are as follows:

- **Temporary and Permanent Changes due to Construction Activities** as a result of temporary uncharacteristic activity due to construction, machinery, workers, artificial lighting, material storage piles, worker facilities and movement of materials during the construction of the dam, new section of highway, creation of a reservoir, and change in upstream river profile, and;. Construction activity is expected to be completed in 2032. FSL is expected to be reached by 2038.
- **Permanent Changes due to Operational Activities** including permanent loss of river characteristics (such as sandbars) and permanent higher water level.

14.4.2. **Figure 14-1** shows an image of the Nurek dam, located downstream of Rogun dam. It is anticipated that, on completion of the Rogun dam construction and reservoir filling, the Rogun site may be visually similar to the Nurek dam. **Figure 14-2** also shows a photograph of the Rogun dam site in 2023.

Figure 14-1 - Photograph of Rogun dam site in 2023 (left); aerial view of Nurek Dam downstream of the Rogun (right)



14.4.3. As outlined in **Chapter 3: Project Description** of this ESIA, the dam construction will be complete by 2032 and the Project reservoir will reach the FSL 1,290m asl by approximately 2038, flooding an area of 170 km².

14.4.4. The land that will be inundated once FSL is reached is mostly village settlements, grassland degraded by farming (grazing), arable land and orchards, including the dekhan farms and kitchen gardens, and some areas of Juniper forest.

CONSTRUCTION

Landscape

14.4.5. During the construction phase, most of the landscape changes are confined to the dam site and its allied infrastructure, such as the construction camp, quarries, storage areas, and from construction traffic, working, and movement of people and plant.

14.4.6. The construction site covers an area of 20 sq km. Approximately 1.3 km of the river reach has already been blocked for construction of the dam. As a result, water has started to accumulate upstream of the dam site, with some areas with low elevation already inundated, as can be seen in the comparison images of year 2013 and 2022 (**Figure 14-2**). This has consequently created a reservoir in the baseline scenario.

Figure 14-2 - Rogun Dam site at the resumption of construction in 2013 (Left) and during construction in 2022 (Right)



14.4.7. Whilst the wider riverine character of the landscape will be largely retained with mountain backdrops and settlements along its course, with the river channel remaining similar downstream, the landscape and topography around the dam site will become permanently modified.

14.4.8. There is potential for alterations to the existing baseline character of the landscapes present due to the following activities:

- **Activity a:** Ground and Ground-Level Disturbance Activities & Changes (primarily left bank works):
  - Loss of existing vegetation to facilitate the construction of access roads/ bridges, relocated construction workers' accommodation/ compounds. demolition of villages, and rising water levels. For the purpose of this assessment the main areas of vegetation loss are considered to be scrubby vegetation, grassland, arable land and orchards, and some areas of Juniper forest. Removal of vegetation may also result in soil erosion and degradation of adjacent landscape;
  - Abandonment of field systems and demolition of villages may degrade local character;
  - Change to the local topography as a result of temporary stockpiling of materials and earthworks during construction of new access road and bridges upstream (left bank works);
  - Continued ground disturbance due to construction of the dam, supporting infrastructure and associated ancillary facilities;
  - Changes in access routes and road management for new construction elements (such as left bank access road and bridges) with loss of existing bridge crossings and permanent diversion of access routes, including the M41 changing the character of the local landscape as construction progresses; and
  - Temporary change in land use to accommodate relocated construction compounds and construction workers' accommodation; relocation of Project affected people (PAP) which may create abandoned or demolished villages on the edge of the FSL; flooding of existing construction areas; and construction of new access roads and bridges upstream creating uncharacteristic temporary construction activities and presence of workers, machinery, materials, and earth movements in areas not currently undergoing such activity.

- **Activity b:** Construction Activities: :
  - Temporary continuation of manmade activity in the landscape due to the construction camp, quarries and storage areas around the dam site;
  - New access roads and bridge connections along the left bank for some 55km will extend the working area upstream introducing some uncharacteristic and activity from construction traffic, and the working and movement of people, machinery and plant.
- **Activity c:** Presence of the Reservoir:
  - The filling of the reservoir will result in permanent changes to the river channel upstream, increasing the level of the water and permanently changing the river channel. The vegetation and river meanders will be submerged by the new reservoir.

14.4.9. All of the above construction activities will collectively impact on the baseline of the landscape character receptors identified, although many activities are already present in the landscape. The construction impacts are therefore considered together and collectively, to create a single Impact at Construction, thus representing the 'worst case' scenario.

14.4.10. The Project will result in direct impacts to all LCAs identified and result in changes to the existing character of the landscape.

14.4.11. In all instances, landscape impacts are considered to be greatest during the construction phase of the Project due to the movement, plant, and works occurring, in addition to the construction of the structures. Whilst many of these activities already occur in the baseline (due to construction of the dam being on-going), some additional activity will occur. Following construction, the Project will be largely static except for rising and fluctuating reservoir water levels and consist of a distinctive manmade dam wall in the landscape.

14.4.12. Overall, the Project during construction is considered to have a very small to medium magnitude of change on LCAs.

14.4.13. The resulting effects are summarised in **Table 14-6**.

Table 14-6 – Assessment of Temporary Changes due to Construction Activities on Landscape Character at Construction

Receptor	Sensitivity	Impact Magnitude	Effect & type	Commentary
LCA 1: Disturbed/ industrial landscape - the Project Site	Low	Very Small adverse	Negligible. The effect will be direct, temporary and medium-term	Additional floodplain scrub/ grassland margins will be permanently lost along with the existing character of the river channel as the reservoir levels rise, but the overall character of construction activity will remain.
LCA 2: Enclosed River Corridor / Riverine villages	Medium	Medium adverse	Moderate (significant) The effect will be direct, permanent and long-term	Existing vegetation is limited and transient due to arable crop rotation, but the well vegetated villages with trees and shrubs will gradually be lost as water levels rise and villages are resettled. All the villages falling within the reservoir boundaries at FSL will be relocated by 2032. The village footprints will be cleared,

Receptor	Sensitivity	Impact Magnitude	Effect & type	Commentary
				and all material and building will be either shifted or demolished. Some of these villages have already been relocated, however, abandonment of field systems and demolished buildings will slightly increase. Even so, the overall character will remain one of water bodies surrounded by mountain sides with occasional villages, partially impacted by existing and on-going construction activity.
LCA 3: Broader alluvial landscape	Medium	Small adverse	Minor The effect will be direct, permanent and long-term	This LCA is more distant from the dam site and therefore less impacted by and activity from the dam construction itself. Rising water levels will be readily noticeable, resulting in loss of floodplain vegetation and alluvial character and replacing it with a lake character. All the villages falling within the reservoir boundaries at FSL will be relocated by 2032, with villages, material and buildings shifted or demolished. Whilst there are already some abandoned villages and agricultural plots in the landscape, the number will slightly increase.
LCA 4: Larger settlements - Rogun City	Low	Very Small adverse	Negligible The effect will be indirect, temporary and medium-term	This LCA, located adjacent to the dam site, so will already be impacted by and activity of the construction works at and around the dam site, and traffic and people from worker camps. The wider construction activities, village resettlement, increasing height of the dam wall and rising reservoir levels will continue to impact the setting of the LCA. but overall, there will be little change to the existing character.

Mitigation and Enhancement Measures

14.4.14. Moderate (significant) effects have been identified for LCA 2: *Enclosed River Corridor / Riverine villages,* where the continuation of construction works and expansion of the reservoir will cause noticeable impacts by demolishing villages, bridges and access routes, building of new access roads and bridges, and the loss of vegetation, including crops associated with agricultural activity.

14.4.15. The key mitigation will be the cessation of construction activity which will restore much of the tranquillity and naturalness back to the local landscape. No landscape specific mitigation is therefore identified at construction.

14.4.16. However, mitigation identified for other purposes are summarised in **Section 14.5**.

Residual Effects

14.4.17. As no mitigation is identified, the residual effects for sandscape receptors at construction remain the same.

Visual

14.4.18. There is potential for alterations to the existing visual amenity of receptors during construction due to the following activities:

- **Activity a:** Ground and Ground-Level Disturbance Activities & Changes (primarily left bank works):
  - Visual disruption and change in views due to limited but uncharacteristic temporary construction activities and presence of workers, machinery, materials, and earth movements in areas not currently undergoing such activity (such as upstream access roads/ bridges on the left bank) may impair visual amenity, especially for nearby residents;
  - Temporary change to land use due to the flooding of existing construction areas in order to accommodate relocated construction compounds and the construction workers' accommodation, and relocation of Project affected people (PAP) which may create some abandoned and demolished villages on the edge of the FSL.
- **Activity b:** Construction Activities: Emissions of Dust:
  - New access roads and bridge connections along the left bank for some 55km will extend the working area upstream introducing some uncharacteristic activity from construction traffic, and the working and movement of people, machinery and plant and changing the experience and visual perception of the view;
- **Activity c:** Presence of the Reservoir:
  - The construction and introduction of a large dam wall and associated earthworks will change the riverine environment upstream with rising water levels; and
  - The filling of the reservoir will result in permanent visual changes to the river channel upstream, increasing the level of the water and losing the characteristic features of the river channel including areas of scrubby vegetation at the margins.

14.4.19. All of the above construction activities will collectively impact on residential, commercial and transport receptors. The above impacts are therefore considered together and collectively, to create a single impact during Construction, thus representing the 'worst case' scenario.

14.4.20. In all instances, visual effects are considered to be greatest during the construction phase of the Project due to the uncharacteristic movement, plant, and works occurring, in addition to the construction of the structures. Following construction, the Project will be largely static, although water levels within the reservoir will fluctuate, and the dam wall will remain a permanent, distinctive manmade feature in some views.

14.4.21. Overall, the Project during construction is considered to have a small to medium magnitude of change on the visual amenity of residential, commercial and transport receptors. The resulting effects are summarised in **Table 14-7.**

Table 14-7 - Assessment of Temporary Changes due to Construction Activities on Visual Amenity at Construction

Receptor	Sensitivity	Impact Magnitude	Effect	Commentary
Residential Residents in Rogun City (west of the river)	Low	Small adverse	Minor This effect would be direct, temporary and medium-term.	Most of the construction activities occur towards the dam site close to Rogun, therefore residents on the edge of the city have direct views towards the adjacent construction sites, construction access routes and the increasing height of the dam wall (upper portions of the dam wall only).

Receptor	Sensitivity	Impact Magnitude	Effect	Commentary
				Construction activities, including machinery, plant construction workers, stockpiles, partially constructed structures and construction vehicles on access roads are already distinctive features in the view. Once the Main dam (Stage 2 dam) is constructed, the activity, compounds and equipment associated with the construction works would be removed, although the top of the dam wall would be a noticeable feature in views for residents on the eastern end of the city. The backdrop of hills and mountains will not be changed by construction.
Residential Residents in retained villages alongside the river within 6.5 km upstream of the dam site	Medium	Medium adverse	Moderate (significant) This effect would be direct, temporary and medium-term.	The presence of construction activity for new access roads and bridges, particularly left bank works, would extend the area of construction upstream, whilst demolished and abandoned villages and agricultural plots would be noticeable for some villagers. Once the dam is constructed, the activity, people, compounds and equipment associated with the construction works would be removed.. However, the gradually increasing higher water levels in the reservoir pose an effect that would remain direct, and permanent in nature. The backdrop of hills and mountains will not be changed and will be same as before, although there may be fewer villages discernible.
Residential Residents in retained villages alongside the river beyond 6.5 km upstream of the dam site	Medium	Medium adverse	Moderate (significant) This effect would be direct, temporary and medium-term.	Most of the construction activities occur towards the dam site close to Rogun City, and therefore more distant from these settlements. However, construction activity for new access roads and bridges, (left bank works) would extend the area of construction upstream, with associated work areas. Loss of villages and abandonment of agricultural land and plots due to resettlement by 2032 will be readily noticeable.
Recreational Users/ visitors to gardens, parks, tourist attractions and outdoor recreational sites on the	Low	Small adverse	Minor This effect would be direct, temporary and medium-term.	Most of the construction activities occur towards the dam site close to Rogun City, therefore, visitors to attractions and recreational spaces on the edge of the town would have direct views towards the dam site and all the existing construction activity. Whilst the dam wall will increase in height, and water levels will continue to rise, much of the existing view will remain unchanged Once the dam is constructed, the activity,

Receptor	Sensitivity	Impact Magnitude	Effect	Commentary
edge of Rogun City				compounds, people and equipment associated with the construction works would be removed, improving the naturalness of the view, albeit with a distinctive, high dam wall and gradually increasing reservoir level.
Recreational Users/ visitors to gardens, parks, tourist attractions and outdoor recreational sites in retained villages within 6.5km upstream of the dam site	Low	Medium adverse	Minor This effect would be direct, temporary and medium-term.	The extent of construction activities will be readily noticeable to visitors enjoying outdoor recreational spaces although the noise, activity, dust, and extent of construction are already features within the existing view. The increasing height of the dam wall and rising water levels will be discernible and change the view. Once the dam is constructed, the activity, compounds, people and equipment associated with the construction works would be removed, although the reservoir levels will continue to slowly rise. The backdrop of hills and mountains will remain although there may be fewer villages discernible.
Recreational Users/ visitors to Vodoyem and Izba outdoor hiking areas (south west of dam site)	High	Small adverse	Moderate. (significant) This effect would be direct, temporary and medium-term.	Existing construction activities at eth dam site and downstream of it will be noticeable to visitors enjoying these outdoor recreational spaces, and the increasing height of the dam wall will become increasingly noticeable. Once the dam is constructed, the activity, compounds, people, machinery plant, vehicles and equipment associated with the construction works would be removed and the quarry site rehabilitated, creating a more tranquil and natural environment for recreational users. Presence of the dam wall will remain, along with the backdrop of hills and mountains.
Commercial Workers in Rogun City	Low	Very Small adverse	Negligible. The effect would be direct, temporary and medium-term.	Workers within the town will be largely focussed on their work or customers and not focused on the view. There will be little change to views due to existing construction activity, although the increasing height of the dam wall and rising water levels may be discernible.
Commercial: Workers in retained villages within 6.5km upstream of dam site	Low	Very Small adverse	Negligible The effect would be direct, temporary and medium-term.	Workers within the villages will be focussed on their work or customers and not focused on the view, although the landscape forms an integral part of the village setting. There is unlikely to be much change to the existing view due to existing construction works.
Commercial:	Low	Neutral	Negligible.	Workers at the existing construction camp

Receptor	Sensitivity	Impact Magnitude	Effect	Commentary
Workers at the existing construction camps			The effect would be direct, temporary and medium-term.	will be directly affected by the construction activities including plant and storage compounds. However, this activity is the same as existing construction activity and will therefore remain characteristic of their existing views.
Transport: Users of the M41 highway	Low	Medium adverse	Minor. The effect would be direct, temporary and medium-term.	Users of the existing highway will be directly affected by the required change in highway alignment, with a section of the M41 being permanently submerged. The new alignment, higher up the mountainside, will replace the submerged section on a newly constructed section. Users will have clear visibility of the highway construction activities, as well as the potential increases in traffic and lorries on access roads and artificial lighting.
Transport: Users of surrounding roads	Medium	Medium adverse	Moderate. (significant) The effect would be direct, temporary and medium-term.	Many roads and access routes, as well as some bridges, will become submerged and therefore users of the existing roads will be directly affected by changing views. As part of the construction works, however, new roads and (where necessary) bridges will be constructed to ensure surrounding villages remain connected with the realigned M41. Users will have clear visibility of the construction activities, as well as potential increases in traffic and lorries on adjacent roads.

Mitigation and Enhancement Measures

14.4.22. Significant effects have been identified for residential, recreational and transport receptors due to construction activities resulting in changes to views. The effects of construction activity are already part of the baseline conditions due to existing dam construction works, so the main mitigation will be completion and removal of the construction activity to create views of a more natural, rural landscape

14.4.23. Construction activities relating to traffic management, air quality, and site rehabilitation are managed through their respective management plans. For example, the Site Rehabilitation Plan will include measures to ensure structures are removed once they are no longer required, helping to ensure impacts reduce as construction activities wind down. These activities are summarised in **Section 14.5**. As a result, specific mitigation for visual receptors is not required.

Residual Effects

14.4.24. As no mitigation is identified, the residual effects for visual receptors at construction remain the same.

OPERATION

Landscape

14.4.25. There is the potential for permanent alterations to the landscapes once the Project is operational, due to the Presence of the Dam and Reservoir. This includes the following elements:

- Presence of the Dam and Reservoir:
  - An area of river channel, settlements, valley and hillsides will become permanently submerged below the new higher water level;
  - Permanent presence of a large working dam potentially resulting in uncharacteristic noise/ water movements in the landscape whilst the hydroelectric dam is operational;
  - Permanent addition of new, built structures within the landscape, including the dam and associated buildings, changing the immediate character of the local landscape;
  - Changes in the textures and colours of the landscapes due to the permanent loss of vegetation and river corridor to the dam, dam buildings, and reservoir behind. Such textures and colours may be different to those in the surrounding landscapes; and
  - Permanent change to the surrounding landscape with amended access roads/ routes and new shoreline.

14.4.26. There is the potential for alterations to the landscapes present once the Project is operational, due to the permanent change to the nature of the landscape directly below the footprint and the permanent presence of the dam with reservoir behind.

14.4.27. Although the impact in terms of loss of land is notable, the wider area from the perspective of landscape and scenic value remains relatively unaffected. The landscape character would still be broadly the same, having a river ecosystem surrounded by grasslands and mountains.

14.4.28. Overall, the Project at operation is considered to have a very small to medium magnitude of change on LCAs as a result of the permanent presence of the dam and reservoir. The resulting effects are summarised in **Table 14-8**.

Table 14-8 - Assessment of permanent presence of the Dam and Reservoir on Landscape Character at Operation

Receptor	Sensitivity	Impact Magnitude	Significance of Impact (Effect)	Commentary
LCA 1: Disturbed/ industrial landscape - the Project Site	Low	Beneficial	Positive The effect would be direct, permanent and long-term.	Existing vegetation is limited but quite commonplace in the landscape. The cessation of construction activity will return much of the landscape to a more natural character, or of similar character to existing HPPs along the river corridor. Previous vegetation and floodplain character will become permanently lost although new vegetation will colonise the new riverbanks.
LCA 2: Enclosed River Corridor / Riverine villages	Medium	Small adverse	Minor The effect would be	All villages falling in the submergence zone (FSL) will be relocated by 2032 and thus at operation, the general

Receptor	Sensitivity	Impact Magnitude	Significance of Impact (Effect)	Commentary
			direct, permanent and long-term.	character of the river valley backdropped by hills will return, along with removal of all construction activity adjacent. However, there will be permanent change in the character of the enclosed river corridor with loss of floodplain vegetation and settlements.
LCA 3: Broader alluvial landscape	Medium	Very Small adverse	Negligible The effect would be direct, permanent and long-term.	Operation of the Project will directly affect this character area by creating a slightly enlarged character area footprint. It would introduce a greater volume of water, although the overall characteristics of the river and floodplain will still be discernible. All villages falling in the submergence zone (FSL) will be relocated by 2032 and thus at operation, the character of the river valley backdropped by hills will return, albeit with fewer villages alongside.
LCA 4: Larger settlements - Rogun City	Low	Neutral	Negligible The effect would be indirect, permanent and long-term.	The noise and visual intrusion of construction activities will have ceased, with all villages falling in the submergence zone (FSL) having been relocated by 2032. The setting of this character area will therefore be enhanced through removal of construction activity, although slightly degraded by loss of riverine character.

Mitigation and Enhancement Measures

14.4.29. No significant effects on any of the four LCAs have been identified once the Project is operational and therefore no mitigation is required.

14.4.30. The local landscape will be enhanced by vegetation planting utilised as part of the soil stabilisation strategy, whilst removal of structures once they are no longer required is outlined in the Site Rehabilitation Plan. Vegetation planting and removal of structures would both contribute to the evolved character of the areas, although over time revegetation would occur naturally.

Residual Effects

14.4.31. At operation, the reservoir with mountain backdrop will appear natural and scenic, once revegetation has softened any abandoned or demolished villages on the edge of the FSL. Residual effects during operation are expected to remain **minor, negligible or positive** for all receptors.

Visual

14.4.32. There is the potential for permanent alterations to existing views and visual amenity once the Project is operational. This includes the following elements:

- Presence of the Dam and Reservoir:

- Permanent presence of high dam and associated built form in views, which may also foreshorten views up the river corridor from downstream locations;
- Permanent loss of meandering river shoreline upstream;
- Permanent new section of M41 highway and connecting roads/ bridges in views; and Permanent presence of reservoir upstream in views.

14.4.33. There is the potential for alterations to the landscapes present once the Project is operational due to the permanent change in landform and land use from natural river corridor to a dam with reservoir behind.

14.4.34. Although the impact in terms of loss of land is notable, the wider area in terms of backdrop and setting remains relatively unaffected, with a river ecosystem surrounded by grasslands and mountains. The identified visual receptors (villagers and travellers on the M41) are relocated to the higher reaches and thus they will still experience views of the mountain ranges and riverine valley, albeit from a higher altitude.

14.4.35. Overall, the Project at operation is considered to have a neutral to small magnitude of change on visual amenity as a result of the permanent presence of the dam and reservoir**.** The resulting effects are summarised in **Table 14-9.**

Table 14-9 - Assessment of permanent presence of the Dam and Reservoir on Visual Amenity at Operation

Receptor	Sensitivity	Impact Magnitude	Effect	Commentary
Residential Residents in Rogun City	Low	Neutral	Negligible. Effects would be direct, permanent and long-term.	All villages falling in the submergence zone will have been relocated and construction activity removed., The character of the river valley backdropped by hills will return. The operational dam activity will remain a permanent feature, along with the dam wall but footfall and traffic activity would considerably reduce with the removal of the construction workers, restoring and in some cases improving much of the character of the existing view.
Residential Residents in retained villages alongside the river within 6.5km upstream of the dam site	Medium	Neutral	Negligible. Effects would be direct, permanent and long-term	Villages will have been resettled, with new and improved access routes operational. The wider character of the river valley backdropped by hills will return, along with removal of all construction activity enhancing views, although the meandering river corridor with agricultural plots and villages alongside will have been replaced by a much wider, higher reservoir. The overall setting of hills, mountains and riverine corridors will remain.
Residential Residents in retained villages alongside the	Medium	Very small adverse	Negligible Effects would be direct, permanent	Villages will have been resettled, new and improved access routes and bridges operational, and the reservoir filled. The wider character of the river valley backdropped by hills will return, along with

Receptor	Sensitivity	Impact Magnitude	Effect	Commentary
river beyond 6.5km upstream of the dam site			and long-term	removal of all (distant) construction activity, although the meandering river corridor will have been replaced by a wider, higher reservoir and fewer villages.
Recreational Users/ visitors to gardens, parks, tourist attractions and outdoor recreational sites on the edge of Rogun City	Low	Beneficial	Negligible. Effects would be direct, permanent and long-term	The quieter character of the river valley backdropped by hills will return. The operational noise and activity of the hydroelectric turbines will remain a permanent feature, but of similar character to the exiting turbine use and without the construction noise and activity, enjoyment of the outdoor activity is likely to increase.
Recreational Users/ visitors to gardens, parks, tourist attractions and outdoor recreational sites in retained villages within 6.5km upstream of the dam site	Low	Beneficial	Negligible. Effects would be direct, permanent and long-term	The character of the river valley backdropped by hills will return, albeit with increased operational noise and activity from the operational hydroelectric turbines, but with all of the noise and activity of construction works ceased. Footfall and traffic activity would considerably reduce with the removal of the construction workers, restoring much of the character of the existing view and enjoyment of the landscape.
Recreational Users/ visitors to Vodoyem and Izba outdoor hiking areas (south west of dam site)	High	Neutral	Minor. Effects would be direct, permanent and long-term	The character of the river valley backdropped by hills will return and all the activity, noise, movement and dust from the construction works, including the quarry, will have been removed. The operational activity of the dam will remain a permanent feature, along with the high dam wall.
Commercial Workers in Rogun City	Low	Neutral	Negligible. Effects would be direct, permanent and long-term.	The character of the river valley backdropped by hills will return. The operational activity of the dam will remain a permanent feature. Footfall and traffic activity would considerably reduce with the removal of the construction workers, restoring much of the character of the existing view.
Commercial: Workers in retained villages within 6.5km	Low	Very Small adverse	Negligible. Effects would be direct, permanent	The character of the river valley backdropped by hills will return, restoring much of the characteristics of the existing wider views for workers. Lower footfall due to removal of construction workers and from loss of surrounding villages may remain

Receptor	Sensitivity	Impact Magnitude	Effect	Commentary
upstream of the dam site			and long-term.	discernible.
Commercial: Workers at the existing construction camps	Low	N/A	N/A	The construction camp will no longer be required and will therefore be removed, with the land reinstated.
Transport: Users of the M41 highway	Low	Beneficial	Negligible. Effects would be direct, permanent and long-term.	A section of the M41 will be discontinued from 2025 due to change in reservoir water levels. The new alignment will be at a higher altitude so users will still retain views of the surrounding landscape of mountain, hills and river valley. Although there will be permanent change to the highway alignment, the road quality along this new section is likely to improve. Overall, users of the existing highway are unlikely to be much affected by the operational activity of the Project.
Transport: Users of surrounding roads	Medium	Beneficial	Negligible. Effects would be direct, permanent and long-term.	The new access roads and bridges to retain connection of surrounding villages to the realigned M41 will be operational and likely to be of improved quality compared to existing. Overall, users of the existing roads are unlikely to be much affected by the operational activity of the Project.

Mitigation and Enhancement Measures

14.4.36. No significant effects have been identified during operation of the Project and therefore no mitigation specific for visual receptors is required.

14.4.37. The Site Rehabilitation Plan will ensure removal of structures once they are no longer in use, and establishing vegetation for soil stability would enhance views. These are covered under their respective technical management plans and as such, no mitigation is required for visual receptors at operation.

Residual Effects

14.4.38. Residual effects during operation are expected to remain **minor** or **negligible** for all receptors.

14.5 MITIGATION AND ENHANCEMENT MEASURES

CONSTRUCTION

14.5.1. Significant effects are identified during the construction phase on both landscape and visual receptors, due to the presence of construction workers, plant, materials, compounds, vehicles and the activity associated with the building works. Their removal on completion of the construction works will therefore largely remove these adverse impacts. Given the extent of the construction area, it cannot be screened. Changing the existing river channel to a reservoir also cannot be mitigated, but its new character is similar to that of other dams along the same river network and

therefore not unusual in the landscape. In some instances, a change from a riverine landscape backdropped by mountains to a lake backdropped by mountains would be neither a positive nor adverse change, just different.

14.5.2. No specific landscape or visual mitigation at construction is therefore identified.

- Minimise drop height of materials; and
- Switch off equipment when it is not in use.

- Mitigation sections of the **Volume 1, Chapter 12 (Geology and Soils), Chapter 15 (Biodiversity), Volume 2, Annex 15.1 (Critical Habitat Assessment)** and **Volume 3 Annex A4 (Biodiversity Management Plan)** of this ESIA include:

  - Translocation of individual plants, macro-turfs or viable reproductive material (such as seeds or fruit) out of the inundation zone to sites that don't already hold important plant assemblages/protected species;
  - Planting plans for the purpose of soil stabilisation will be informed by biodiversity specialists to maximise biodiversity benefits derived from these plans;
  - Planting for the purposes should be done in consultation with the ECoW (and botany specialist, as required) and should comprise native species of local provenance, sourced from (or in consultation with) Vakhdat Forest Nursery;
  - Monitoring will also be required to ensure ongoing effectiveness of planting undertaken as part of the soil stabilisation mitigation. Planting will be a historically and ecologically suitable native species mix, informed by the Ecological Clerk of Works (ECoW);
  - No net loss (NNL) of floodplain habitat and Juniper woodland, with options to deliver NNL outlined in the No Net Loss Framework (NNLF) plan such as creation of new floodplain habitat upstream of the flooding zone;
  - Replacement woodland planting around the flooding zone and/or in off-site locations along the Vakhsh River valley;
  - Avoidance of juniper woodland loss in relation to the left bank road through detailed design;
  - ECoW 'toolbox talks' including sensitive use of lighting (such as directional lighting); and
  - Creation of woodland/scrub habitat adjacent to the reservoir for soil stabilisation purposes which will help regenerate the existing character of the local landscape.

OPERATIONAL

14.5.3. No mitigation measures have been identified, although the implementation of the Site Rehabilitation Plan and Biodiversity Management Plan will include monitoring of sapling success and a program of replacing failed saplings

RESIDUAL EFFECTS

14.5.4. No landscape or visual specific mitigation is identified at construction, although implementation of mitigation measures for soil stability, biodiversity, and air quality may reduce the landscape and visual effects of the Project. The residual effects may therefore be slightly different to the pre-mitigation effects.

14.5.5. As no mitigation is identified at operation, the residual effects remain the same as the pre-mitigation effects.

14.6 SUMMARY

14.6.1. The construction phase will result in some new and on-going ground disturbance activities (earthworks, storage of materials, excavations), and plant movements, and the relocation of construction compounds and construction workers' accommodation following flooding of existing sites, as well as the presence of the reservoir and rising water levels changing the character and appearance of the alluvial river corridor. This will result in a significant change to the Project area and result in some direct impacts to landscape character and visual amenity.

14.6.2. In all instances, landscape and visual effects are considered to be greatest during the construction phase of the Project due to the movement, plant, and works occurring, albeit characteristic in the local landscape, and in addition to increasing height of the dam wall and rising water levels in the reservoir behind. Whilst no landscape or visual specific migration was identified, the mitigation identified for other technical disciplines (including biodiversity, and soils) will be of benefit in reducing adverse impacts on landscape and visual receptors, such as planting for soil stabilisation alongside the reservoir, and removing unused structures to help soften the visual changes and contribute to local character, but the scale and nature of the Project means it cannot be screened during construction.

14.6.3. Following construction, the Project will be largely static (albeit with fluctuating river/reservoir levels) but will consist of distinctive, higher manmade features in the view and considerably higher water levels than are seen in the current baseline. The presence of a reservoir and dam along this river are already existing features in the wider landscape, and the removal of construction activity will restore much of the existing character and visual amenity. The effects of the Project are therefore lessened at operation, so no mitigation was identified at operation.

CONSTRUCTION EFFECTS

Ground Disturbance Activities; and Presence of the Reservoir

14.6.4. **Table 14-10**, **Table 14-11** and **Table 14-12** summarise the landscape and visual effects of the Project at construction, taking into consideration any mitigation measures to identify the remaining residual effects following mitigation.

Table 14-10 – Summary of Impact on Landscape Receptors at Construction

Impact	Ground Disturbance Activities and Presence of the Reservoir	Ground Disturbance Activities and Presence of the Reservoir	Ground Disturbance Activities and Presence of the Reservoir	Ground Disturbance Activities and Presence of the Reservoir
Receptor	LCA 1: Disturbed/ industrial landscape	LCA 2: Enclosed River Corridor / Riverine villages	LCA 3: Broader alluvial landscape	LCA 4: Larger settlements - Rogun City
Receptor sensitivity	Low	Medium	Medium	Low
Frequency	Single Event	Single Event	Single Event	Single Event

Likelihood	Likely	Likely	Likely	Likely
Extent	Local	Local	Local	Local
Duration	Medium term	Medium term	Medium term	Medium term
Magnitude	Very Small	Medium	Small	Very Small
Effect	Adverse	Adverse	Adverse	Adverse
Direct / Indirect	Direct	Direct	Direct	Direct
Significance	Negligible	Moderate	Minor	Negligible
Mitigation	No	No	Yes	No
Residual Significance	Negligible	Moderate	Minor	Negligible

Table 14-11 – Summary of Impact on Residential & Recreational Visual receptors at Construction

Impact	Ground Disturbance ActivitiesPresence of the Reservoir	Ground Disturbance Activities and; Presence of the Reservoir	Ground Disturbance Activities andPresence of the Reservoir	Ground Disturbance Activities and Presence of the Reservoir	Ground Disturbance Activities andPresence of the Reservoir	Ground Disturbance Activities andPresence of the Reservoir
Receptor	Residential Residents in Rogun City	Residential Residents in retained villages alongside the river within 6.5km upstream of the dam site	Residential Residents in retained villages alongside the river beyond 6.5km upstream of the dam site	Recreational Users/ visitors to gardens, parks, tourist attractions and outdoor recreational sites	Recreational Users/ visitors to gardens, parks, tourist attractions and outdoor recreational sites in retained villages within 6.5km upstream of the dam site	Recreational Users/ visitors to Vodoyem and Izba outdoor hiking areas (south west of dam site)
Receptor sensitivity	Low	Medium	Medium	Low	Low	High
Frequency	Single Event	Single Event	Single Event	Single Event	Single Event	Single Event

Likelihood	Likely	Likely	Likely	Likely	Likely	Likely
Extent	Local	Local	Local	Local	Local	Local
Duration	Medium term	Medium term	Medium term	Medium term	Medium term	Medium term
Magnitude	Small	Small	Medium	Small	Medium	Small
Effect	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse
Direct / Indirect	Direct	Direct	Direct	Direct	Direct	Direct
Significance	Minor	Minor	Moderate	Minor	Minor	Moderate
Mitigation	No	No	No	No	No	No
Residual Significance	Minor	Minor	Moderate	Minor	Minor	Moderate

Table 14-12 – Summary of Impact on Commercial & Transport Visual receptors at Construction

Impact	Ground Disturbance Activities and Presence of the Reservoir	Ground Disturbance Activitiesand Presence of the Reservoir	Ground Disturbance Activities; Emissions of Dust, and Presence of the Reservoir	Ground Disturbance Activities; Emissions of Dust, and Presence of the Reservoir	Ground Disturbance Activities; Emissions of Dust, and Presence of the Reservoir
Receptor	Commercial Workers in Rogun City	Commercial Workers in surrounding villages relevant to the dam site	Commercial Workers at the existing construction camp	Transport Users of the M41 highway	Transport Users of surrounding roads
Receptor sensitivity	Low	Low	Low	Low	Medium
Frequency	Single Event (construction)	Single Event (construction)	Single Event (construction)	Single Event (construction)	Single Event (construction)
Likelihood	Likely	Likely	Likely	Likely	Likely
Extent	Local	Local	Local	Local	Local

Duration	Medium term	Medium term	Medium term	Medium term	Medium term
Magnitude	Very Small	Very Small	Neutral	Medium	Medium
Effect	Adverse	Adverse	Neutral	Adverse	Adverse
Direct / Indirect	Direct	Direct	Direct	Direct	Direct
Significance	Negligible	Negligible	Negligible	Minor	Moderate
Mitigation	No	No	No	No	Yes
Residual Significance	Negligible	Negligible	Negligible	Minor	Moderate

OPERATIONAL EFFECTS

Permanent Presence of the Dam and Reservoir

14.6.5. **Table 14-13, Table 14-14,** and **Table 14-15** summarise the landscape and visual effects of the Project at operation.

Table 14-13 – Summary of Impact on Landscape receptors at Operation

Impact	Permanent presence of the Dam and Reservoir	Permanent presence of the Dam and Reservoir	Permanent presence of the Dam and Reservoir	Permanent presence of the Dam and Reservoir
Receptor	Character Area 1: Disturbed/ industrial landscape	Character Area 2: Enclosed River Corridor / Riverine villages	Character Area 3: Broader alluvial landscape	Character Area 4: Larger settlements - Rogun City
Receptor sensitivity	Low	Medium	Medium	Low
Frequency	constant	constant	constant	constant
Likelihood	Likely	Likely	Likely	Likely
Extent	Local	Local	Local	Local
Duration	Long-term	Long-term	Long-term	Long-term
Magnitude	Medium	Small	Very Small	Neutral

Effect	Beneficial	Adverse	Adverse	Neutral
Direct / Indirect	Direct	Direct	Direct	Direct
Significance	Positive	Minor	Negligible	Negligible
Mitigation	N	N	N	N
Residual Significance	Positive	Minor	Negligible	Negligible

Table 14-14 – Summary of Impact on Residential & Recreational Visual Receptors at Operation

Impact	Permanent presence of the Dam and Reservoir	Permanent presence of the Dam and Reservoir	Permanent presence of the Dam and Reservoir	Permanent presence of the Dam and Reservoir	Permanent presence of the Dam and Reservoir	Permanent presence of the Dam and Reservoir
Receptor	Residential Residents in Rogun City	Residential Residents in retained villages alongside the river within 6.5km upstream of the dam site	Residential Residents in retained villages alongside the river beyond 6.5km upstream of the dam site	Recreational Users/ visitors to gardens, parks, tourist attractions and outdoor recreational sites	Recreational Users/ visitors to gardens, parks, tourist attractions and outdoor recreational sites in retained villages within 6.5km upstream of the dam site	Recreational Users/ visitors to Vodoyem and Izba outdoor hiking areas (south west of dam site)
Receptor sensitivity	Low	Medium	Medium	Low	Low	High
Frequency	constant	constant	constant	constant	constant	constant
Likelihood	Likely	Likely	Likely	Likely	Likely	Likely
Extent	Local	Local	Local	Local	Local	Local
Duration	Long-term	Long-term	Long-term	Long-term	Long-term	Long-term
Magnitude	Neutral	Neutral	Very small	Very small	Very small	Neutral
Effect	Neutral	Neutral	Adverse	Beneficial	Beneficial	Neutral

Direct / Indirect	Direct	Direct	Direct	Direct	Direct	Direct
Significance	Negligible	Negligible	Negligible	Negligible	Negligible	Minor
Mitigation	No	No	No	No	No	No
Residual Significance	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

Table 14-15 – Summary of Impact on Commercial & Transport Visual Receptors at Operation

Impact	Permanent presence of the Dam and Reservoir	Permanent presence of the Dam and Reservoir	Permanent presence of the Dam and Reservoir	Permanent presence of the Dam and Reservoir	Permanent presence of the Dam and Reservoir
Receptor	Commercial Workers in Rogun City	Commercial Workers in retained villages within 6.5km upstream of the dam site.	Commercial Workers at the existing construction camp	Transport Users of the M41 highway	Transport Users of surrounding roads
Receptor sensitivity	Low	Low	Low	Low	Medium
Frequency	constant	constant	N/A	constant	constant
Likelihood	Likely	Likely	N/A	Likely	Likely
Extent	Local	Local	N/A	Local	Local
Duration	Long-term	Long-term	N/A	Long-term	Long-term
Magnitude	Neutral	Very Small	N/A	Very small	Very small
Effect	Neutral	Adverse	N/A	Beneficial	Beneficial
Direct / Indirect	Direct	Direct	N/A	Direct	Direct
Significance	Negligible	Negligible	N/A	Negligible	Negligible
Mitigation	No	No	N/A	No	No

Residual Significance	Negligible	Negligible	N/A	Negligible	Negligible

PUBLIC

JSC “Rogun HPP”

State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT - UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Volume 1: Chapter 15: Biodiversity



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QUALITY CONTROL

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15 BIODIVERSITY

15.1.1. This chapter presents an assessment of the potential impacts of the Project upon biodiversity. The biodiversity baseline is presented in **Volume 2, Annex 7.1 (Baseline Conditions Report)** of this ESIA and a summary is provided in **Volume 1, Chapter 7 (Source of Secondary Baseline)** of this ESIA. This chapter should also be read in conjunction with **Volume 2, Annex 15.1 (Critical Habitat Assessment)** and **Volume 3, Biodiversity Management Plan (BMP) and No Net Loss Framework (NNLF).**

15.1.2. The baseline assessed in this chapter represents the current condition after existing and approved disturbances, such as the partially-completed dam wall with its current inundation level and Project impacts to be assessed include the filling of the reservoir up until the maximum inundation level (i.e. to 1290m – hereafter referred to as the 'flooding zone') along with other Project components such as new roads (including the AIIB-funded left bank road) and stockpiling areas.

15.1.3. Both terrestrial and aquatic biodiversity impacts are considered within separate Areas of Influence (AoI), see **Section 15.4**.

15.1.4. Associated facilities, as described in **Volume 1, Chapter 3 (Project Description)** of this ESIA, are assessed in accordance with ESS1 and referenced explicitly where relevant. A full assessment of impacts predicted to arise from the most significant of these projects, for example the 500kV overhead line connection and new major roads outside of the immediate dam site and flooding zone, are addressed within the separate ESIAs produced for these developments. Cross-reference to the likely risks and impacts associated with these projects is included within this chapter.

15.1.5. This assessment has been undertaken in alignment with the World Bank Environmental and Social Standard 1 Assessment and Management of Environmental and Social Risks and Impacts (ESS1) and World Bank Environmental and Social Standard 6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources (ESS6). The assessment comprises a brief review of existing work undertaken in 2014 to support an ESIA for the Project, followed by further assessment undertaken in 2023 that was informed by updated information and with contextual reference to the 2014 ESIA where relevant.

15.2 LEGISLATIVE FRAMEWORK, POLICY AND GUIDANCE

15.2.1. This section outlines the legislation, policy and guidance considered as part of the assessment, which includes applicable national and international conventions and treaties, international guidance and World Bank Environmental and Social Standards (ESS). See also **Volume 1, Chapter 2 (Legislation and Standards)** of this ESIA.

15.2.2. The overall strategy with regards to nature conservation in Tajikistan is underpinned by the country's constitution, adopted in November 1994, that guarantees the right of citizens to a healthy environment. Since independence in 1991, numerous specific acts of legislation applicable to biodiversity have been adopted; those of most relevance to this chapter are as follows:

- Forest Code of the Republic of Tajikistan (2011)
- Water Code of the Republic of Tajikistan (2020)
- Law "On Environmental Protection" (2011) (which importantly includes protection of species listed on the Tajikistan Red Book).

- Law "On Ecological Information" (2011)
- Law "On Protection of the Air" (2012)
- Law "On the Protection and Use of Flora" (2004)
- Law "On Fauna" (2008)
- Law "On Soil Protection" (2009)
- Law "On Special Protected Natural Territories" (2011)
- Law "On Environmental Impact Assessment" (2017)
- Law "On Hunting and Hunting Economy" (2014)

15.2.3. In addition to the above, Tajikistan has ratified or signed the following major environmental agreements related to natural resources:

- Convention on Biological Diversity (1992) - Ratified in 1997.
- Convention on Wetlands on International Importance as Waterfowl Habitat (Ramsar) - Ratified in 2001.
- Convention on International Trade in Endangered Species (CITES) - Ratified in 2016.
- Bonn Convention on the Conservation of Migratory Species of Wild Animals - Ratified in 2000).

15.2.4. The above conventions are referenced where relevant within this assessment.

15.2.5. This assessment follows international standards (and associated guidance), in particular the World Bank Environmental and Social Framework and the following documents were used to inform this chapter:

- World Bank (2017). Environmental and Social Standard 1 (ESS1): Assessment and Management of Environmental and Social Risks and Impacts.
- World Bank (2017). Environmental and Social Standard 6 (ESS6): Biodiversity Conservation and Sustainable Management of Living Natural Resources.
- World Bank (2018). Guidance Note for Borrowers. ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.
- European Investment Bank. (2018). Guidance Note for Environmental and Social Standard 3 on Biodiversity and Ecosystems.
- International Finance Corporation (IFC). 2019. International Finance Corporation's Guidance Note 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.
- Hardner, K., Gullison, R. E., Anstee, S. & Meyer, M. 2015. Good Practices for Biodiversity Inclusive Impact Assessment and Management Planning.

15.2.6. Where appropriate, the most stringent of the relevant Lender requirements is adopted, and this is referenced accordingly. Similarly, some Lenders (such as EIB) adhere to European Union legislation, even outside of this jurisdiction, where EIB require '…*projects in other countries must provide the necessary assurance that similar outcomes can be achieved to those that would be required under EU legislation, using methods or procedures that broadly align with those specified in relevant EU instruments.'* Relevant examples include:

- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive'); and
- Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (the 'Birds Directive').

15.2.7. In the cases of the above Directives, their application is considered at a level proportionate to the species or receptor in question, recognising how the Project is located outside of geographies for which these Directives are intended and therefore not always explicitly transferable. For example, the level of protection afforded to a species in Europe will reflect the species' scarcity or threatened status within Europe, which may be very different from the population status elsewhere.

15.2.8. In the absence of suitable national guidance, the approach to ecological assessment is broadly underpinned by the methodology outlined by the Chartered Institute of Ecology and Environmental Management (CIEEM, 2018).

15.3 ASSESSMENT METHODOLOGY

15.3.1. This section provides detail on the approach adopted in assessing potential impacts to biodiversity from the Project. This should be read in conjunction with **Volume 1, Chapter 5 (ESIA Methodology)** of this ESIA, which describes the broad approach to impact assessment that has been implemented within this ESIA. Impact assessment methods specific to biodiversity also include methods described in CIEEM (2018), such as confidence level thresholds, and Hardner *et al*. (2015).

RECEPTOR SENSITIVITY

15.3.2. The sensitivity of ecological resources has been valued by considering both resources that have been designated for their nature conservation interest and the use of professional judgement to determine biodiversity values, including any social, community and economic values of ecological resources. The valuation has made use of available guidance and information and considered the distribution or status of the species or features. Where uncertainty exists, or where features cannot be valued with confidence due to the acknowledged limitations, a higher sensitivity category has been applied as a precautionary approach. The categories in **Table 15-1** have been used.

Table 15-1 – Receptor Sensitivity Evaluation Categories

Category	Criteria	Examples
High	High importance and rarity at the international, national or regional scale with allowing limited disturbance due to project activiity.	Internationally recognised designated site (e.g. Ramsar, Biosphere Reserves, National Protected Areas, etc.) Areas protected under Tajik legislation for their importance to biodiversity Critical Habitats (as per ESS6) Critically Endangered (CR) or Endangered (EN) Species (as per IUCN and Red Data Book of Tajikistan (TRB)) that of sufficient value as to trigger Critical Habitat Qualifying/trigger species for any of the above designated sites/areas

Category	Criteria	Examples
Medium	High or medium importance and rarity at the local or regional scale, and allowing limited disturbance.	Natural Habitats as per ESS6 Regionally protected areas Natural/semi-natural habitats that do not meet threshold for Critical Habitat Nationally important populations of IUCN Vulnerable (VU) species, or locally important populations of CR / EN or TRB species; or Regionally important endemic / restricted range species and/or migratory species.
Low	Low or medium importance and rarity at the local scale.	Modified habitats of low ecological value Non-designated sites / areas of some local biodiversity; or TRB species and locally important VU or IUCN Near Threatened (NT) species populations
Negligible	Very low importance and rarity, local scale.	Other sites with little or no local biodiversity – e.g. built-up areas; and Non-threatened species; common species with widespread distribution.

15.3.3. To focus the assessment on those receptors of greatest ecological value, only those receptors that are categorised as Low sensitivity and above have been considered through the assessment process. Hereafter these are referred to as sensitive receptors.

IMPACT MAGNITUDE

15.3.4. The assessment of the impact magnitude considers:

- The type of impact, i.e., positive, negative or neutral.
- The size (spatially), value and sensitivity of the receptor.
- The duration, magnitude and extent of the impacts.
- The timing and frequency of the impacts.
- The ability of the affected receptor to recover from temporary impacts and timescale of recovery.
- The potential for implementation of, and effectiveness of, additional mitigation or enhancement measures.
- The level of confidence in these predictions (i.e. certainty over impact materialising as described).

The criteria used for assessing impact magnitude in the assessment are described in **Table 15-2**.

Table 15-2 – Impact Magnitude Criteria

Magnitude	Criteria
Large	Large effect on the nature conservation status of the site, habitats or species, likely to threaten the long-term integrity or viability of the receptor.
Medium	Medium effect on the nature conservation status of the site, habitats or species, but would not threaten the long-term integrity of the system.
Small	Noticeable effects, but either of sufficiently small scale or short duration to cause no harm to the conservation status of the site, habitats or species.
Very Small	If noticeable, then negligible effects, either of sufficiently very small scale or short duration to cause no harm to the conservation status of the site, habitats or species
No Change	Not expected to affect the conservation status of the site, habitats or species under consideration in any way, therefore no noticeable effects on the ecological resource.
Beneficial	A positive effect.

EFFECT SIGNIFICANCE

15.3.5. The final stage of the assessment uses the value as obtained with reference to **Table 15-1** and **Table 15-2.**

15.3.6. In order to provide a qualitative assessment of the resulting effects. The matrix for assessing significance of effects is shown in **Volume 1, Chapter 5 (ESIA Methodology)** of this ESIA and effects that are classified as moderate or major are considered significant effects. Effects classified as minor and negligible are not considered significant.

15.3.7. For effects identified as significant, and where possible, additional mitigation is required to reduce residual effects to an acceptable level. In the absence of feasible additional mitigation, the effect will remain significant. Mitigation is also described where measures are required to achieve compliance with Tajik legislation and/or Lender standards (e.g. EIB's requirements, see **15.2.6)**

CRITICAL HABITAT / NATURAL HABITAT

15.3.8. Adherence to ESS6 mandates that No Net Loss (NNL), and for Critical Habitat a Net Gain (NG), must be achieved for any Critical Habitat / Natural Habitat values identified as being adversely affected by the Project. Any materially adverse impacts (i.e. those classified as minor and above) will be subject to mitigation, as if they were considered significant.

15.3.9. ESS6 defines Natural Habitat as: '*Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.'* While Critical Habitat is defined as: '…*areas with high biodiversity importance or value, including:*

(a) Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches;

(b) Habitat of significant importance to endemic or restricted-range species;

(c) Habitat supporting globally or nationally significant concentrations of migratory or congregatory species;

(d) Highly threatened or unique ecosystems; and)

(e) Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).'

15.3.10. ***Volume 2- Chapter 15.1*** *includes the Critical Habitat Assessment (CHA) for the project.* This CHA has concluded that **there are no areas of Critical Habitat within the Project AoI**.

ASSUMPTIONS AND LIMITATIONS

15.3.11. Given that this ESIA is an update to the 2014 ESIA the biodiversity baseline collection for this Project has relied more heavily upon desk-based study and consultation than would be the case for a 'new' ESIA. Field survey effort during 2023 was targeted and does not represent a full suite of surveys for any receptor; however, when considered collectively with the extensive desk study information available (including that derived from the 2014 ESIA studies) and within the context of a heavily modified AoI across large parts of which the biodiversity assemblage is heavily depleted, is considered proportionate to the predicted impacts from the Project (in line with ESS1). Additionally, ongoing monitoring has been recommended to increase and update the baseline understanding going forward, which also helps to manage potential data validity issues associated impacts that will occur incrementally over a number of years. Further detail on baseline limitations is provided within **Volume 2, Annex 7.1 (Baseline Conditions Report)** of this ESIA.

15.4 SCOPE OF ASSESSMENT

15.4.1. Two separate spatial areas are referenced throughout this assessment, reflecting both the extent of impacts associated with the Project and the consideration of a landscape or ecosystem-level area, within which a broadly uniform biodiversity assemblage could feasibly be present. This ecosystem level approach allows for biodiversity receptors to be assessed within the context of an appropriate biogeographical range, and it also serves to inform those biodiversity receptors likely to be present within the Project Area of Influence (AoI), as part of an initial screening process. The two separate spatial areas are described within the following sections.

AREA OF INFLUENCE

Terrestrial Biodiversity

15.4.2. The AoI is a widely used concept to describe the maximum potential area over which impacts from the Project will be experienced. For the purposes of this assessment, the AoI initially extended to the end of the Vakhsh catchment beyond the flooding zone, within which an impact from displaced biodiversity and humans can reasonably be expected to occur; e.g., territorial fauna being displaced into neighbouring territories, livestock farmers being displaced into previously unused areas, etc. Beyond this distance, and in the absence of any evidence to the contrary, it is assumed that any Project influence beyond the AoI will be negligible.

15.4.3. As the studies and assessment developed and the project description was refined, an updated AoI was defined, specific to various receptors/receptor groups. This is defined within **Table 15-3** And is summarised as follows:

Terrestrial Biodiversity

15.4.4. The terrestrial ecology AoI extends across the Project site, flooding zone to FSL, footprint of the left bank road/bridges and 100m 'disturbance zone' around these areas (i.e., where fauna may be displaced). The AoI is extended to 500m when considering the potential spread of invasive plant species.

Aquatic Biodiversity

15.4.5. From an aquatic biodiversity perspective, the AoI has been defined as Vakhsh River upstream of the Nurek Reservoir, to its full capacity at 1290m asl. (Novabad area) and includes tributaries directly impacted by the flooding zone or resettlement. To account for these tributaries, a 2km buffer was included. As the project description was refined, an updated AoI was defined, incorporating the footprint of the left bank road/bridges and 100m 'disturbance zone' to account for any tributary crossings.

ECOLOGICALLY APPROPRIATE AREA OF ANALYSIS (EAAA)

15.4.6. This assessment follows industry guidance and focuses upon impacts associated with the Project, within an area that is ecologically linked to the functioning of that receptor. This is defined as the ecologically appropriate area of analysis (EAAA) and in most cases will comprise a continuous habitat or ecosystem area, within which the ecology is functionally linked.

15.4.7. From an aquatic biodiversity perspective, two distinct EAAAs have been defined based on connectivity within the Vakhsh River system. The first EAAA (downstream) comprising the Nurek Reservoir and the reach of river between the Nurek Reservoir and Rogun Dam, while the second EAAA (upstream) compromises the Vakhsh River upstream of the Rogun Dam to Damburacha, which is approximately 100 km upstream from full supply level at an elevation of 500 m above FSL.

15.4.8. For species that were screened as part of the Critical Habitat Assessment, where the Project AoI fell outside of the known geographic extant but were included at the request of key stakeholders, the EAAA includes the mapped geographic extant for the species as described in **Volume 2, Annex 15.1 (Critical Habitat Assessment)**.

SCOPING SUMMARY

15.4.9. In order to ensure the assessment remains proportionate and fully cognisant of relevant assessment conclusions presented within the 2014 ESIA, it is considered appropriate to define a concise scope of the assessment for this ESIA. For clarity on this approach, **Table 15-3** details those receptors/impacts that have been considered and their inclusion/exclusion, together with associated justification and detail of the AoI and EAAA being considered.

Table 15-3 – Receptor/impact scoping table

Receptor	Impact	Scoped in/out	Justification	AoI	EAAA
All	Air quality impacts	In	Potential air quality impacts have been scoped out for the dam site on the basis that measurable impacts beyond the current baseline of disturbance are not predicted (i.e. the construction activities have been occurring for a number of years meaning the sensitive receptors will either have habituated or been displaced). Impacts associated with the new left bank road are included out to a distance of 50m based on GIIP air quality assessment guidance (Holman *et al.* (2014)).	50m	n/a
All	Noise/acoustic impacts	In	Potential acoustic impacts have been scoped out for the dam site on the basis that measurable impacts beyond the current baseline of disturbance are not predicted (i.e. the construction activities have been occurring for a number of years meaning the sensitive receptors will either have habituated or been displaced). Impacts associated with the new left bank road are included out to a precautionary distance of 50m based on GIIP bat mitigation guidelines (Reason & Wray (2023)).	50m	n/a
All	Barrier effect from the new reservoir (including fish migration)	Out	No important migration routes were identified for fauna that would be severed by the new reservoir. It should be noted that the impact has largely already occurred, with the current dam presence, and fish migration has already been interrupted by the dam wall (and other downstream dams) being partially constructed.	n/a	n/a
Protected Areas	All	Out	No protected areas are present within the initial Project AoI, with those sites identified downstream of the Project (but upstream of Nurek) not having any connectivity with the Vakhsh River and will therefore experience no potential effects (further detail on this is	n/a	n/a

Receptor	Impact	Scoped in/out	Justification	AoI	EAAA
			provided within **Volume 2, Annex 15.1 (Critical Habitat Assessment)**. There will be no significant downstream impacts arising from the Project that extend downstream of the Nurek dam, and therefore there is no potential effect pathway on the Tigrovaya Balka protected area. See the Transboundary Cumulative Impact Assessment (CIA) produced for the Project, which states: '*.There will be no additional* (to Nurek) *negative effect of Rogun HPP on Tigrovaya Balka. This means that a negative impact of Rogun HPP, or a cumulative impact of Rogun in combination with the Vakhsh cascade, can be excluded.'* (Zwahlen, 2024 draft). See also **Volume 1, Chapter 12 (Water)** and **Chapter 24 (CIA)** of this ESIA.		
Terrestrial habitats (general)	All	Out	The 2014 ESIA did not identify any material impacts to valuable habitat receptors (beyond the potential presence of Natural Habitat floodplains). Updated surveys in 2023 also identified remnant juniper woodland present within the flooding zone. All other habitats are heavily modified, common and widespread within the region, and not of any value beyond the site level, and therefore do not require for impacts to them to be mitigated. No IUCN Red List of Threatened Ecosystem habitats were identified. Further to the above, the existing dam construction has resulted in most impacts to habitats having already occurred (and extending across a habitat assemblage similar to that remaining across the flooding zone, based upon review of historic satellite imagery). The broad habitat loss calculations within the 2014 ESIA remain relevant here (for the general habitats) as per below, with only slight increases as a result of the left bank road habitat losses: **Habitat type** | **Area (ha)**	n/a	n/a

Receptor	Impact	Scoped in/out	Justification	AoI	EAAA
			<table><tr><td>Pasture/degraded grassland</td><td>8995</td></tr><tr><td>River/floodplain</td><td>4850</td></tr><tr><td>Urban areas (inc. associated land)</td><td>1465</td></tr><tr><td>Agriculture</td><td>986</td></tr><tr><td>Woodland</td><td>188</td></tr><tr><td>**TOTAL**</td><td>**16484**</td></tr></table> As part of the pre-flooding clearance activities, the Forestry Agency have been contracted by DFZ to cleat significant vegetation within the flooding zone; trees will be removed and processed for firewood that will be distributed amongst local communities.		
Floodplain habitats	Land-take (flooding during Operational stage)	In	Two discrete floodplain habitats have been identified that are considered to be Natural Habitat as per ESS6. These areas are found upstream of the confluence of the Vakhsh and Obikhingou rivers and will be wholly lost during the flooding of the inundation zone.	Flooding zone	Extent of discrete floodplain habitats
Juniper woodland	Land-take Increased human pressures (e.g. grazing, firewood collection, etc.) Encroachment by invasive plants upon flooding	In	The juniper woodland identified within the AoI will be subject to habitat loss impacts when the reservoir is at the 1290m inundation level. However, tree removal will occur prior to this inundation level and so the woodland will be lost in advance. An assumed clearance extent has been assessed based on the maximum inundation level and a buffer distance of 25m. Impacts from the spread of invasive species during construction have not been included due to the distance of any construction	500m on the basis of an area around the flooding zone in which invasive species would readily colonise, based also on elevation preferences of	Collective extent of five discrete woodland parcels adjacent to the Vakhsh River.

Receptor	Impact	Scoped in/out	Justification	AoI	EAAA
			activities (or associated works, such as stockpiling) from this habitat. At its closest, any potential effect pathway is approximately 19km from the juniper woodland.	*Xanthium spinosum,* which are thought to be up to a maximum of between 1000-1875m (Keil *et al.* 2023).	
Flora	Encroachment by invasive plants Land-take (flooding during Operational stage)	In	The 2014 ESIA did not identify any adverse impacts to flora from the Project; however, given the presence/potential presence of TRB plants (as confirmed during 2023 surveys) within the flooding zone and immediately surrounding area, it is considered appropriate to consider them within the assessment. General good practice environmental management will be included within the Project Biodiversity Management Plan (BMP) that will include measures to manage invasive species and protect wild plants.	500m on the basis of an area around the flooding zone in which invasive species would readily colonise, based also on elevation preferences of *Xanthium spinosum,* which are thought to be up to a maximum of between 1000-1875m (Keil *et al.* 2023).	Broad 500m EAAA given continuation of sub-optimal conditions across the area surrounding the flooding zone.
All	Hunting, fishing and foraging of wildlife by the construction workforce at the HPP construction site.	Ou	Given the heavily controlled nature of the construction areas, and the high security controls, together with the history of significant disturbance this isn't considered to represent a material impact and is therefore scoped out.	n/a	n/a
Amphibians	All	Out	The 2014 ESIA did not identify any significant adverse impacts to amphibians from the Project.	n/a	n/a

Receptor	Impact	Scoped in/out	Justification	AoI	EAAA
			2023 surveys did not identify any rare/notable species within the AoI that would require consideration under the requirements of ESS1. No TRB or Red List species were recorded from any baseline source. Additionally, a detailed study of macroinvertebrates undertaken in the Shokdhara River valley (albeit at a higher altitude than the Project) retuned only one amphibian species (Afanasyev *et al.* 2024). General good practice animal welfare/biodiversity protection commitments will be included within the Project BMP that will include measures to protect amphibians.		
Reptiles	Land-take – loss of important habitat/features Injury/killing of fauna as a result of construction activities. Land-take (flooding) Direct mortality/drowning during flooding	In	The 2014 ESIA did not identify any significant adverse impacts to reptiles from the Project; however, given the presence/potential presence of TRB reptiles within the flooding zone (four species were identified during baseline studies in 2023), it is considered appropriate to consider them within the assessment for the impacts listed. General good practice animal welfare/biodiversity protection commitments will be included within the Project BMP that will include measures to protect reptiles; however, this isn't considered sufficient to scope out this receptor.	Flooding zone given impacts will be realised from clearance activities and flooding. Footprint of associated facilities and 100m disturbance zone.	Flooding zone plus 500m buffer, broadly to encompass the home range extents of the identified species (on a precautionary basis), and when considering broad/generalist habitat tolerance.
Mammals	Land/vegetation clearance within the flooding zone. Land-take (flooding)	In	The 2014 ESIA did not identify any significant adverse impacts to mammals from the Project; however, given the presence/potential presence of TRB mammals within the flooding zone and immediately surrounding area, it is considered appropriate to consider them within the assessment for the impacts listed. The 2023 baseline studies identified 12 mammal species listed on either the IUCN Red List, TRB, or both. This includes small/medium-sized	Flooding zone given impacts will be realised from clearance activities and flooding. Footprint of associated	Same as reptiles given broad/general habitat tolerance. For otter the EAAA is the

Receptor	Impact	Scoped in/out	Justification	AoI	EAAA
	Direct mortality/drowning during flooding Change in habitat composition		mustelids such as least weasel and otter, as well as resident bat species, which although not recorded in significant numbers may rely on locally important roost sites within the flooding zone. General good practice animal welfare/biodiversity protection commitments will be included within the Project BMP that will include measures to protect mammals; however, this isn't considered sufficient to scope out this receptor.	facilities and 100m disturbance zone.	same as for fish (see below).
Birds (breeding)	Land-take – loss of important habitat/features	In	The 2014 ESIA did not identify any significant adverse impacts to birds from the Project. Spring 2023 surveys did not identify any sensitive receptor birds within the Project AoI; however, during the WSP visit in September/October 2023, ibisbill, golden eagle, Egyptian vulture and Eurasian sparrowhawk were all observed. Desk study results would suggest a low level of presence across this area. No areas of elevated interest in this regard are thought to exist within the AoI (such as key nesting features/habitat, important foraging areas), with sightings likely to represent overlaps between the species' ranges and the AoI rather than key territory extents. The heavily modified nature of the flooding zone (and surrounding AoI) has likely played a significant role in limited the breeding/resident bird assemblages to common/widespread species, with those species of greater conservation concern occupying areas of less disturbed habitat outside the AoI, in particular at higher elevations (such as where the aforementioned species were observed). However, given the scale of terrestrial habitat loss, and the staggered timeframe over which this loss will occur, it is reasonable to scope this receptor in for consideration **under the operational phase only**. This will also align with the spirit of important bird legislation (such as the EU Birds Directive).	Flooding zone. Footprint of associated facilities and 100m disturbance zone.	Up to 10km based on largest home range extent (Egyptian vulture).

Receptor	Impact	Scoped in/out	Justification	AoI	EAAA
			In addition, general good practice animal welfare/biodiversity protection commitments will be included within the Project BMP that will include measures to protect birds at all phases.		
Migrating birds	Land-take – loss of important habitat/features Collisions with new grid infrastructure. Barrier effect	In In Out	The 2014 ESIA did not identify any adverse impacts to migrating birds from the Project. However, it was considered feasible that the Vakhsh River valley could be of topographical importance got migratory birds given Tajikistan's position on the Central Asian flyway (a recognised migratory bird flyway running from Central Asia to the Indian subcontinent). Additional desk study and fieldwork was undertaken to inform this assessment. The 2023 surveys (in spring and autumn) also did not identify any significant movement of migrating birds within the Vakhsh River valley sensitive receptors within the Project AoI, although it is recognised that localised movement of migrating birds may occur along the Vakhsh valley and within the AoI of the new transmission lines and therefore this receptor is scoped in in relation to land take and collision mortality/electrocution impacts. No barrier effects are predicted given the heights at which birds are known (i.e., generally above 1500m (from Newton, 2020)), especially within mountainous regions (such as much of the CAF, where studies have shown birds migrating above 6500, and for long distances above 3500(from Kuma *et al.* 2020)), thereby not likely to be impacted by the completed dam structure. Should birds at much lower levels, then it is expected that simple of avoidance of the dam structure would occur rather than any material barrier effect.	Flooding zone. Footprint of new transmission line(s).	Same as AoI.
Aquatic Biodiversity	Release of pollutants into the river	In	The 2014 ESIA identified the change to a lake system and the associated ecological and species changes as the primary effect of the Rogun Dam. The report also highlighted the obstacle to migration.	Vakhsh River upstream of the Nurek Reservoir, to its full capacity	Vakhsh River upstream of the Nurek Reservoir, to Damburacha,

Receptor	Impact	Scoped in/out	Justification	AoI	EAAA
	Entrainment and Impingement of fish through the turbines Change in habitat from a lotic (river) to a lentic (lake) system. Changes in flow and channel configuration downstream between Rogun and Nurek, with reduced flows in summer and increased flows in winter. Loss of tributaries and short-range migration		Given the complete alteration of the freshwater ecosystem and the lack of detailed studies, it is considered appropriate to consider all freshwater biodiversity, including fish, aquatic macroinvertebrates and habitats within the assessment for the impacts listed.	at 1290 m asl. Includes tributaries directly impacted (2 km) by the flood zone, resettlement and the footprint of the left bank road/bridges and 100m 'disturbance zone' to account for any tributary crossings.	which is approximately 100 km upstream from full supply level and > 500 m higher in elevation.
Primary Suppliers	All	Out	The only Primary Suppliers identified are concrete supply and steel liners (see **Volume 1, Chapter 3 (Project Description)** of this ESIA. There is limited scope for influence from Rogun JSC (in particular regarding the latter) upon these suppliers, while the potential for risk of conversion or significant degradation of natural or critical habitats (as per ESS6) in relation to an established concrete batching facility is considered limited.	n/a	n/a

SENSITIVE RECEPTORS

15.4.10. **Table 15-4** provides receptor evaluation for those receptors confirmed a being present/potentially present across the AoI and scoped in as per **Table 15-3.** This evaluation process should be read in conjunction with **Volume 2, Annex 15.1 (Critical Habitat Assessment)** of this ESIA.

Table 15-4 – Receptor Evaluation

Receptor	Value / Sensitivity	Justification
Floodplain habitat	Medium	Most of the floodplain habitat across the AoI is heavily modified and lacking any notable species or species composition that would signify Natural Habitat (as per ESS6). Two notable exceptions are found upstream of the confluence of the Vakhsh and Obikhingou rivers (one within each channel). The example within the Vakhsh River comprises deposited materials that appear to have altered the braided channel here, creating a 'new' floodplain which exhibits far more natural habitat composition. Given low levels of modification, these floodplain extents area considered to be Natural Habitat and therefore of **Medium** value.
Juniper woodland	Medium	The juniper woodland recorded from the AoI is a remnant feature of habitat that would have been extensive in the past. It shows some signs of modification (from grazing/animal movements and firewood collection), but not to the extent that its integrity as a functioning habitat is compromised. It is therefore considered to be Natural Habitat as per ESS6 and therefore of **Medium** value.
Sensitive flora	Medium	The baseline studies identified 20 TRB species as being present/potentially present across the AoI (no IUCN Red List species are considered present within the AoI). From the available literature reviewed, it appears that all of these species have habitat preferences that are generally lacking within the AoI, and therefore any records of presence/potential presence are likely to be from remnant populations that would have previously been more widespread (i.e. prior to the extensive habitat modification that has occurred across the AoI). In particular in relation to the four of the five species identified during field surveys within the AoI, *Fritillaria eduardii* (TRB CR) prefers elevations above 1200m asl, and within wooded habitats; *Crocus korolkowii* (TRB EN) prefers more natural meadows/grassland without significant modification; *Juno Nicolai* (TRB EN) prefers mixed forest habitat; and *Tulipa praestans* (TRB CR) prefers broadleaved woodland on stony slopes. *Vitex agnus-castus* (TRB CR) has a more generalist habitat preference, although is largely lacking from the AoI due to ongoing collection of plants for firewood and pharmaceutical use; the species has been identified from gravelly slopes where its persistence is presumed to relate to its relative inaccessibility here. In addition, the most recent distribution maps of these species suggests that the Vakhsh River valley is not a core area for these plants, with most of their distribution occurring further west and south (as per Nowak & Nobis, 2020). Two other TRB species, the VU *Cousinia leptocampyla* and *C. corymbose,* while not identified within the AoI during field surveys, are associated with juniper woodland and so assumed as present in these Natural Habitat areas. A total of seven sensitive species are therefore considered as being present/potentially present within the AoI. It's considered likely that the populations within the AoI will not be of significant importance within the context of the wider population; however, in the absence of robust evidence to corroborate this (these species are all relatively under-studied), a precautionary value of **Medium** is considered appropriate here.

Receptor	Value / Sensitivity	Justification
		None of these species are considered to trigger Critical Habitat as per ESS6.
Notable reptile species	Low	Four species of reptile were recorded during baseline studies that are on the TRB (two VU; two EN), including one also listed as VU by IUCN (Asian tortoise *Testudo horsfieldii*). None of these were found within the AoI, although their presence is considered likely in places given the broad habitat tolerances of these species. There is no indication that the reptile populations recorded within the AoI are of particular importance within the context of the wider population, with species either being common and widespread, regionally and beyond, or rare within the AoI. On this basis, a value of **Low** is considered appropriate. None of these species are considered to trigger Critical Habitat as per ESS6.
Notable mammal species	Low	Baseline studies recorded 12 species of mammal that are on the TRB (10 listed as VU; two as EN – snow leopard and least weasel; no CR), with one also having IUCN Red List classification (snow leopard: VU). However, only three of these were encountered during field surveys in 2023 (least weasel, otter and Savi's pipistrelle), and a number of the more sensitive species are not considered present within the updated AoI given their respective habitat preferences. None of the species considered present/potentially here have populations across their EAAA that are considered to be greater than of local importance and therefore a value of **Low** is considered appropriate. None of these species are considered to trigger Critical Habitat as per ESS6.
Breeding birds	Low	Baseline studies have not identified any particularly important breeding bird populations being supported by habitats within the AoI, and the habitats do not appear to offer optimal conditions for birds aside from relatively widespread (albeit TRB VU) species such as blue whistling thrush and Indian paradise flycatcher that inhabit scrubby and rural areas, and white-capped water-redstart that inhabits the riparian zone around fast-flowing watercourses. Given the abundance of the habitats present, and the number of territories of these species that may be supported here a value of **Low** is considered appropriate on a precautionary basis. None of these species are considered to trigger Critical Habitat as per ESS6.
Migrating birds	Low	Baseline studies (undertaken in spring and autumn 2023) have not identified any particularly important migratory bird populations being supported by habitats within the AoI, and the habitats do not appear to offer optimal conditions for birds that will stop on their migration through the Vakhsh River valley. However, it is possible that the floodplain habitats and exposed braided channel in particular, might be of use to roosting/resting birds and value of **Low** is considered appropriate on a precautionary basis.

Receptor	Value / Sensitivity	Justification
		None of these species are considered to trigger Critical Habitat as per ESS6.
Aquatic Biodiversity (fish)	Medium	Given that the Vakhsh River has been fragmented by 5 dams, including the Nurek Reservoir, any long-range fish migrations that would have occurred between the Amu Darya or the lower parts of Vakhsh River to its headwaters have already been interrupted. Given this level of modification to the longitudinal connectivity across the EAAA, and acknowledging the presence of Amu Darya trout and Turkestan Catfish (TRB: VU) within the Study Area, a value of **Medium** is considered appropriate.
Aquatic Biodiversity (general)	Low	The aquatic habitat across the AoI has been given a value of **Low** as a result of the above-mentioned interruption in longitudinal connectivity, the presence of non-native species, and there were no IUCN listed aquatic invertebrates identified. It Vakhsh River within the AoI is therefore not considered to be Natural Habitat as per ESS6.

15.5 POTENTIAL IMPACTS AND EFFECTS

15.5.1. This section comprises a precautionary assessment of the impacts upon sensitive receptors that require consideration through the assessment process.

15.5.2. The basis for receptor evaluation is derived from ESS6, which requires receptors of increased value (Natural Habitats and Critical Habitats) to be identified and appropriately assessed in order that a project can demonstrate compliance. These classifications represent the most important biodiversity values (in the case of Critical Habitat, the very highest), which require particular conditions to be met before projects can proceed in areas where such values are present. A detailed assessment of Critical Habitat and Natural Habitat is presented in **Volume 2, Annex 15.1 (Critical Habitat Assessment)** of this ESIA.

15.5.3. For each impact, the assessment considers the sensitive receptors that will be affected, and how this will materialise, before considering the effect that will result. Mitigation is then applied where appropriate in order that effects are reduced to a level that is considered acceptable, with enhancement measures also described. Measures to deliver compliance for a particular Lender's requirements (such as protection of species listed on EU Habitats Directive – see **15.2.6**) are also listed.

15.5.4. Given that there is significant overlap between the construction and operation phases of the Project, it is necessary to define activities under each of these phases from which impacts will derive and be assessed within the following sections.

CONSTRUCTION

15.5.5. The activities that will be considered under the construction phase will be:

- Clearance activities across the flooding zone, left bank road and associated facilities, and ongoing inundation up to Full Supply Level (FSL)
- Construction activities at the HPP site and associated facilities
- Current HPP operation and maintenance

OPERATION

15.5.6. The activities that will be considered under the operation phase:

- Operational reservoir regime including annual drawdown (c. 30m) and associated facilities
- Reservoir at FSL

POTENTIAL IMPACTS

15.5.7. Impacts are defined within the context of the Project as the direct or indirect interferences produced by the Project's actions on the environment, able to influence the state or quality of one or more ecological receptors. It should be noted that many impacts have already materialized to a certain degree as a result of the existing disturbances, such as the partially-completed dam wall with its current inundation level.

15.5.8. Impacts assessed in relation to the biodiversity receptors (and the phases that they'll occur) include:

Construction

Clearance activities across the flooding zone and associated facilities, and ongoing inundation up to FSL

- Loss/degradation of habitat and species
- Direct mortality/drowning of sensitive fauna
- Encroachment / introduction of invasive species

Construction activities at the HPP site and associated facilities

- Disturbance and injury/killing of fauna as a result of construction activities
- Release of pollutants into the river

Current HPP Operation and Maintenance

- Entrainment and Impingement of fish through the turbines
- Changes to downstream flow regimes

Operation

Operational reservoir regime including annual drawdown (c. 30m) and associated facilities

- Mortality/displacement of sensitive fauna from new roads and overhead transmission lines
- Release of pollutants into the river
- Entrainment and Impingement of fish through the turbines
- Changes to downstream flow regimes

Reservoir at FSL

- Impacts from increased human pressures (e.g. grazing, hunting, firewood collection, fishing, etc.):
- Change in habitat composition
- Loss of tributaries and short-range migration

15.5.9. The following assessments are made with reasonable confidence unless otherwise stated.

15.5.10. These impacts will be assessed against each relevant sensitive receptor as per the scoping table (Table 15-3). Following each assessment, specific mitigation and enhancement measures are described before concluding with an updated residual effect.

15.6 CONSTRUCTION

CLEARANCE ACTIVITIES AND ONGOING INUNDATION

Loss/degradation of habitats

15.6.1. The clearance activities across the flooding zone, left bank road and resettlement sites have the potential to result in the loss of important habitat and habitat/features relied upon by sensitive biodiversity. The ongoing reservoir inundation will result in the complete loss of habitats and features across the flooding zone and may alter functionality of neighbouring habitats through fragmentation and disruption of current ecological processes, causing habitat degradation in these areas.

15.6.2. The State Forestry Agency (SFA) are undertaking an exercise to clear the flooding zone in advance of inundation. This will comprise removal of trees and woody scrub, as well as remaining built structures (much of these have already been removed as part of the resettlement that has already occurred).

15.6.3. The new AIIB-funded left bank road and associated bridges will extend for approximately 55km and will result in the clearance of habitats across its route within an expropriation corridor (not yet defined but assumed to be 50m width to allow for the new road and associated working area). Additionally, the new road will result in fragmentation and severance of habitats along its route.

15.6.4. Similarly, associated facilities will require land clearance, which will adversely impact upon the habitat assemblage present, and any species supported by these habitats.

15.6.5. Continued flooding until maximum inundation level of 1290m will result in the loss of terrestrial habitats within the flooding zone. Additionally, the flooding will result in the permanent and irreversible loss of plants, and features used by sensitive biodiversity across the flooding zone as they become submerged. This impact will be realised on an incremental basis, over a number of years.

15.6.6. It is acknowledged that a new reservoir in the landscape is a change in habitat composition with respect to the existing river and the surrounding terrestrial habitats and will be an impact that materializes incrementally. The filling of the dam will result in the loss of surrounding terrestrial habitats as well as a loss in lotic (river) habitat as the Vakhsh River will be transformed into a lentic (lake) system, adversely affecting those species reliant on the flowing waters within the AoI. This impact is assessed singularly under the 'Reservoir at FSL' section (**15.7.43** onwards).

Impact Assessment

Sensitive Habitats

15.6.7. The only habitats scoped in for assessment are two discrete floodplains, and juniper woodland habitats, with all other habitats being heavily modified and not of requisite value for consideration (as a habitat receptor in their own right). Most of the floodplain habitats across the AoI are already degraded as a result of ongoing/historic modification. The floodplains at Mehrobod and most of the floodplain extent upstream of the confluence of the Vakhsh and Obikhingou rivers have been heavily modified as a result of ongoing human influence from settlements, cultivation/localised agriculture and widespread grazing use. Two exceptions to this prevalence of degradation are discrete floodplain areas; one within the Obikhingou River immediately upstream of the confluence with the Vakhsh River, and one approximately 6km upstream of this confluence where it is likely that recent geomorphological changes have resulted in a 'new' floodplain area that has yet to experience any material human influence and therefore supports habitat that appears to be largely unmodified. It is therefore considered appropriate to classify both as Natural Habitat as per ESS6 (see **Volume 2, Annex 15.1 (Critical Habitat Assessment)** of this ESIA).

15.6.8. The clearance activities and ongoing inundation from the Project will result in the permanent and irreversible loss of the two Natural Habitat floodplains within the flooding zone footprint; this comprises approximately 77ha and a relative loss of 100% of the habitat's occurrence within its EAAA. This is anticipated to occur around 2027 when 1185m inundation level is reached and represents a **large** impact magnitude that is permanent and irreversible and will result in an adverse effect that is **major** (significant). This assessment is made with certain confidence.

15.6.9. The woodland habitat within the AoI is restricted to remnant areas of juniper woodland on the left bank of the Vakhsh River that represent the last remaining fragments of a once common habitat in the landscape. This is a habitat that shows some signs of modification through grazing pressure and some tree loss but still retains of sufficient natural character (especially in terms of species diversity and composition) to be classified as Natural Habitat as per ESS6 at this stage (see **Volume 2, Annex 15.1 (Critical Habitat Assessment)** of this ESIA).

15.6.10. The ongoing inundation and associated clearance activities across the flooding zone will result in the permanent and irreversible loss of approximately 160ha of habitat type (when also considering removal of trees across an assumed 25m buffer zone from the 1290m level). In addition, the left bank road will result in the permanent and irreversible loss of approximately 28ha of this habitat. In total, 188ha of this habitat will be lost, which is a relative loss of approximately 18% of the habitat's occurrence within its EAAA. This is anticipated to occur between the years 2034-36 (depending on the left bank road construction programme), allowing for pre-flooding clearance and the anticipated maximum inundation level being reached around 2038 and represents a **medium** impact magnitude that will result in an adverse effect upon this receptor that is **moderate** (significant). This assessment is made with certain confidence.

Sensitive Flora

15.6.11. Seven species of sensitive flora (i.e., listed on TRB; there were no species identified that are on the IUCN Red List) were recorded during baseline surveys, considered to represent remnant populations persisting in sub-optimal habitats for these species.

15.6.12. The ongoing flooding will result in the permanent and irreversible loss of notable plants within the flooding zone, while the impact of clearance activities across this area may include loss of *Vitex agnus-castus* plants (TRB CR), given that this species can grow to beyond 2m and therefore represents a scrub/small tree that may be included within SFA clearance activities. Additionally, it is possible that sensitive flora may be lost during construction of the left bank road.

15.6.13. The EAAA for all notable plants represents sub-optimal habitat conditions (with those plants identified considered to be remnant populations), which extends across a much wider area Table 15-4), and the loss of some specimens within the AoI is not considered to materially affect any species' conservation status beyond this extent. With regards *Vitex agnus-castea,* a single population of this species was recorded immediately upstream of Chorsada, on gravelly slopes, which will feasibly be lost in its entirety on the assumption that clearance activities will remove all plants within this area. Although this species is listed as CR on the TRB; a more recent review of the species' conservation status (Nowak & Nobis 2020) has classified it as Least Concern (LC) within Tajikistan and so there is uncertainty of the species' genuine conservation status. Additionally, the range and distribution of all these species within Tajikistan is predominately outside of the AoI (in particular to the west and south of the country), which suggests greater habitat suitability is present elsewhere. With this in mind, the impact is considered to be **small**, resulting in an adverse effect that is **minor** (not significant).

15.6.14. With regards *Vitex agnus-castea*, given its predicted total loss within the AoI, the Project impact is precautionarily considered to be **large**, permanent and irreversible, resulting in an effect that is **major** (significant).

Sensitive Fauna

15.6.15. Baseline surveys resulted in a range of sensitive fauna species being present/potentially present from the AoI (and wider study area), as follows:

- 38 species of mammals, 12 of these being of increased conservation interest (e.g., by virtue of TRB or IUCN Red List status)
- 13 species of reptiles, four species of increased conservation interest. No amphibians of increased conservation interest.
- 158 bird species, 18 species of increased conversation interest

15.6.16. The main source of potential impact to sensitive fauna (notable mammals, reptiles and breeding birds) is predicted to be the ongoing clearance activities within the flooding zone and across the left bank expropriation corridor, together with ongoing flooding across the flooding zone which will result in the losses of important habitat/features and the displacement of sensitive fauna. Given the typically small home ranges of these animals, this may result in displacement and population losses at a local scale as suitable habitat/features are lost. However, the animals recorded from the baseline studies occupy a varied suite of habitats and are unlikely to be dependent upon any particular habitat/feature; it is therefore reasonable to assume that they will be readily displaced during clearance activities to other habitats (i.e. outside of the flooding zone).

15.6.17. Reptiles are particularly sensitive to impacts to, and losses of, hibernacula, given the particular environmental conditions that these features provide. Such features generally comprise rock piles, log piles, burrows, and are required to be offer stable conditions over winter months when reptiles are inactive. Similarly, roosting bats are also sensitive to loss of roost features/habitat and there is the potential that mature trees (most likely present within the juniper woodland identified), built structures and crevices within rocks/cliffs may support bat roosts. In both cases, the clearance activities and flooding have the potential to result in losses of these features and displacement of animals.

15.6.18. With regards migratory birds, it is feasible that the braided channels are of use to migratory birds as a stopover habitat when exposed; however, no observations of such behaviour were made during any of the surveys undertaken (during 2014 ESIA surveys, or spring/autumn surveys undertaken in 2023), and given the predicted lack of much food resource here (see the baseline description within **Volume 2, Annex 7.1** of this **ESIA**), it is reasonable to conclude that any such use of these floodplains is not considered to be of significant importance.

15.6.19. Although this impact will be constant, permanent and irreversible, all of the sensitive species recorded (excluding bats and migratory birds) occupy a varied suite of habitats and are unlikely to be dependent upon any particular habitat/feature; it is therefore reasonable to assume that they will be readily displaced during construction activities to other habitats (i.e. outside of the clearance areas), which would be a **medium** impact, resulting in a **minor** effect (not significant).

15.6.20. With regards bats and recognising the relative uncertainty here over the extent of bat roosts present, the loss of these supporting features is precautionarily considered to be **medium** and therefore an effect that is **minor** (not significant).

15.6.21. With regards migratory birds, beyond the flooding zone there is extensive braided channel habitat upstream of Novabad, which would require birds to fly an additional 7km+, which given the distances travelled by migratory birds is considered feasible. The impact from land-take is predicted to be **small**, permanent and irreversible resulting in an adverse effect that is **negligible** (not significant).

Additional Mitigation and Enhancement Measures

15.6.22. To reduce potential significant effects, and to ensure good practice construction methods relating to protection of biodiversity, the following measures shall be implemented.

Sensitive Habitats

15.6.23. Floodplain and juniper woodland habitat have been defined as Natural Habitat (as per ESS6) and so the Project is required to deliver No Net Loss (NNL) for these habitats. An NNL Framework (NNLF) has been produced as part of the BMP and this explores various options to delivering NNL, with a feasibility appraisal of each to enable a conclusion of those that are feasible and will be taken forward for further development.

15.6.24. The floodplain habitat prevails because of morphological processes as well as through species composition, and so it may be difficult to recreate or restore this habitat within the overall Project footprint; however, options for on-site mitigation in this regard have been fully explored in line with the mitigation hierarchy and considered within the NNLF.

15.6.25. At this stage, other options considered include the following:

- Creation of new floodplain habitat upstream of the flooding zone or within a different catchment; and
- Other, out of kind, projects such as supporting creation of another habitat type that will be demonstrated to compensate for the loss of floodplain through creation of a sufficient area of another sensitive, native habitat type.

15.6.26. With regards juniper woodland, a single avoidance option exists, in relation to the left bank road, and the design will be finalised to avoid all areas of juniper woodland.

15.6.27. For areas of woodland that will be lost to clearance activities prior to flooding the options for on-site mitigation may comprise replacement planting of woodland at various locations around the flooding zone and Project site, which will align with complementary planting requirements such as for soil stability purposes or making use of the aforementioned stabilised water levels at Nurek as a result of the constructed Rogun dam to undertake planting there.

15.6.28. Regardless of on-site options that may be considered to mitigate for losses to juniper woodland, it is considered that off-site options will be required, and so juniper woodland has been included within the NNLF. Numerous potential options exist to deliver NNL for this habitat, especially given its formerly extensive coverage of the landscape in Vakhsh River valley. Discussions with relevant stakeholders on this have identified a number of options that are explored within the NNLF, including:

- Expansion of existing remnant areas of juniper woodland through planting and habitat management;
- Restoration of remnant areas of juniper woodland to improve overall habitat quality/value;
- Creation of new woodland areas;

- Collaboration with/contribution to existing juniper woodland management projects, such as those within the Nurek Management Area, or currently being delivered by Gesellschaft für Internationale Zusammenarbeit (GIZ) in partnership with FFI; and
- Other, out of kind, conservation projects such as supporting planting and management of native fruit and nut tree woodlands.

15.6.29. As with the work required to inform floodplain mitigation, an essential requirement will be to complete a detailed botanical inventory of the juniper woodland habitat that will be lost. This will be completed by a suitably experienced botanist with experience of Tajik flora.

15.6.30. The NNLF also includes monitoring, including establishment of feedback mechanisms to ensure successful NNL delivery in perpetuity.

Sensitive Flora

15.6.31. Mitigation is required to reduce significant effects specific to *Vitex agnus-castea*, but this extends to all TRB plants given the protection they received under Tajik law.

15.6.32. In advance of clearance activities across the flooding zone, a repeat survey for sensitive flora will be undertaken within those areas within the flooding zone where species were previously identified, along the route of the left bank road and within areas of Natural Habitat. These areas are illustrated within the Project Biodiversity Management Plan (BMP). This will be completed by a suitably experienced botanist following a method for surveying that has been put forward in the BMP and approved by the Lender consortium. The botanist will be experienced in Tajik botany, with at least 10 years of professional experience and demonstrable experience, and knowledge of the habitat types and flora found in the Vakhsh River valley.

15.6.33. Findings from the surveys will be added to a Biodiversity Constraints Tracker (BCT) for the Project so that the nature and location of these findings can inform ongoing mitigation and monitoring.

15.6.34. Any rare plants encountered will be collected and moved to receptor sites that will be pre-identified in which these plants will remain to mitigate the Project-related impacts. These receptor sites will be chosen in consultation with botanical specialists and will consider ongoing risks from the anthropogenic impacts currently affecting the species in question (i.e., a particular focus will be in areas that will likely become less used by local communities and livestock once local resettlement has occurred and inundation is complete). Indicative illustrations have been provided within the BMP, which will also describe the survey methodology, responsibilities and experience of the specialists, survey results and success criteria.

15.6.35. Given the incremental nature of this impact (i.e., increasing in spatial extent over time), this translocation measure will be implemented sufficiently far in advance of land-clearing to allow translocation prior to clearing and flooding (under the guidance of the Lead ECoW and associated botanist support).

15.6.36. Additionally, should monitoring suggest that the translocation has not been successful, then adaptive management in the form of a supplementary planting programme supported by the local botanic garden/nursery will be undertaken. With regards *Vitex agnus-castus*, this is a species that is readily propagated, from both seeds and cuttings (as described within Ari 2016); the four other species confirmed as being present are also subject to cultivation programmes at Tajik botanical

gardens (as per TRB) and so it is expected that should this be required, this would represent a viable adaptive management strategy. However, it is still recognised that the Project may result in the loss of these local populations given the inherently variable success rate for plant translocations, and the numerous factors that will influence whether plants will become established in the receptor sites. This has been factored into the residual impact conclusion accordingly.

Sensitive Fauna

15.6.37. Although no significant effects are predicted from this impact with regards sensitive fauna, measures are required to ensure compliance with Tajik law as well as Lender standards.

15.6.38. In advance of clearance activities (and programmed accordingly by the Lead ECoW and detailed within the BCT), a walkover will be undertaken of all areas to be cleared, with a particular focus on those features used by reptiles for sheltering purposes, such as log piles, rock piles, loose built structures, etc. This will be completed by a suitably experienced herpetologist, following a method for surveying that is presented in the BMP and approved by the Lender consortium.

15.6.39. Pre-clearance/flooding walkovers for bats will be undertaken that focus on areas that have the potential to support bat roosts, such as stable cliff features and buildings, and Natural Habitat juniper woodland (including areas within the route of the left bank road); these areas are identified within the BMP and will be covered incrementally in line with the proposed clearance programme and flooding (i.e., these checks will be done within six months of the predicted impact). The surveys will be completed by a suitably experienced bat surveyor and will comprise a mix of daytime roost searches and night-time bat activity surveys, with the aid of appropriate bat survey equipment such as high-powered torches and handheld and/or static bat detectors.

15.6.40. The import of suitable broadband bat detectors into Tajikistan (assuming that they cannot be sourced in-country) may be complicated. On other recent projects in Central Asia the process has been lengthy, and the sourcing of field-equipment will be planned at the earliest opportunity to ensure that surveying is not compromised. In the worst-case scenario the Lead ECoW would have to rely on bat detection equipment travelling out with the bat specialists (i.e. their own personal equipment) or searches would have to be entirely manual/visual.

15.6.41. Findings from the surveys will be added to the Project BCT, and this will inform timing of specific clearance activities so that clearance of important features can be avoided during the winter months when they may be used as hibernacula.

15.6.42. Any reptiles encountered will be moved away from the flooding zone and translocated to an area of suitable habitat outside of the inundation zone (within a similar habitat/altitude). Given the generalist nature of the species identified, it isn't necessary to identify specific receptor sites for this translocation; the main focus is for the animals to be moved away from clearance activities and flooding. The Lead ECoW shall have overall responsibility for the reptile translocation program taking expert herpetological guidance as necessary. The reptile translocation process within the BMP sets out biosecurity measures to be employed to ensure the safe handling of animals and to prevent disease spread and enforced intra- and/or inter-species competition. It establishes criteria for the selection of suitable release sites and there is an assumption that given reduced general human pressure in the wider area as a result of displaced communities, a relatively higher carrying capacity will be realised that will accommodate this predicted small-scale translocation exercise. The progress of inundation may, in cases, not be gradual and progressive but (dependent on

topography) be more episodic in nature. The translocation methodology considers this so that translocation activities are not abortive. Solutions to this are likely to be translocations at greater distances than would be normally undertaken to ensure there is no risk of animal returns to the flooding zone.

15.6.43. Given the incremental nature of this impact, i.e., increasing in spatial extent over time, this measure will be implemented on a regular basis (e.g. annually) but informed by the programme of clearance activities across the flooding zone (i.e. checks will only be done within six months of the predicted clearance/flooding impact), and reported/tracked within the BCT.

15.6.44. Where bat roosts are identified and not in use during clearance activities, and if adequate alternative natural roost sites are available in the wider area, then no further action will be required. If a roost is found and no adequate alternate sites are available, the following applies:

- It will be necessary to provide artificial roost sites for use by bats when they return to the roost site. The artificial roost shall be suitable for they species/number of bats that use the roost that will be lost; expert input shall be provided to inform this. Artificial bat roosts are available online. At least five genera of bats (Pipistrellus, Nyctalus, Myotis, Eptesicus, and Barbastella – all of which are present in the Project area) are known utilise artificial bat boxes to varying degrees. Other encountered species may require more bespoke solutions. It is expected that an artificial bat box such as the FSC Triple Cavity Bat Box [for example, https://www.wildcare.co.uk/treble-crevice-bat-box-black-10562.html] can be used as a default unit in the Project area for general purposes – the unit possesses design features that make it suitable for several of the species that may be encountered in the Project area. If the sourcing of bat boxes proves difficult a template plan for the units can be provided and they can then be constructed locally – no specialised material or equipment are necessary.
- If the roost is in use during construction works, and if these works cannot be delayed until the bats have vacated the roost, then a suitably experienced bat specialist shall be consulted to formulate an appropriate course of action. For small/single bat roosts of limited conservation value it may be appropriate for the bat worker to move the bats to an alternative roost site (whether natural or artificial), such as a suitable tree of rock/crevice outside of the affected area (to be informed by the bat specialist in the field); whereas for more significant roosts, a more robust approach will need to be adopted, following the advice of the bat specialist. It is important than an experienced bat worker is engaged to undertake this work given the risk of rabies transmission when handling bats.

15.6.45. No additional mitigation measures are required (or possible) to avoid impacts to nesting birds from habitat/feature loss given that the area will be flooded to the maximum inundation level. Good practice measures are detailed within 15.10 to minimise impacts to nesting birds at all phases of the Project in line with Lender requirements.

15.6.46. There will be complementary mitigation measures that will be implemented as part of site rehabilitation (see **Volume 3, Outline Site Rehabilitation Plan)** that will include tree-planting that may provide nesting opportunities for a range of breeding bird species, depending on the nature of the species planted and with a timeline dependent upon the age of trees planted. This is detailed further in **15.10**.

Residual Effects

15.6.47. Compensation mitigation to deliver NNL is defined in the NNLF. The NNLF provides information on the process to be followed to demonstrate successful delivery as required by ESS6 and other Lender standards; this will reduce the impact to **very small** resulting in a **negligible** effect, at a minimum. The outcome will not only achieve NNL, but a net gain for both floodplain and juniper woodland habitats.

15.6.48. On the assumption that plant translocation is at least partially successful for each species being considered, the residual impact to all sensitive flora will be reduced to **small** resulting in an effect that is **minor.** In relation to *Vitex agnus-castus,* this uncertainty will result in a **medium** impact prevailing, resulting in an effect that is **moderate**, on a precautionary basis. This conclusion should be considered within the context of a local population that was likely unviable (given only a single stand was recorded) and trending towards local extinction due to the aforementioned pressures upon it; additionally it is feasible that the receptor evaluation is unrealistically high that has inflated the assessment.

15.6.49. The residual impact to sensitive fauna will be remain to **small** resulting in an effect that is **negligible.**

Direct Mortality / Drowning

15.6.50. The clearance activities and ongoing flooding (as described from 15.6.1 onwards) will also result in a direct mortality/drowning impact that has the potential to affect sensitive fauna, in particular less mobile species of mammals (notably roosting bats), reptiles and nesting birds (or more specifically their dependent young).

15.6.51. The effect of direct mortality/drowning associated with ongoing flooding will depend upon the rate at which flooding will occur, together with the timing of this impact. A *very* crude estimate of the latter is 0.5m per day (based upon filling to the maximum inundation level within the shallowest gradient in the flooding zone and therefore the area where 'quickest' average flooding will occur at any one point).

15.6.52. The main impact pathway will be mainly from flooding (on the assumption that clearance activities will be undertaken during spring/summer months, so not affecting hibernating mammals and reptiles), although clearance activities do have the potential to impact dependent young of all these animals (in particular nesting birds), which will be less able to escape the impact.

Impact Assessment

15.6.53. With a worst-case flooding impact scenario being realised during winter months when reptiles are inactive, and clearance activities during the months when nesting birds will have eggs/dependent young the impact magnitude is considered to be **medium**, permanent and irreversible, resulting in a **minor** adverse effect (not significant).

Additional Mitigation and Enhancement Measures

15.6.54. No mitigation for significant effects is required, although measures will be adopted to ensure compliance with Tajik law and Lender standards. This is described in relation to the loss/degradation of habitats impact, at **15.6.37** onwards.

Residual Effects

15.6.55. The impact magnitude will be reduced to **small** resulting in an effect that is **negligible** (not significant).

Encroachment / Introduction of invasive species

15.6.56. Vehicle movement associated with clearance activities, and the ongoing flooding across the flooding zone have the potential to facilitate the introduction and/or cause the spread of invasive species across the wider area, which may have an adverse impact on native biodiversity. This impact can materialise as seeds/plant material is transported on vehicles, and/or seeds are carried by floodwaters.

15.6.57. The highly invasive Bathurst burr was recorded from numerous locations across the AoI, in particular across modified floodplain and braided channel habitats. This species is known to adversely affect a wide range of important natural and agricultural habitats, and spreads very easily through various sources (including on livestock and during flooding as the seeds floats – both pathways that will be very prevalent across the AoI). Clearance activities (movement of vehicles) and ongoing flooding may therefore contribute to the further spread and establishment of invasive species communities across the AoI, especially given the acknowledged potential for spreading across flooded areas.

15.6.58. Of the 21 fish species expected to occur in the Project AoI, twelve (12) have been introduced (**Volume 2, Annex 7.1 (Baseline Conditions Report**). Invasive and non-native species have the ability to cause ecological harm by dramatically alter food web structures. Invasive and non-native species can prey on or out compete native species and often have high reproductive abilities. Once introduced, these species will have the ability to move upstream and extend their distribution regionally and permanently.

Impact Assessment

Sensitive Habitats

15.6.59. Any new invasive species presence across the AoI will affect disturbed or open areas preferentially due to the nature of such plants' colonisation strategy, and because ecosystem resilience is impaired. Both of these considerations apply to the juniper woodland, which is naturally quite open but has also experienced a level of modification through sporadic tree removal and the through-movement of livestock. With this in mind, it is feasible that Bathurst burr will spread to the juniper woodland habitats during ongoing inundation as the reservoir will provide an effective pathway to these remnant woodland habitats. This has the potential to significantly alter the woodland species composition, which would represent a **large** impact magnitude that will result in an adverse effect that is **major** (significant). This assessment is made with reasonable confidence.

Sensitive Flora

15.6.60. With regards sensitive flora, the assessment text presented for sensitive habitats is relevant here, and over time it is feasible that introduced invasive species could spread to areas where the sensitive flora is present. While there is very little certainty in this regard, it is feasible that such a scenario could result in threatened plant species being lost across a large area as invasive species colonise and out-compete other plants. Such an impact would likely be irreversible in practice but given the limited extent of sensitive flora present within the AoI, and the extensive similar habitat

across the wider landscape, together with the fact that invasive plant species are already present in the wider area, the predicted impact would be **small** (in terms of an impact attributable to the Project), resulting in a **minor** effect (not significant) for rare plants in general (it is also acknowledged that in the case of *Vitex agnus-castus*, it will be less prone to loss to this species given its larger size/more scrubby form). While the Project could ultimately lead to the permanent loss of some of these threatened plants from the AoI, it is not thought that this would materially affect the conservation status of any species given the small populations considered to be present here, and the wider distribution (and more optimal habitat) elsewhere in the country for all species, in particular the south and west of Tajikistan, together with their more favourable conservation status described within more recent reviews (as illustrated within Nowak & Nobis 2020).

Aquatic Biodiversity

15.6.61. With regards fish, it should be noted that a number of non-native species are already present within the Rogun Reservoir and surrounding waterbodies, and it is likely that non-native species will further establish within the reservoir. Non-native species have been introduced into the Nurek Reservoir and are reportedly already within the Rogun Project area (2014 ESIA).

15.6.62. In accordance with the Rules of fishery in reservoirs of the Republic of Tajikistan, as approved by the Order of the Ministry of Agriculture and Environment of the Republic of Tajikistan of September 22, 2007, it is forbidden to "*make acclimatization and cultivation of new species of fish without the corresponding biological reasons and permission of bodies of fish conservation*".

15.6.63. A mix of lentic and lotic non-native fish species are found within the AoI. Many of the species that have been introduced into reservoirs and ponds have a preference for standing or slow flowing waters, and are unlikely to out compete native species in the fast-flowing waters upstream (e.g. Carp, Goldfish). Species such as the Sharpbelly and Common Bleak are found in flowing rivers and would be able to move upstream.

15.6.64. As no Critical Habitat for fish species has been identified upstream of Rogun, and it has been reported that non-native species are already within the Vakhsh River upstream of the Rogun Dam, the impact magnitude of the introduction of non-native species is considered **small** and therefore the added effect of the Project on the Vakhsh River within the Project AoI is considered to be **minor** (not significant).

Additional Mitigation and Enhancement Measures

15.6.65. To reduce potentially significant effects to juniper woodland, the following measures shall be implemented:

- The extent of invasive species present (currently considered to just comprise Bathurst burr) within proximity to the juniper woodland habitat will be recorded within the growing season prior to predicted flooding at 1290m asl (i.e. the time at which flooding is predicted to reach the juniper woodland habitat). This is currently around 2036-2038.
- An Invasive Species Management Plan (ISMP) will be produced in advance of flooding to 1290m asl. This will detail measures to control the spread of invasive plant species identified in proximity to the juniper woodland habitat, such as plant removal and safe disposal. The ISMP will also identify measures for reducing the risk of contaminated materials being imported onto site such as wheel-washing and adherence to identified access routes. The DFZ (or their lead contractors) will develop the detail of the plan and integrate it into their working practices. The ISMP will be an

explicit commitment of the Environmental and Social Commitments Plan (ESCP). The requirement for separate ISMPs for construction and operation will be at the discretion of DFZ.

- The Lead Ecological Clerk of Works (ECoW) will ensure the delivery of toolbox talks to contractors operating outside of the current dam site to raise awareness of invasive species identification and good practice to minimise the risk of invasive species spread from the Project.

15.6.66. No additional mitigation measures have been identified for non-native fish species, beyond the restriction of their introduction. It is further recommended that any introduction of non-native species for aquaculture (if considered) should be limited to the Nurek Reservoir, as this is a contained system, already has a high proportion of non-native fish species, is close to market and will have a controlled water level. It should be noted that this could be viewed as economically beneficial, however is not considered at this stage.

Residual Effects

15.6.67. Implementation of the additional measures will reduce the impact of invasive species encroachment to **very small**, resulting in a **negligible** effect (not significant) to habitats and sensitive flora.

15.6.68. With non-native fish species already present within the Vakhsh River and surrounding waterbodies, there is little that one can do to eradicate them from the system, and as such the effect will remain **minor** (not significant).

CONSTRUCTION ACTIVITIES AT THE HPP SITE AND ASSOCIATED FACILITIES

15.6.69. For the purposes of this assessment, this phase comprises ongoing construction activities beyond the partially completed dam structure, i.e., construction required to complete the dam structure and other Project components, such as construction of the new left bank road and bridges. Associated facilities such as construction of new settlements and transmission lines are also considered here. Impacts will relate to movement of plant machinery, air quality (including dust), noise and vibration as well as pollution impacts.

Habitat degradation and disturbance and injury/killing of fauna as a result of construction activities

15.6.70. Sensitive habitats are at risk of degradation from construction activities where air quality impacts occur; most notably from emissions and dust.

15.6.71. Fauna is at increased risk of disturbance and injury/death in areas where construction activities are occurring, including from construction machinery, air quality, noise and vibration impacts.

15.6.72. Direct mortality from construction activities may occur from a number of sources including vehicle movement, excavation and vegetation clearance across the flooding zone and within the footprint of associated facilities (such as stockpiling areas and resettlement sites) and hunting/poaching by construction workers. This impact will be most notable in areas where constructions are new/infrequent, as opposed to where they have been ongoing (such as the dam site), and is predicted to affect sensitive reptiles and mammals.

15.6.73. The left bank road will require ongoing construction activities across a length of 55km and an assumed working corridor of 50m. The impact sources here will be numerous, with air quality, noise and vibration and pollution impacts all having the potential to disturb sensitive fauna here as well as degrade the habitats upon which the fauna depends.

15.6.74. Based on ariel imagery, the left bank road will cross numerous watercourses. Impacts associated with instream structures and downstream sedimentation have the potential to disturb downstream habitats.

15.6.75. It is assumed that construction activities will take place predominately within the spring/summer months, especially in relation to the left bank road. With this in mind, sensitive fauna of increased sensitivity will comprise roosting bats and nesting birds (other animals will be readily able to disperse).

Impact Assessment

Sensitive Habitats

15.6.76. The only habitat scoped in and potentially at risk of being adversely affected by construction activities is the juniper woodland in proximity to the left bank road. Here, dust produced during construction has the potential to degrade the juniper woodland through affecting the physiology and processes of the tree components, in particular the leaves and the photosynthesis that they undertake. Additionally, the dust may contain harmful compounds that can adversely affect the plant chemistry (e.g., as per Carr, 2021).

15.6.77. Given the sensitivity of the juniper woodland habitat, the potential impact of dust pollution has the potential to be an impact of **medium** magnitude, resulting in an effect that is **moderate** (significant), in the absence of demonstrable good practice from the contractors during construction.

Sensitive Fauna

15.6.78. It is assumed that most animals will be displaced as a result of construction activities and associated disturbance, which will reduce the mortality risk and potential for hunting/poaching; however, there may be animals that will not be able to relocate (such as roosting bats and the young of nesting birds), together with those that will be killed by vehicle movements. Roosting bats are known to be susceptible to disturbance from acoustic stimuli, with distances from which this impact is realised varying according to the source of disturbance (as per Reason & Wray 2023). Generally, distances of >30m are included when it comes to predicting disturbance impacts. With this in mind, the construction activities at the left bank road when in proximity of the juniper woodland in particular will represent a potential effect pathway.

15.6.79. This impact is considered likely to only affect a small proportion of those animals present (on a precautionary basis), with most able to relocate without any discernible medium/long-term impact. However, given the relative uncertainty over this (in particular in relation to the left bank road), the impact is considered to be **medium** infrequent, medium-term and local in nature, resulting in an adverse effect that is **minor** (not significant).

Additional Mitigation and Enhancement Measures

15.6.80. Mitigation is required to reduce effects to juniper woodland in proximity to the left bank road. Primarily, this mitigation will be achieved through the design process of the new road whereby the juniper woodland is avoided by at least 100m.

15.6.81. Other measures to minimise construction-related disturbance are included within **Volume 1, Chapter 8 (Air Quality)** and **Chapter 11 (Noise and Vibration)** of this ESIA. These are summarised below:

- Several bowsers water the road and dampen dust along many sections, but visual observation shows this is not entirely adequate and that further effort is required;
- Enforce a speed limit to reduce the dust generated by HGVs;
- Locate stationary machinery (i.e., pumps, compressor, concrete mixing, etc) away from noise-sensitive receptors;
- Start-up machinery and vehicles sequentially;
- Select plant and equipment that conforms to Directive 2000/14/EC (noise emission in the environment by equipment for use outdoors, or equivalent);
- Reversing alarms without tonal component (i.e., broadband);
- Undertake regular and effective maintenance for the construction machinery and any sound-reducing equipment;
- Install temporary acoustic enclosure for noisy equipment;
- Loading and unloading will be done away from noise-sensitive areas;
- Minimise drop height of materials; and
- Switch off equipment when it is not in use.

15.6.82. These measures will also serve to minimise impacts to sensitive fauna, as will general biodiversity measures prescribed within the BMP.

Residual Effects

15.6.83. The impact upon sensitive habitats will be reduced to **very small**, resulting in an effect that is **negligible** (not significant).

15.6.84. Effects to sensitive fauna will remain **minor** (not significant).

Release of pollutants into the river

15.6.85. Pollution into the water environment can derive from a number of sources during construction activities and can adversely affect freshwater biota and habitats, through changes in chemical, sediment or thermal conditions.

15.6.86. A release of pollutants will encompass deleterious substances, which when released into the river/lake would degrade or alter the water quality such that it could directly or indirectly harm fish, fish habitat, or the use of fish by humans, and includes petroleum products, chemicals, untreated wastewater, sediments, suspended solids and thermally altered water.

15.6.87. This risk is considered minimal at present, pending raising of the reservoir to inundate Construction Site 1, where most substandard fuel storage, sewage management, and concrete washing occurs. The migration of support activities to the new camps will lead to major improvements (in part through implementation of requirements of the new Contractor waste management plans based on the waste management frameworks) and the contaminated lands survey will allow identification of remedial actions that will be needed before the legacy areas are inundated.

Impact Assessment

15.6.88. A risk to water quality exists for the construction phase of the Rogun HPP. There are several potential impacts to water quality, including:

- Runoff from oils, lubricants, or other chemicals and substances associated with construction activities and vehicles/machines;
- Contamination arising from the use and storage of fuels and oils (hydrocarbons);
- Exposure of water to concrete, which may lead to changes in pH;
- Thermal pollution with cooler waters being released downstream from the Rogun HPP;
- Blasting, which may result in elevated peak pressures and the introduction of nitrate or nitrite from the use of explosives; and
- Wastewater discharge from construction camps and the workforce on site during construction.

15.6.89. The release of a pollutants into the river/reservoir would degrade or alter the water quality such that it could directly or indirectly have an impact on the ecosystem as a whole, harming fish, aquatic macroinvertebrates and their habitats.

15.6.90. The majority of construction activities are taking place within the confinements of the dam and not in direct contact with the river, reducing the potential for pollutants to be released directly into the river. Based on the scale of the Project, the impact is considered to be **medium**, local, short-term and reversible with an adverse effect that will be **moderate** (significant).

15.6.91. Additional Mitigation and Enhancement Measures

15.6.92. As outlined in **Volume 1, Chapter 13 (Water)** and **Volume 2, Annex 12.1 (Contaminated Land)** of this ESIA, Rogun JSC will be required to develop and implement management plans and mitigation measures to avoid and minimise construction-related disturbances related to water quality. These are summarised below:

- Sources of pollution and contamination during construction must be identified upfront and measures established to prevent any pollution into the river systems.
- Contractors shall direct runoff waters from drains and gullies from workshop areas through an interceptor prior to discharge into the river or to ground, allowing for the separation of free phase Light Non-Aqueous Phase Liquids (LNAPL) from water (significantly reducing the contaminant mass being lost to ground or surface water).
- Where workshops do not have a current drainage or gully system, the contractor shall ensure all runoff is contained, with all runoffs either being disposed/treated offsite, or onsite via interceptor (as a minimum).
- Additional treatment prior to discharge maybe necessary depending on the workshop activities and nature of any chemicals utilised.
- At 'general use' washout areas Rogun HPP shall establish an area where wash waters are contained and as a minimum undergo basic settlement prior to discharging to the river or reservoir.
- No refuelling or washing of equipment will take place within 30 m of a watercourse.

- Where contractors 'wash out' within their own compounds or facilities, each contractor shall contain and treat any wash waters prior to discharge. As with the general 'wash out' area as a minimum any wash waters shall undergo basic settlement prior to discharge.
- Ensure management plans, such as Sediment Management Plans, Borrow Pit Management Plans, as well as procedures on fuel storage and disposal of waste / hydrocarbons are developed.
- Contractors shall develop spill response/ cleanup plans.

Residual Effects

15.6.93. With the application of the above mitigation, the residual impact will be reduced to **small**, resulting a residual effect that is **minor** (not significant).

CURRENT HPP OPERATION AND MAINTENANCE

Entrainment and Impingement of fish through the turbines

15.6.94. The current operation of the existing Rogun HPP has the potential to result in physical injury and mortality of fish passing through the two turbines and associated components as water passes through the dam.

15.6.95. Entrainment occurs when a fish is drawn into a water intake and cannot escape, while impingement occurs when an entrapped fish is held in contact with the intake screen and is unable to free itself. Only fish within the local vicinity of the intakes would be exposed to this risk. With the high volume of water moving through the turbines, it is likely that fish would suffer entrainment and impingement.

Impact Assessment

15.6.96. No screening to exclude fish from entering the intakes and passing through the turbines is present at the moment. Barnthouse (2013), undertook a review of peer-reviewed literature and concluded that any impacts caused by impingement and entrainment are small compared to other impacts on fish populations and communities, including overfishing, habitat destruction, pollution, and invasive species. Further to this Kemp *et al* (2005) stated that fish that are good swimmers and exhibit behavioural avoidance when encountering velocity gradients (e.g., juvenile salmonids) are less susceptible to impingement. Based on the limited fish habitat around the intakes, and with no reports of dead fish downstream, the risk of fish mortality from entrainment or impingement during construction is considered **small**, and the resulting effect is **minor** (not significant).

Additional Mitigation and Enhancement Measures

15.6.97. As the turbines are already in place and operational, no further mitigation is possible.

Residual Effects

15.6.98. Under the current design, the residual effect from entrainment and impingement of fish through the turbines will remain **minor.**

Changes to downstream flow regimes

15.6.99. It is accepted that some effects from the existing dam structure have already been realised, notably the barrier effect, which was screened out as the impact has already occurred, and fish migration

has already been interrupted. The operation if the existing Rogun HPP has altered the natural flow regime of the Vakhsh River between the Rogun and Nurek Reservoir.

Impact Assessment

15.6.100. A risk to fish, aquatic biota (aquatic macroinvertebrates) and their habitats exists during the construction phase of the Rogun HPP as natural flows have been altered. Impacts resulting from the change in quantity and timing of flow may negatively impact biota within the downstream reach.

15.6.101. Under current operation, the average monthly streamflow exceeds the minimum environmental flows, and simulations presented in the **Volume 1, Chapter 13 (Water)** showed that the impact on the flows in the river reach downstream of Rogun Dam will not be significantly impacted by the dam during the filling period when compared to the inflows to the dam.

15.6.102. The Vakhsh River between the Rogun and Nurek Reservoir is a steep gorge with few tributaries that would provide refuge or upstream migration.

15.6.103. The change in quantity and timing of flow is constant and certain as the Rogun Dam is permanently in place and is currently operating. The magnitude of this impact for aquatic biodiversity is local and is considered to be **very small**. Having already assessed the effects of thermally altered water and the effect of pollutants impacting the aquatic ecology during construction, the change is considered to be **minor** (not significant).

Additional Mitigation and Enhancement Measures

15.6.104. As Rogun Dam is already in place and operational, and the minimum environmental flows for the Vakhsh River downstream of Rogun are being met, no further mitigation is required.

Residual Effects

15.6.105. Under the current operational configuration, the residual effect to Aquatic Biodiversity from changes to downstream flow regimes (within the Vakhsh River between the Rogun and Nurek Reservoir) will remain **minor.**

15.7 OPERATION

OPERATIONAL RESERVOIR REGIME INCLUDING ANNUAL DRAWDOWN (C. 30M) AND ASSOCIATED FACILITIES

Mortality/displacement of sensitive fauna from new roads and overhead transmission lines

15.7.1. The Project and associated facilities (see **Volume 1, Chapter 3 (Project Description)** of this ESIA) include a number of installations with the potential to cause direct mortality and displacement to sensitive fauna. In particular this relates to the following:

- Collision and electrocution risk to sensitive birds (both breeding and migratory birds) from the new overhead transmission lines – most notably the two planned 500kV lines (of 400km and 350km) connecting to Saikhun substation and Khujand substation, respectively).
- The 55km left bank road which will the Project site with a new major bridge over the new reservoir at Darband has the potential to result in collision mortality to sensitive fauna, as well as severance of local migration.

15.7.2. Collision mortality can pose a significant risk to bird populations where energy infrastructure is located within an area that birds (especially those in relatively large numbers) frequently fly through, either for seasonal migration or for local migration (i.e. to/from foraging and roosting areas). For the former, these locations are normally linked to topography (e.g. river valleys), where the landform funnels birds to create 'hotspots' of flight activity that if bisected by new energy infrastructure can result in significant collision mortality, especially in poor visibility. In the case of the latter, the flight activity is less topography-based and more reflective of the shortest distance between two key habitats, which if bisected by new energy infrastructure can also result in significant collision mortality.

15.7.3. The potential collision impact is largely influenced by species. Birds with larger body sizes and high wing loadings, birds flying in flocks and/or in low light, birds with limited visual capacity, birds distracted while engaged in hunting/breeding behaviours, younger and more inexperienced birds and migrants not familiar with the landscape may all be at increased collision risk. For example, swans and other large waterfowl are of particular concern for collisions (Taylor *et al.,* 2015 in SNH, 2016).

15.7.4. Electrocution is generally only a risk in low and medium voltage networks (Birdlife International, 2015), where bird wingspans are feasibly large-enough to span two points and create a short circuit.

15.7.5. The sensitive bird species identified as being present/potentially present across the AoI include those which will be at risk of impacts from these new installations, in particular larger birds with low manoeuvrability such as geese, swans, cranes and large raptors/vultures. There is nothing to suggest that the new overhead transmissions lines will extend across any areas of importance to significant migratory bird movements (e.g., those associated with the Central Asian Flyway, which is a broad north/south front and therefore parallel with the new overhead transmission lines, and for which most flight activity is east of Tajikistan). Localised movement of birds was observed incidentally when travelling to Rogin from Dushanbe.

15.7.6. There is one internationally recognised area (designated for birds) that appears to be located in proximity to the western of the two new overhead transmission lines - Kattasay and Daganasay Reservoirs KBA. This is designated for (amongst other things) it's importance as a stopover for migratory birds and is located at an elevation of 1165m asl.

15.7.7. The new left bank road introduces a new source of collision mortality impact in an area where vehicle movement is currently very limited (and generally at low speed). This has the potential to result in death of animals (most notably reptiles and mammals) moving between areas of previously connected habitats.

Impact Assessment

15.7.8. Given the scale of the new overhead transmission lines being planned, it is entirely feasible that their route will take them across areas within which at-risk bird species will be present and therefore a collision risk that effects the population a species of high sensitivity cannot be ruled out. With this in mind and impact that is **large** is considered appropriate, when applying the precautionary principle. No electrocution impacts beyond **small** are expected.

15.7.9. The overall effect to birds from collision risk is therefore considered to be **moderate** (significant).

15.7.10. The extent of impacts deriving from vehicle movements along the new left bank road (and other roads being constructed for the Project) will depend on several factors including the exact location of

new roads, together with the number of vehicles using the roads and the speed of vehicle movements. However, there isn't expected to be a level of vehicle movement that will result in any more than a **small** collision mortality impact, which will result in a **negligible** effect (not significant).

Additional Mitigation and Enhancement Measures

15.7.11. In order to mitigate the significant effect deriving from collision mortality, and acknowledging the separate baseline and assessment work that will be undertaken specific to the new overhead transmission lines, the following is recommended:

- The ESIA(s) for the associated facilities should include consideration of impacts to birds as a result of the new overhead transmission lines.
- The new overhead transmission lines should be designed to avoid potential flight activity hotspots, such as protected areas/internationally recognised areas, river valleys, ridge lines and wetlands. This should include routing at lower elevations and undergrounding where appropriate.
- Industry-standard flight divertors should be installed on new overhead transmission lines around any hotpots that cannot be avoided through the design process.
- Fatality monitoring should be undertaken at the locations where bird divertors are fitted (and elsewhere, depending upon ESIA findings) to monitor the effectiveness of this mitigation.
- Where fatality monitoring identifies a collision mortality impact greater than expected within the relevant ESIAs, then additional mitigation will be required, such as increased divertor installation.

15.7.12. These measures will be included within the BMP(s) for these ESIAs, with a commitment to them included within the ESCP for this Project.

Residual Effects

15.7.13. With the application of the above mitigation, the residual impact will be reduced to **small**, resulting a residual effect that is **minor** (not significant).

Release of pollutants into the river

15.7.14. Pollution into the water environment can derive from a number of sources during operation and can adversely affect freshwater biota and habitats, whether as a result of changes in chemical, sediment or thermal conditions.

Impact Assessment

15.7.15. During the operation of the Rogun HPP, it is unlikely that pollutants in the form of petroleum products, chemicals, untreated wastewater, sediments and suspended solids will be released into the lake/river that would have an effect to a regional extent.

15.7.16. Voith Hydro has confirmed that the governor sump tank, governor and ring gate accumulators will be enclosed in an oil "bund" (a surrounding wall) such that any oils spills and leaks are contained and do not enter the powerhouse drainage system. Furthermore, all generator bearings will be properly ventilated, and the oil vapour piped to the outside of the generator housing and condensed. The handling of waste oil will be in accordance with environmental standards.

15.7.17. Any spills would be contained locally and would be short in duration.

15.7.18. Under operational conditions the reservoirs may show thermal stratification during the summer months where there are high surface temperatures but colder temperatures at depth.

15.7.19. A slight increase to the current levels of thermal pollution has been identified as a risk to fish, relative to the current conditions. As the turbine intake structures are located below the surface, cooler water is likely to be released into the river downstream of the power plant (section of river between Rogun and Nurek). This impact has already been realised with the current turbines, but is expected to continue periodically as discharges from Rogun HPP change seasonally. During the low flow winter months, discharge will be higher than the natural flows. During the summer months flows will be reduced as water is stored in the reservoir to maintain the winter flows. The impact will decrease in magnitude as the thermal pollution dissipates into the Nurek Reservoir.

15.7.20. The magnitude of this impact for aquatic biodiversity is considered to be **small**. The effect of pollutants impacting the aquatic biodiversity during operation is considered to be **negligible** (not significant).

Mitigation and Enhancement Measures

15.7.21. As outlined in **Volume 1, Chapter 13 (Water)** and **Volume 2, Annex 12.1 (Contaminated Land)** of this ESIA, and similarly to the construction phase, Rogun JSC will be required to develop and implement management plans and mitigation measures to avoid and minimise incidents from occurring during operation.

15.7.22. Auditing and monitoring as outlined in the BMP will be implemented to identify any potential issues and or trends so that corrective measures can be implemented early on.

Residual Effects

15.7.23. With the application of regular audits and monitoring as well as the implementation of management plans and mitigation measures, the residual impact can be reduced to **very small**, resulting a residual effect that is **negligible** (not significant).

Entrainment and Impingement of fish through the turbines

15.7.24. The operation if the Rogun HPP will include an additional four turbines, which will have the potential to result in physical injury and mortality of fish passing through the turbines and associated components as water passes through the dam.

Impact Assessment

15.7.25. No screening to exclude fish from entering the intakes and passing through the turbines is planned for the additional four turbines. Based on the fisheries information obtained from the Nurek Reservoir, studies showed that after the filling phase (oligotrophic), most fish species disappeared and none of the species still present are found in substantial numbers (ESIA 2014); additionally, no Critical Habitat for fish species has been identified upstream of Rogun. It is therefore assumed that Rogun will respond in a similar manner and after filling will have a low diversity and abundance of fish, thus reducing the risk of frequent entrainment or impingement. With this in mind, and as stated in **Section 15.6.96**, the risk of fish mortality from entrainment or impingement during operation is **small**, the resulting effect is **minor** (not significant).

Mitigation and Enhancement Measures

15.7.26. No additional mitigation measures are required as during operations, entrainment and impingement of fish through the turbines is considered not significant.

Residual Effects

15.7.27. Under the current design, the residual effect from entrainment and impingement of fish through the turbines will remain **minor.**

Changes to downstream flow regimes

15.7.28. The operation of the completed Rogun HPP will include four additional turbines and will further alter the natural flow regime of the Vakhsh River between the Rogun and Nurek Reservoir.

Impact Assessment

15.7.29. A risk to fish, aquatic biota (aquatic macroinvertebrates) and their habitats exists during the operation phase of the Rogun HPP as the reservoir is managed to regulate water levels within the Nurek Reservoir. Impacts resulting from the change in quantity and timing of flow may negatively impact biota within the downstream reach.

15.7.30. The simulations presented in **Volume 1, Chapter 13 (Water**) showed that during operations, the flow pattern in the river reach between the Rogun and Nurek Reservoirs will be altered due to the HPP operating rules. The flows released from Rogun Reservoir during the summer months will be reduced as water is stored in the reservoir to maintain the winter flows. The overall inflow volume to the reservoir is released but the release pattern is different with flow from the high summer flows released during the winter. The winter flows will be higher and less variable due to the energy generation requirements.

15.7.31. The minimum flows required for energy generation are sufficient to meet the environmental flow requirements presented in **Volume 1, Chapter 13 (Water)** of this ESIA.

15.7.32. The change in quantity and timing of flow is constant and certain as the Rogun HPP will be permanently in place. Considering the environmental flows will be met as part of the operating rules, the magnitude of this impact for aquatic biodiversity is local and is considered to be **very small**. Having already assessed the effects of thermally altered water and the effect of pollutants impacting the aquatic biodiversity, the change is considered to be **negligible**(not significant).

Mitigation and Enhancement Measures

15.7.33. No additional mitigation measures are required as during operations, release of water is sufficient to meet the environmental flow requirements.

Residual Effects

15.7.34. The magnitude of this impact for aquatic biodiversity remains **negligible** (not significant)

RESERVOIR AT FSL

Impacts from Increased Human Pressures

15.7.35. The new reservoir in the landscape has the potential to displace people/communities into areas which are currently not affected by human pressures, which may result in an increase in activities which damage resident plants/habitats and animals there. However, it is also acknowledged that the general population within the local area has been/will be reduced as a result of resettlement activities.

Impact Assessment

Sensitive Habitats

15.7.36. The creation of a large reservoir within the landscape will displace people from the flooding zone, potentially increasing use of the areas around/within the juniper woodland for grazing, foraging and other ecosystem services. It is unlikely that there will be a material increase in the collection of firewood based on current levels of firewood collection as well as the reduced access to this location given the bridges and paths/rough tracks that will be lost within the flooding zone, together with the general reduction in the local population (in close proximity to the flooding zone). Furthermore, given this loss of access, it is likely that livestock movement will be displaced altogether from the area immediately adjacent to the woodland here. While permanent, loss of woodland to tree clearance and grazing as a result of increased human pressures is considered to be reversible and **small**, on a precautionary basis, resulting in an adverse effect that is **minor** (not significant).

Sensitive Fauna

15.7.37. With regards fish, the large new waterbody is expected to attract people into the area, increasing the harvesting of fish during the initial productive years.

15.7.38. In accordance with Article 25 of the Law of the Republic of Tajikistan (About fish breeding, fisheries and about protection of fish resources), there is a restriction on catching species listed as being rare and or under the threat of disappearing. Furthermore, Article 63 (Protection of rare plants and animals that are in danger of extinction) outlines that species listed in the TRB are protected and thus are prohibited from being captured as this would be an activity that would reduce the population.

15.7.39. Much like it has been documented and observed at the Nurek Reservoir, it is likely that the targeted species will be those that are introduced or common, such as carp and marinka. As detailed in **Volume 2, Annex 15.1 (Critical Habitat Assessment),** no Critical Habitat for fish species has been identified upstream of Rogun. Therefore, the impact to the sensitive receptor will be **small**, resulting in a maximum **minor** effect (not significant).

Mitigation and Enhancement Measures

15.7.40. The mitigation described within **15.6.23** will extend across an area sufficient to deliver NNL for any additional, limited losses to juniper woodland as a result of increased human pressures.

Residual Effects

15.7.41. Implementation of the additional measures will reduce the impact of increased human pressures to juniper woodland to **very small**, resulting in a **negligible effect** (not significant).

15.7.42. The residual effect to Aquatic Biodiversity (fish) from increased human pressure will remain **minor.**

Change in habitat composition

15.7.43. A new reservoir in the landscape is a change in habitat composition with respect to the existing river and the surrounding terrestrial habitats and will be an impact that materializes incrementally (although is considered here at FSL). This will adversely affect those species currently reliant upon lotic conditions but has the potential to benefit other species that are attracted to lentic habitats.

15.7.44. Regarding terrestrial species, the change in habitat composition has the potential to permanently benefit those species that make use of riparian/marginal habitats (such as otters, species of foraging bats that utilise such habitats – e.g. Savi's pipistrelle), which are known to be present within the Vakhsh River system.

Impact Assessment

Sensitive Fauna

15.7.45. The reservoir will offer a more stable environment for foraging animals (even when considered seasonal level fluctuations, when compared to the current meltwater fed Vakhsh system here), and will also significantly increase the freshwater resource, meaning that the AoI has the potential to support a greater number of otters territories when considered from a spatial perspective. However, reservoirs can offer suboptimal habitat conditions for otters when considering other environmental factors (Basto *et al.* 2011), especially when compared with the pre-reservoir watercourse habitat (Pedroso and Santos-Reis 2012), especially those with predominately deep water, which the species tends to avoid (Melissen 2000); at the same time, studies have also shown that reservoirs can offer more favourable conditions to the species in areas with pronounced water level fluctuations (Pedroso and Santos-Reis 2012). With this in mind, it is feasible that the upstream reservoir extents, where conditions will be shallower, will end up supporting a larger otter population, although given the recognised uncertainty discussed (and also limited current plans for ongoing/future fisheries management of the new reservoir), it is therefore more appropriate to conclude an impact that is **beneficial** to **very small** adverse and therefore a **negligible** effect in respect of this impact, with the current small otter population unlikely to be reduced.

15.7.46. Depending upon the terrestrial habitat being submerged, new reservoir habitats in the landscapes can support a greater diversity of bird species than the pre-flooding baseline (e.g. Bohada-Murillo *et al.* 2023). Nidup and Dorji (2024) in their study impacts from the Kurichu Dam, Bhutan identified increased avian diversity in the new reservoir, in particular for lentic species, while Nasruddin-Roshidi *et al.* (2021) in a study of a Malaysian hydropower project reported increasing species richness following a decrease associated with clearance of forest habitat (again, the relative importance of the pre-flooding habit is a key consideration here, with this example being a habitat that supports a far richer bird assemblage than is currently present within the Rogun flooding zone), although it is accepted that this will likely include many common, pioneer species. It is reasonable to assume that species with a preference for lentic systems (such as osprey, pochard and other waterfowl) may benefit from the new waterbody in the landscape, while species with a preference for lotic systems such as white-capped water redstart will likely be adversely impacted. Given the relatively uncertainty over how local bird populations will react to the new reservoir in the landscape and when considering this assemblage as a whole, it is therefore more appropriate to conclude a neutral effect in respect of this impact.

15.7.47. With all the above in mind, it is feasible that any loss in stopover resource will be offset by the increased resource provided by the new reservoir, as well as the potential benefits that may arise to the wider bird assemblage. The overall impact is therefore predicted to be permanent and irreversible, and **very small**. This will result in an effect that is **negligible** (not significant).

Aquatic habitats

15.7.48. The construction of the Rogun Reservoir will result in a change in habitat from a river system (lotic) to a lake (lentic), resulting in changes to flow, water depth, water temperature and subsequently

species composition, making this a permeant change that is certain and irreversible. Due to the similarities with Nurek, the evolution of this change (approximately 16 years) is expected to be similar, resulting in a low productivity, oligotrophic lake system once the reservoir has reached its full supply level. The difference will be that species within Rogun will have access to upstream habitats and tributaries.

15.7.49. Rheophilic species that favour fast flowing waters and shallow rocky areas will likely be displaced and therefore an adverse effect is predicted; this applies to Turkestan Catfish (the species' population is considered stable and expected to occur in more than 2000 km of river and many more than 10 populations (Karimov, 2020)).

15.7.50. The first two years after completion of the Nurek Reservoir (the filling phase), the waters were considered relatively sterile, with very low nutrient content (ESIA, 2014). As the reservoir continued to fill, the surrounding vegetated landscape became inundated, increasing the nutrient content of the water. These nutrients promoted the growth of algae (phytoplankton) and zooplankton, which formed the basis of a food web, and supported the growth of fish within the reservoir (ESIA, 2014).

15.7.51. Once the reservoir had reached its full supply level, the input of organic materials from upstream was not enough to maintain a productive ecosystem, and many of the fish species within the reservoir disappeared. This cycle was demonstrated by the introduction of Northern Whitefish (Peled) at the beginning of the filling phase. Northern Whitefish is a pelagic plankton feeder that flourished during the first few years after introduction but ceased to exist once the reservoir reached full supply level due to a lack of nutrient inputs. Various species of trout and carp were also introduced with limited success (ESIA, 2014).

15.7.52. Similar to fish, the change in habitat will affect different aquatic macroinvertebrates in different ways. For example, the Trichoptera (caddisflies) and Ephemeroptera (mayflies) species recorded that prefer fast flowing riffle habitats will be negatively impacted, while species such as Hemiptera (bugs) and Coleoptera (beetles) may thrive. Field sampling and eDNA analysis found that Diptera (flies) dominated the aquatic macroinvertebrate community, with non-biting midges (Chironomidae) most widely spread and abundant through the AoI.

15.7.53. The magnitude of this impact for aquatic biodiversity in the landscape is considered to be **large** and the adverse effect is considered to be **moderate** (significant), with approximately 80 km of river (less than 15%) lost upstream of the Rogun Dam. The Vakhsh River (main channel) extends a further 460 km upstream from the Rogun Dam to its headwaters in the Pamirs Mountains.

15.7.54. The change in flows between Rogun and Nurek have been considered under 'Changes to downstream flow regimes'.

Mitigation and Enhancement Measures

15.7.55. No additional mitigation measures are possible given that the habitat change will be a permanent component of the Project.

Residual Effects

15.7.56. As a maximum, the residual effects from a change in habitat composition will remain **moderate** (in relation to aquatic biodiversity).

Loss of tributaries and short-range migration

15.7.57. The Project will result in the loss of access to tributaries and the ability for fish to undertake short-range migration.

15.7.58. Fish migration into the tributaries of the Vakhsh River will be limited as a result of the gradient, however the lower portions of these inlets are considered to be important for fish as refuge areas off the main channel, as they offer clear, cooler waters and are often used for spawning. Further to the tributaries impacted by the inundation, this assessment also includes the tributaries downstream between Rogun and Nurek, as well as littoral habitats that will be impacted by the fluctuating water levels.

15.7.59. Operating the Rogun HPP will result in water level fluctuations in the reservoir, leading to shoreline displacement and loss of a productive littoral zone, potentially resulting in sediment deposition and inaccessibility. Simulated water levels in the Nurek and Rogun Reservoirs show the variation of the water levels due to the regulation of the discharges from the HPP to meet the operating rule (**Volume 1, Chapter 13 (Water**)).

15.7.60. The extent of the littoral zone is regulated by the water level and is of disproportionate importance to the food web in Lakes (Hirsch, *et.al*., 2014). The freshwater littoral zone is the area near the shore characterized by submerged, floating, or emergent vegetation and is driven by the presence of sunlight at the sediment level (BD Editors, 2017). Littoral plants and algae account for a major part of the primary production of lakes and are particularly important in clear high-altitude lakes with low nutrient concentration (Hirsch, *et.al*., 2014). Therefore, any regular and extreme changes in water levels are likely to have an adverse effect on ecosystem processes because it affects the littoral zone.

15.7.61. The extent of the loss of tributaries and short-range migration as a result of the project will be limited to the Project AoI affected by the inundation and/or downstream fluctuations in flow.

Impact Assessment

15.7.62. Given that inundation is inevitable and the reservoir will be permanent, the loss of tributaries and associated short-term migration is considered **medium.** No Critical Habitat for fish species or aquatic macroinvertebrates has been identified upstream of Rogun. Despite these tributaries continuing to discharge into the lake, the fluctuating water level as a result of HPP operating rules will likely reduce the refuge potential in the lower portions of these inlets potentially resulting in deposition of sediments and inaccessibility. A site visit to the Nurek Reservoir provided an example of how the shoreline may look, with a barren littoral zone resulting from the fluctuating water levels. To be conservative, the inundation effect of these habitats is likely to be **moderate** (significant) for aquatic biodiversity because of the number of tributaries that will be affected.

Mitigation and Enhancement Measures

15.7.63. No additional mitigation measures have been identified as HPP peaking will occur, and downstream discharges are already occurring.

Residual Effects

15.7.64. The residual effect to aquatic biodiversity from the loss of tributaries and short-range migration will remain **moderate.**

15.8 TRANSBOUNDARY EFFECTS

TERRESTRIAL BIODIVERSITY

15.8.1. No transboundary effects upon terrestrial biodiversity have been identified. The only receptor for which transboundary effects have been considered is migratory birds, whose conservation is often dependent upon suitable habitat/features being maintained across a number of countries. No significant adverse effects were identified for migrating birds and therefore transboundary effects are not considered any further.

AQUATIC BIODIVERSITY

15.8.2. No transboundary effects upon aquatic biodiversity have been identified. The cumulative impact assessment concluded that Rogun may have added to a small extent to a further reduction in short-range fish migrations from Nurek reservoir upstream. Other than that, the situation in the downstream area, especially concerning Tigrovaya Balka and fish migrations, will not be changed due to Rogun.

15.8.3. As per **Volume 1, Chapter 13 (Water)** the flows downstream from Nurek are not significantly impacted by Rogun and the proposed operating rule. The flows during the winter months will be less variable with Rogun in place when compared to the releases from Nurek without Rogun. The total volume of water released from the Nurek Reservoir is the same as the total volume flowing into the Rogun reservoir. The reservoir and the HPP operating rule, changes the pattern of flow. The minimum flows required for energy generation are met which are sufficient to meet the environmental flow requirements and current irrigation demands.

15.8.4. The construction of the Project is therefore not expected to have any further adverse transboundary effects on aquatic biodiversity.

15.9 MITIGATION AND ENHANCEMENT MEASURES

15.9.1. Mitigation and enhancement will be secured through adoption and implementation of a **Biodiversity Management Plan** (BMP – see **Volume 3, A4** of this ESIA).

15.9.2. As part of delivery of the BMP, a Biodiversity Constraints Tracker (BCT) will be produced to facilitate timely implementation of each required action. The BCT will list all known and emerging biodiversity constraints together with actions required to ensure ongoing protection and compliance with the BMP. It will be a simple tracker tool that will be managed by the Lead ECoW to help programme all elements of the BMP delivery; as such, it will need to be regularly updated with Project programme details (such clearance programming, construction activities outside of the HPP site, inundation progress, etc.). The BCT will also serve as a useful auditing tool, demonstrating how the requirements of the BMP have been delivered.

15.9.3. Mitigation and enhancement measures are split into two separate categories: those that are required to address specific effects identified for a particular receptor as included within **section 15.6** and **15.7**; and those which will reduce effects to multiple receptors, as well as ensuring biodiversity losses are reduced and animal welfare measures and general environmental good practice is adhered to (detailed within this section).

15.9.4. A Lead Ecological Clerk of Works (ECoW) (or similar title) will be employed to support Rogun JSC and DFZ to provide biodiversity support in advance of, and throughout project construction/operation (as defined within this Chapter); given the scale of the Project. The scope of the Lead ECoW role

will vary, depending on programme activities, but will be responsible for ensuring the requirements of the BMP are delivered and to facilitate proactive biodiversity protection during construction activities (including any clearance activities within the flooding zone).

15.9.5. Given the scale of the Project the Lead ECoW should possess at least 10 years of experience of supervision of larger infrastructure projects and have demonstrable experience of working in Central Asia. The Lead ECoW will forecast the need for and be responsible for the recruiting and management of a ECoW Support Team who collectively will deliver ECoW supervision at peaks of requirement. It is anticipated that the Lead ECoW will be a permanent position throughout Construction and into the first three years of Operation. The Lead ECoW will determine and consult with other specialists (such as botanists, bat experts, ornithologists, etc.) as required depending on the mitigation being delivered. The Lead ECoW will need to be supported by a ring-fenced budget for the duration of ECoW services.

PRE-CONSTRUCTION WALKOVERS

15.9.6. In order that the mitigation strategy is fully informed and to ensure ongoing validity of important biodiversity baseline information in line with GIIP (data are generally considered valid for up to between 12-18 months (as per CIEEM 2019)), additional pre-construction survey effort will be required. This requirement reflects the staggered time over which impacts will occur (as per the reservoir inundation by year level table within **Volume 1, Chapter 3 (Project Description)** of this ESIA), and effects will be realised. Some of these walkovers will also inform receptor-specific mitigation measures but these walkover surveys will primarily focus on:

- Floodplain habitat – to fully inform compensation measures for this habitat, as part of the NNLF.
- Juniper woodland habitat – as above for floodplain habitat, as part of the NNLF.
- Pre-clearance biodiversity walkovers of areas where vegetation clearance will be needed, including (but not limited to): pre-clearance of the juniper woodland within the maximum flooding zone; Forestry Agency land-clearing in advance of pre-inundation land-clearing; and DFZ contractor land-clearing in advance of construction of the left bank road and new infrastructure as part of the resettlement program. Walkovers will focus on identifying nesting birds and roosting bats/bat roosts.
- Flooding zone walkovers of suitable habitat for target species of reptile and TRB plants.
- Surveys of suitable bat roost features – to inform ongoing mitigation for this receptor in light of recognised limitations to the baseline data collection for this species group.
- Walkover of areas outside the flooding zone to identify ‘receptor’ sites for the translocation of TRB flora species.

15.9.7. The timing of these walkovers is summarized in **Table 15-5**. Findings from these surveys will be added from existing baseline information to the BCT and schedule of mitigation and will be used to update the BMP. The BMP will remain a ‘live’ document throughout its implementation.

Table 15-5 – Preconstruction Walkover – Indicative Schedule

Receptor	Walkover timing	Notes
Floodplain habitat Juniper woodland habitat	May-August 2025/26	Findings to be incorporated into updated BMP (NNLF) reporting.
Nesting birds	May-August of the year preceding the clearance activity	This walkover is only required if clearance activities are due to take place within the nesting bird season.
TRB plants receptor sites	May-August 2025	-
Reptiles to be relocated	April/May annually until maximum inundation	Within pre-defined areas of land that will be flooded (or cleared, in the case of the left bank road and resettlement sites) within the following six months.
TRB Plants to be relocated	May-August 2025-27 inclusive	Within pre-defined areas of land that will be flooded (or cleared, in the case of the left bank road and resettlement sites) within the following 12 months.
Bat roosts	April-October annually until maximum inundation	Within pre-defined areas of land that will be flooded (or cleared, in the case of the left bank road and resettlement sites) within the following 12 months.

15.9.8. Further detail regarding these walkovers is provided throughout subsequent sections.

15.10 GENERAL BIODIVERSITY

15.10.1. Construction activities will be timed to avoid the breeding bird season where possible. This will be informed by pre-construction walkovers and at present is considered most applicable to areas where tree/scrub vegetation clearance will be undertaken. Concurrent with this, the ECoW will conduct walkovers of ongoing and near-future DFZ areas that are designated for clearance, with the Forestry Agency and construction contractor land-clearing representatives; in particular in locations where there is potential to harm nesting birds, other wildlife and sensitive flora through ground and vegetation clearance. The frequency of these walkovers will be informed by DFZ site clearance programmes, with walkovers completed no later than one-month in advance of all planned clearance activities or at the discretion of the ECoW. It is expected that this will only be required for areas where clearance of more natural vegetation and other habitat features is planned.

15.10.2. The Lead ECoW will undertake/manage pre-works checks of suitable areas and advise on mitigation to protect any bird nests identified. Specifically, this will comprise avoidance of known nest sites or areas of suitable nesting habitat being excluded until such point that the young birds have fledged the nest (or the nest has failed for natural reasons). To help minimise the impact of this measure upon the overall construction programme where works cannot avoid this period, necessary vegetation clearance shall take place in advance of works and outside the breeding bird season so that habitat suitability is reduced, and birds are dissuaded from nesting in these areas during construction.

15.10.3. The ECoW will upskill Forestry Agency staff in identifying and removing animals such as reptiles and amphibians which may not be able to disperse quickly enough and would therefore be at risk of mortality during Forestry Agency clearance activities. This will be done as part of the toolbox talks that the Lead ECoW will regularly undertake. Any such animals will be moved to nearby suitable habitat identified through pre-construction walkovers.

15.10.4. An important component of the pre-construction survey will be management of Bathurst burr spread during construction and operation (flooding), and identification of any new invasive plant species in the area. An Invasive Species Management Plan (ISMP) will be produced which will detail measures to be adopted to stop the spread of such species along the construction corridor and across the flooding zone, in particular around/within the juniper woodland habitat. This Plan will be delivered as a requirement of the BMP and will be produced prior to flooding at 1150m asl (timing to be determined – see **Volume 1, Chapter 3 (Project Description)** of this ESIA. This will allow time to implement any proactive measures required.

15.10.5. The ECoW will deliver a series of 'toolbox talks', including site inductions, to relevant Forestry Agency staff, DFZ construction workers and supervisors to raise awareness of particular ecological issues. This will include, but is not limited to:

- Ecological exclusion zones and working around features of increased ecological sensitivity (e.g. nesting birds, mammal burrows, reptile hibernacula, watercourses, etc.);
- Construction site good practice (e.g. keeping the construction site safe for wildlife when not in use; covering excavations, sensitive use of lighting, etc.);
- How to recognise particular animal or plant species (including invasive species) or groups;
- What to do if particular animal or plant species are encountered; and
- Awareness-raising in relation to hunting/poaching of sensitive fauna, and prohibition in the construction workers Code of Conduct, as required in the ESMP.

15.10.6. The ECoW will also undertake ad hoc monitoring of relevant works areas to check implementation of toolbox talk content.

COMPLEMENTARY MEASURES

15.10.7. There is the potential for a beneficial impact to habitats across the Project through the planting plans that will be delivered as part of site rehabilitation (see **Volume 3, Site Rehabilitation Plan)**. Planting will comprise native species of local or regional provenance and will be informed by inputs from the ECoW with additional specialist inputs sourced as required, such as from botanical expert. Similarly, there will be planting required to assist with slope stabilisation and to prevent or minimise soil erosion, which is described in **Volume 1 Chapter 12 (Geology and Soils)** of this ESIA. As above,

this planting will comprise native species of local or regional provenance and planting plans will include inputs from the Project ECoW to ensure species composition is of optimal value to biodiversity while remaining cognisant of its primary function.

15.10.8. Of particular potential benefit from planting plans required to provide soil stabilisation will be creation of woodland/scrub habitat adjacent to the reservoir that will provide a nesting and roosting resource for birds and bats, respectively as well as shelter for other species that currently use the riparian corridor, such as otter. Similarly, the increased habitat structure and heterogeneity that will be created will improve conditions for foraging by these species, in particular insectivorous bats given the greater abundance of insects supported in woodland habitats compared to unwooded areas.

15.11 MONITORING

15.11.1. An appropriate monitoring programme will be a critical component in ensuring the ongoing success of mitigation described above. Monitoring has been referenced within the above sections and has been detailed more specifically within BMP. Monitoring requirements and methods shall be reviewed and updated periodically, e.g. on an annual basis, to ensure they are still fit for purpose. The overall monitoring commitment should be partnered with the Project capacity building objective, with the Project identifying individuals to be increasingly involved on the Project's biodiversity monitoring, through a training and mentoring programme overseen and managed by the ECoW.

15.12 SUMMARY

Table 15-6 – Summary of Biodiversity Impacts (Construction)

Impact	Loss/degradation of habitats			Direct mortality & drowning	Encroachment / Introduction of invasive species			Habitat degradation/disturbance/killing of fauna etc.
Receptor	Sensitive habitats	Sensitive flora	Sensitive fauna	Sensitive fauna	Sensitive habitats	Sensitive flora	Aquatic biodiversity - fish	Sensitive habitats
Receptor sensitivity	Medium	Medium	Medium to High	Low	Medium	Medium	Medium to High	Medium
Frequency	Constant	Constant	Constant	Single event	Infrequent	Infrequent	Infrequent	Periodic
Likelihood	Certain	Unlikely	Unlikely	Likely	Unlikely	Unlikely	Unlikely	Likely
Extent	Local	Local	Local	Local	Local	Local	Local	Local
Duration	Permanent	Permanent	Permanent	Short-term	Medium-term	Medium-term	Medium-term	Short-term
Magnitude	Medium to Large	Small to Large	Small to Medium	Medium	Large	Small	Small	Medium

Impact	Loss/degradation of habitats			Direct mortality & drowning	Encroachment / Introduction of invasive species			Habitat degradation/disturbance/killing of fauna etc.
Effect	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse
Direct / Indirect	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct
Significance	Moderate to Major	Minor to Major	Negligible to Minor	Minor	Major	Minor	Minor	Moderate
Additional Mitigation (Y/N)	Y	Y	Y	Y	Y	Y	N	Y
Residual Significance	Negligible	Minor to Moderate	Negligible	Negligible	Negligible	Negligible (incidentally)	Minor	Negligible

Impact	Habitat degradation/disturbance/killing of fauna etc.	Release of pollutants into the river	Entrainment and Impingement of fish through the turbines	Changes to downstream flow regimes
Receptor	Sensitive fauna	Aquatic biodiversity	Aquatic biodiversity – fish	Aquatic biodiversity
Receptor sensitivity	Low	Low to High	Medium	Low to High
Frequency	Infrequent	Infrequent	Infrequent	Constant
Likelihood	Certain	Probable	Unlikely	Certain
Extent	Local	Local	Local	Local
Duration	Medium-term	Short-term	Permanent	Permanent
Magnitude	Medium	Medium	Small	Very small
Effect	Adverse	Adverse	Adverse	Adverse
Direct / Indirect	Direct	Direct	Direct	Direct
Significance	Minor	Moderate	Minor	Minor
Additional Mitigation (Y/N)	Y	Y	N	N
Residual Significance	Negligible	Minor	Minor	Minor

Table 15-7 – Summary of Biodiversity Impacts (Operation)

Impact	Mortality/displacement of sensitive fauna	Release of pollutants into the river	Entrainment and Impingement of fish through the turbines	Changes to downstream flow regimes	Impacts from increased human pressures	
Receptor	Sensitive fauna	Aquatic biodiversity	Aquatic biodiversity - fish	Aquatic biodiversity	Sensitive habitats	Sensitive fauna
Receptor sensitivity	Low	Low to High	Medium	Low to High	Minor	Medium
Frequency	Periodic	Periodic	Infrequent	Constant	Infrequent	Infrequent
Likelihood	Unlikely	Probable	Unlikely	Certain	Unlikely	Unlikely
Extent	Local	Local	Local	Local	Local	Local
Duration	Permanent	Short-term	Long-term	Permanent	Permanent	Permanent
Magnitude	Small to Large	Small	Small	Very small	Small	Small
Effect	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse
Direct / Indirect	Direct	Direct	Direct	Direct	Direct	Direct
Significance	Negligible to Moderate	Negligible to Moderate	Minor	Negligible to Minor	Minor	Minor
Additional Mitigation (Y/N)	Y	Y	N	N	Y	N
Residual Significance	Negligible	Negligible to Minor	Minor	Negligible to Minor	Negligible	Minor

Impact	Change in habitat composition		Loss of tributaries and short-range migration
Receptor	Sensitive fauna	Aquatic biodiversity	Aquatic biodiversity
Receptor sensitivity	Low	Low to High	Medium
Frequency	Single event	Single event	Single event
Likelihood	Certain	Certain	Certain
Extent	Local	Local	Local
Duration	Permanent	Permanent	Permanent
Magnitude	Very small	Large	Medium
Effect	Adverse	Adverse	Adverse
Direct / Indirect	Direct	Direct	Direct
Significance	Negligible	Moderate	Moderate
Additional Mitigation (Y/N)	N	N	N
Residual Significance	Negligible	Moderate	Moderate

PUBLIC

JSC “Rogun HPP”

State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT - UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Chapter 16: Ecosystem Services



MAY 2025

PUBLIC

PUBLIC

PROJECT NUMBER

PROJECT REF

DATE: MAY 2025

QUALITY CONTROL

LIST OF ACRONYMS AND ABBREVIATIONS

Term	Definition
AoI	Area of Influence
BMP	Biodiversity Management Plan
CHMP	Cultural Heritage Management Plan
ESIA	Environmental and Social Impact Assessment
ESS	Environmental and Social Standard
LRP	Livelihood Restoration Plan
RAP	Resettlement Action Plan
RLRF	Resettlement and Livelihood Restoration Framework
WRI	World Resource Institute

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16 ECOSYSTEM SERVICES

16.1.1. This chapter presents the impact assessment for Ecosystems Services for the Project. Ecosystems Services impacts are described in **Section 16.4** using the assessment methodology described in **Chapter 5.** A summary of the results of the impact assessment is presented in **Section 16.7**.

16.1.2. This chapter is organized as follows:

- Legislative Framework, Policy And Guidance
- Assessment Methodology
- Potential Impacts and Effects
- Mitigation Measures
- Residual Effects
- Summary

16.2 LEGISLATIVE FRAMEWORK, POLICY AND GUIDANCE

16.2.1. This chapter follows the same international guidance as the **Chapter 15** of this ESIA, namely:

- World Bank, 2018. Environmental and Social Standard (ESS) 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- European Investment Bank, 2018. Environmental and Social Standards: Guidance Note for Standard 3 on Biodiversity and Ecosystem;
- Asian Infrastructure Investment Bank, 2024. Environmental and Social Framework: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- Asian Development Bank, 2009. Safeguard Policy Statement: Biodiversity Conservation and Sustainable Natural Resource Management.

16.3 ASSESSMENT METHODOLOGY

16.3.1. The spatial scope of the assessment includes the Project area and Area of Influence (AoI) and the temporal scope includes the Project construction and operational phases.

16.3.2. Ecosystem services are the benefits that the natural environment provides to people. As per the WRI guidance, these can be categorised as:

- **Provisioning services:** the goods or products obtained from ecosystems;
- **Regulating services**: the contributions to human well-being arising from an ecosystem's control of natural processes;
- **Cultural services**: the non-material contributions of ecosystems to human well-being; and
- **Supporting services**: the natural processes that maintain other ecosystem services.

16.3.3. The ecosystem services assessment is informed by the process outlined by WRI's guidance: World Resource Institute (WRI), 2013. Weaving Ecosystem Services into Impact Assessment. The approach follows six steps:

- Step 1: Identify relevant ecosystem services (scoping stage);
- Step 2: Prioritize relevant ecosystem services (start of the baseline and impact analysis stage);

- Step 3: Define the scope and information needs of the ecosystem services assessment;
- Step 4: Establish the baseline for priority ecosystem services;
- Step 5: Assess project impacts on priority ecosystem services; (end of the baseline and impact analysis stage); and
- Step 6: Mitigate impacts of the project on priority ecosystem services (mitigation stage).

ASSUMPTIONS AND LIMITATIONS

16.3.4. This is assessment complements the Biodiversity and Social assessment. Its aim is to provide a general overview of ecosystem services that are likely to be impacted by the project and demonstrate the link between biodiversity and social impacts.

16.3.5. This assessment was applied retrospectively. The analysis is based on pre-existing data; primary data was not collected for the purpose of the ecosystem services assessment.

16.3.6. In light of these characteristics:

- The assessment comprehensively investigates provisioning, regulating, cultural and supporting ecosystem services and identifies those that are key to the Project.
- To manage uncertainty, which is a known limitation of a high-level and retrospective assessment, the precautionary approach has been applied to the extent that it was deemed appropriate based on professional opinion and experience. The precautionary approach is recommended by ESS6 and follows the principle of, where there is a lack of information, a cautious scenario is applied. In the case of this ESIA, this means that where there is potential for an adverse impact but there is uncertainty regarding the impact likelihood or the significance of the consequence, a significant adverse impact should be assumed and the mitigation should address a significant impact.

BASELINE ASSESSMENT

16.3.7. The findings of the baseline studies are presented in the **Annex 7.1: Environmental and Baseline Conditions Report**. The Baseline Report also includes gender considerations (**section 11.3**).

16.3.8. The baseline data was collected from:

- Previous ESIA documentation;
- Information from other technical workstreams, specifically **Chapter 15: Biodiversity**, **Chapter 17: Socio-economics** and **Chapter 20: Cultural Heritage.** This information includes the primary data from field surveys and stakeholder engagement for these assessments. Further details regarding the baseline data collection exercise are provided within the **Chapter 15** and **Chapter 17** of this ESIA.
- Academic literature and other documentation available online.

16.3.9. Data was interpreted to describe ecosystem services across the Project's AoI to understand the socio-economic impact on communities across the wider study area.

16.3.10. Ecosystem services can be identified with an appropriate level of confidence through a desktop study, since certain natural features (i.e. receptors) are known to provide specific types of ecosystem services. Primary data, collected predominantly through the Social and Biodiversity Technical workstreams, confirmed the presence of most ecosystem services.

16.3.11. For ecosystem services which are only potentially present, we have applied the precautionary approach which should be applied as recommended by ESS6 (see definition in **paragraph 16.3.6**).

16.3.12. The identification of ecosystem services followed the methodology outlined by the document developed by the World Resource Institute (WRI) in 2013: *Weaving Ecosystem Services Into Impact Assessment*. This involved identifying the main ecosystem and habitat types, protected or important areas and species, and key abiotic resources (e.g., watercourses, geological features); then refining the possible ecosystem services produced by these elements and used by local or global beneficiaries or the Project.

16.3.13. A list of ecosystem services confirmed as being present or potentially present within the scope of the project was developed. To ensure rigor, ecosystem services were classified by:

- The **Receptor** (i.e., the ecological feature of interest);
- The receptor's **Location**;
- The **Type of Ecosystem Service** provided by the ecological feature (General class, CICES group, CICES group code). These were identified as per the recognized International Classification of Ecosystem Services (CICES): *Towards a Common International Classification of Ecosystem Services (CICES) for Integrated Environmental and Economic Accounting*, V5.2, European Environment Agency[1];
- The **Beneficiaries** of the ecosystem service (e.g. local communities, global communities, the Project, tourists, etc);
- A **Short Description of the Benefit** of the ecosystem service provided by the receptor;
- **Prioritization**, meaning whether or not the ecosystem service was retained for the impact analysis;
- A **Reason for Prioritization**. Ecosystem services were prioritized as per the best practice ESS 6 criterium: "*Any important ecosystem services that are provided by the biodiversity and living natural resources that may be affected by the project, and their value to project-affected and other interested parties*."; and
- **Source of Information**, meaning the data source of the ecosystem service.

16.3.14. The results of the impact assessment are presented in **Section 16.4**. A summary is also provided in **Section 16.5.2**.

RECEPTOR SENSITIVITY EVALUATION

16.3.15. The sensitivity of an ecosystem service estimates the value of the ecosystem service to relevant beneficiaries. It considers both the level of dependence that beneficiaries have on the ecosystem service, as well as the level of importance that ecosystem service is given by beneficiaries (e.g., social, community, cultural, recreational and economic).

[1] https://cices.eu

16.3.16. The valuation has been made using available guidance and information, and considers the distribution, extent and condition of the receptors. The sensitivity categories are provided in **Table 16-1.**

Table 16-1 - Receptor Sensitivity Categories

Receptor Sensitivity	Description
High	Beneficiaries are highly dependent on the ecosystem service and it is crucial for their survival and maintenance of an adequate quality of life (i.e. not living in hardship). Impacts on such an ecosystem service must be mitigated as a requirement for the ESIA to ensure that the ecosystem service is not compromised in terms of service provision.
Medium	The ecosystem service is valuable to beneficiaries, but they are not highly dependent on the ecosystem service, and it is not crucial for their survival and maintenance of an adequate quality of life (i.e. not living in hardship). Mitigation is required in the ESIA if the assessment identifies that the significance of the impact is major or moderate.
Low	The ecosystem service is of limited value to beneficiaries. They are not highly dependent on the ecosystem service, and it is not crucial for their survival and maintenance of an adequate quality of life (i.e. not living in hardship). To follow best practice of the ESS 6, these ecosystem services should be mitigated where possible; however, this is not a requirement for the ESIA.

16.3.17. In line with the above definitions, **Table 16-2** presents the receptor sensitivity for each receptor prioritized in the baseline assessment.

Table 16-2 - Receptor Sensitivity for Prioritized Receptor

ID number	Receptor	Receptor Sensitivity	Justification
R11-1	Wild plants	Medium	Wild plants are valuable to local communities for their medicinal and possibly nutritional purposes and local practices and customs. Local communities are not highly dependent on them.
R11-2	Trees used for memorials and shrines	Medium	Trees used for memorials and shrines are valuable to local communities for local practices and customs. Local communities are not highly dependent on them.
R11-3	Trees associated with local stories and taboo	Medium	Trees associated with local stories and taboo are valuable to local communities for local practices and customs. Local communities are not highly dependent on them.
R11-4	Protected areas	N/A	Not prioritized.
R11-5	Local healing and thermal waters	N/A	Not prioritized.

ID number	Receptor	Receptor Sensitivity	Justification
R11-6	Croplands and orchards	High	Local communities are highly dependent on agricultural lands for food provision.
R11-7	Pastures	High	Local communities are highly dependent on pasture lands for food provision.
R11-8	Remaining woody areas (Juniper forests)	Medium	Local communities use the remaining forested areas for wood resources. Community management also provides some cultural and social benefit. Local communities are not highly dependent on them. Juniper forests also provide some level of carbon sequestration and erosion prevention services, that provide non-localised benefits. However, these areas are fragmented and fairly limited in size, therefore providing limited benefit.
R11-9	Habitats (terrestrial, riparian floodplains, freshwater)	Medium	Habitats support the survival of species which strengthen the provision of other land-based ecosystem services. They also provide a sense of place to local communities, though communities are not highly dependent on this.
R11-10	Floodplains	Medium	Floodplains provide of benefits such as soil sediment retention, water flow regulation and recreation which the local and downstream communities rely on. However, local and downstream communities are not highly dependent on these services.
R11-11	Freshwater streams	Medium	Freshwater streams provide a range of services including fishing, drinking and irrigation and soil sedimentation which the local communities rely on. However, local communities are not highly dependent on these services.
R11-12	Species	Low	Species in the area provide a pool of genetic diversity that helps maintain their populations and may provide sources for medicinal and biochemical products in the future, which is of some value to local and global communities.

IMPACT SIGNIFICANCE

16.3.18. The assessment considers the effects of the Project with the application of mitigation linked to resettlement. This gives an indication of the need for other forms of mitigation to be implemented. The likely effectiveness of that mitigation has then been considered and a residual effect stated. Impacts were assessed for both the construction and operational phases.

16.3.19. Each impact is assessed as follows:

- The **Receptor** impacted and the **Receptor Sensitivity**;
- The **Frequency** of the impact;
- The **Likelihood** and certainty of the impact occurring;
- The **Extent** of the impact;

- The **Duration** of the impact and whether it is reversible;
- The **Magnitude** of the impact. This is determined as per the criteria definitions in **Table 16-4**;
- The **Effect** of the impact (e.g. whether it is adverse or beneficial);
  - Whether the impact is **Direct or Indirect**;
  - The **Significance** of the effect, based on the results of the above criteria;
  - Identification of any **Mitigation**; and
  - The **Residual Significance**.

Table 16-3 - Impact Magnitude

Magnitude	Criteria
Large	Major effect on the ecosystem service, likely to threaten the long-term integrity of the service provision.
Medium	Moderate effect on the ecosystem service but would not threaten the long-term integrity of the service provision.
Small	Noticeable effects, but either of sufficiently small scale or short duration to cause little harm to the service provided.
Very Small	Limited effects that cause no harm to the service provided.
Beneficial	The ecosystem service is affected positively, increasing the provision/quality of the ecosystem service.

IMPACTS

16.3.20. Impacts are defined as the direct or indirect changes produced by the Project activities on the environment, able to influence the state or quality of one or more receptors.

16.3.21. The list below provides a summary of the impacts considered in this assessment in construction and operational phases. These overlap greatly with those identified in the **Chapter 15** of this ESIA, which provides more detail as to the nature of these impacts.

16.3.22. Relevant construction phase impacts comprise:

- **I11-1:** Land and vegetation clearance within the flooding zone;
- **I11-2:** Hunting of local wild mammals and birds and fishing by the construction work force;
- **I11-3:** Reductions in water quality due to sediment release into the river system from the deposition of construction and tunnelling waste into the river, release of contaminants into the river and localized water quality issues due to discharges from construction facilities and reduction in air quality due to release of dust and emissions of pollutants;
- **I11-4:** Water abstraction for construction activities;
- **I11-5:** Injury or killing of fauna as a result of construction activities;
- **I11-6:** Disturbance – including noise and vibration and visual disturbance;

- **I11-7:** Introduction and spread of alien or invasive species.

16.3.23. Relevant operational phase impacts will comprise:

- **I11-8:** Flooded area resulting in habitat loss and change in habitat type (new reservoir within the landscape)
- **I11-9:** Water pollution arising from new reservoir by altering temperature balances, water chemistry and sedimentation;
- **I11-10:** Barrier effect arising from new reservoir in the landscape.

16.4 POTENTIAL IMPACTS AND EFFECTS

CONSTRUCTION IMPACTS

16.4.1. **Land clearance (I11-1)** is a direct adverse impact that will affect several ecosystem services present in the Project AoI. Land clearance involves the removal of vegetation in the area which will become flooded as the dam is constructed. For all ecosystem services, the impacts are certain to occur and are permanent. The following receptors are adversely affected by land clearance:

- **Wild plants (R11-1, of medium sensitivity as per Table 16-2):** the impact is of medium magnitude, as wild plants are more widely present in the region and could provide the ecosystem service in resettled locations.
- **Trees used for memorials and shrines (R11-2, of medium sensitivity):** the impact magnitude is **medium** as the community will no longer be present to benefit from this ecosystem service; however they will still be able to benefit from the knowledge that these trees are still alive and present. It is the individual trees in their specific location that are important to local communities, therefore other trees of the same species present more widely in the region could not provide the ecosystem service.
- **Trees associated with local stories & taboo (R11-3, of medium sensitivity):** same reasoning as R11-2 above.
- **Croplands and orchards (R11-6, of high sensitivity):** the magnitude of the impact is **very small**. There will be an impact but resettlement as part of this project have organised replacement lands and alternative incomes for local communities. There will be a delay between the creation on new orchards and the time they can be harvest. Therefore, even though agricultural lands will no longer be available in that location, resettlement will provide agricultural lands for use and or alternative forms of income. There will therefore be no harm to service provision.
- **Pastures (R11-7, of high sensitivity):** same reasoning as R11-6 above.
- **Remaining woody areas, including remnants of Juniper Forest (R11-8, of medium sensitivity):** the magnitude of the impact is **small**. This is due to several factors: (a) resettled communities will be provided with alternative wood resources (see reasoning given for R11-6 above); (b) resettled communities will have access to managed forest areas for the cultural and social benefit; (c) the area occupied by these forests is very limited, therefore carbon sequestration benefits are negligible on a global scale; and (d) the erosion service they provide will no longer be relevant once the area is flooded.

16.4.2. The construction phase impacts R11-1/2/3/6/7 are local, as the ecosystem services they provide benefit local communities within the AoI. Carbon sequestration provides non-localized benefits, however these are very minor at a scale due to the small size of the remnant woody areas that are flooded.

16.4.3. The significance of land clearance impacts on croplands and pastures will be **negligible**; impacts on wild plants and remaining woody areas will be **minor**; and impacts on trees used for memorials/shrines and local stories/taboo will be **minor**. As discussed in the **Chapter 20** of this ESIA, mitigation will be implemented in the form of a Cultural Heritage Management Plan for R11-2/3. This lowers the significance of the residual impact of R11-2/3 to **negligible**.

16.4.4. **Fishing and hunting by the construction workforce, the release of contaminants and sediments, and water abstraction (I11-2/3/4)** are direct adverse impacts that may are likely to affect **freshwater streams (R11-11)**. This is because such activities could harm freshwater flora, fauna and drinking water quality and quantity. The characteristics of these impacts means that the impact would likely occur periodically, could possibly occur, is of regional extent (encompassing downstream communities), and is of medium-term duration (during construction phase). The magnitude of the impact is **small**, as the intermittent nature of the impact would cause minimal harm the integrity of freshwater streams. It has therefore been concluded that the significance of the impact is **minor**, due to the unlikelihood and medium duration of the impact. No mitigation has been planned for this impact.

16.4.5. **All construction impacts (I11-1 to I11-7)** are direct and indirect adverse impacts that will affect **species (R11-12) and habitats (R11-9)**. This is because habitats, fauna and flora will be removed through land clearance or could be disrupted by other construction activities. The characteristics of these impacts means that the impacts are likely to be periodic (for construction activities) or constant (for land clearance). It is certain to occur and is of long-term or even permanent duration. It is predominantly local to the AoI, with some benefits provided to the global community (e.g. genetic information providing a source for undiscovered treatments/pharmaceuticals/technologies). The magnitude of the impacts for both receptors is **medium**, as (a) habitats and species present outside of the AoI will continue providing ecosystem services, or (b) ecosystem services that are lost in the cleared area will no longer be relevant when the area is flooded. It has therefore been concluded that the magnitude of the impact is **moderate**.

16.4.6. As discussed in the **Chapter 15** of this ESIA, mitigation will be implemented in the form of a Resettlement Action Plan, Livelihood Restoration Plan, Biodiversity Management Plan and No Net Loss Framework. This lowers the significance of the residual impact to **minor**, as equivalent habitats and species will be enhanced in other areas to provide these broad supporting ecosystem services.

OPERATIONAL IMPACTS

16.4.7. **Flooded area (I11-8)** is a direct adverse impact that are a continuation of the land clearance impacts (I11-1) in the construction phase. Land was cleared in order for inundation to occur during operation. This means that the characteristics of the impacts to **receptors R11-1/3/6/7/8** and the significance of the impacts remain the same as those described in **paragraph 16.4.1**.

16.4.8. **Trees used for memorials and shrines (R11-2, of medium sensitivity):** the impact magnitude is **large** as the flooded landscape will no longer be able to provide this ecosystem service. It is the individual trees in their specific location that are important to local communities, therefore other trees of the same species present more widely in the region could not provide the ecosystem service.

16.4.9. This is similarly the case for how **all operational impacts (I11-8 to I11-10)** are a continuation of construction impacts on **species (R11-12) and habitats (R11-9)**. During operation the impacts to these receptors remain consistent with the construction phase, however during the operation the impacts will be constant and permanent. The significance is **moderate** without mitigation and made minor with mitigation.

16.4.10. **Flooded area (I11-8)** will also directly and adverse impact **floodplains (R11-10) and freshwater streams (R11-11)**. This is because these habitats will no longer exist once the area is flooded. The characteristics of the impact (frequency, likelihood, extent, duration) are the same as described above. The magnitude of the impact on both receptors is **small**, as although the habitats will no longer exists and therefore the ecosystem services will not be provided, (a) these ecosystem services will not be relevant at the scale of the flooded reservoir and (b) resettled communities will be provided with water and food and recreational opportunities. The significance is **minor** for both receptors. No mitigation has been planned for this impact.

16.5 MITIGATION MEASURES

16.5.1. A list of mitigation plans relevant to the mitigation of ecosystem services is presented in **Table 16-4**.

Table 16-4 - Mitigation Documentation

Receptors	Documents summarising mitigation measures
R11-6: Croplands and orchards & R11-7: Pastures	Gender Action Plan, Resettlement and Livelihood Restoration Framework (RLRF), Livelihood Restoration Plan and Resettlement Action Plan (RAPs)
R11-12: Species	Biodiversity Management Plan (BMP) and No Net Loss Framework
R11-12: Species	BMP
R11-2: trees used for memorials and shrine & R11-3: trees associated with local stories & taboo	Cultural Heritage Management Plan (CHMP), RLRF, RAP and BMP

16.5.2. As described in the referenced documents in Table 16-4, To reduce potential significant effects, and to ensure good practice construction methods, the following measures shall be implemented

16.5.3. **Prior to Land clearance (I11-1)** across the flooding zone, a repeat survey for notable flora will be undertaken within those areas within the flooding zone where species were previously identified, along the route of the left bank road and within areas of Natural Habitat.

16.5.4. Findings from the surveys will be added to a Biodiversity Constraints Plan (BCP) for the Project so that the nature and location of these findings can inform ongoing mitigation and monitoring. Any rare plants encountered will be collected and moved to receptor sites that will be pre-identified in which these plants will remain to mitigate the Project-related impacts

16.5.5. To minimize the impacts on **Juniper Forest (R11-8),** the left bank road design should be finalised to avoid all areas of juniper woodland by at least 100m.

16.5.6. For areas of woodland that will be lost to clearance activities prior to flooding the options for on-site mitigation may comprise replacement planting of woodland at various locations around the flooding zone and Project site, which should align with complementary planting requirements such as for landscaping and soil stability purposes or making use of the aforementioned stabilised water levels at Nurek as a result of the constructed Rogun dam to undertake planting there.

16.5.7. Other measures to minimise construction-related disturbance on **Species (R11-12) and Habitats (R11-9)** are included within **Volume 1, Chapter 8 (Air Quality)** and **Chapter 11 (Noise and Vibration)** of this ESIA. These are summarised below:

- Several bowsers water the road and dampen dust along many sections, but visual observation shows this is not entirely adequate and that further effort is required;
- Enforce a speed limit to reduce the dust generated by HGVs;
- Locate stationary machinery (i.e., pumps, compressor, concrete mixing, etc) away from noise-sensitive receptors;
- Start-up machinery and vehicles sequentially;
- Select plant and equipment that conforms to Directive 2000/14/EC (noise emission in the environment by equipment for use outdoors, or equivalent);
- Reversing alarms without tonal component (i.e., broadband);
- Undertake regular and effective maintenance for the construction machinery and any sound-reducing equipment;
- Install temporary acoustic enclosure for noisy equipment;
- Loading and unloading will be done away from noise-sensitive areas;
- Minimise drop height of materials; and
- Switch off equipment when it is not in use.

16.5.8. The removal of **Croplands and orchards (R11-6)** and **Pastures (R11-7)** will be mitigated to the extent possible through the implementation of RAPs and LRPs. The RAPs and LRPs define and quantify the entitlements of PAPs to compensation, livelihood restoration support, and other benefits, and are publicized to maximize awareness of these entitlements.

16.5.9. The restoration of livelihoods, social networks and agricultural production takes time, and these mitigation measures will take several years to be fully effective. However, if they are implemented in full, the impact size will be reduced.

16.6 RESIDUAL EFFECTS

16.6.1. Implementation of the described mitigation will reduce the significance of residual impacts to **Minor or Negligible** for all impacts on ecosystem services. To ensure this is realised, mitigation and enhancement measures must be implemented and relevant performance indicators monitored to ensure the efficacy of the mitigation measures.

16.7 SUMMARY

16.7.1. A summary of the assessment of Project activities on ecosystem services for the construction phase is provided in **Table 16-5** and for the operational phase in **Table 16-6.** The Project will result in limited adverse effects to ecosystem services. This is due to the prevailing landscape displaying the legacy of ongoing human influence that has resulted in a diminished biodiversity within both terrestrial and aquatic habitats.

Table 16-5 - Summary of Ecosystem Services Impacts (Construction)

Impact	I11-1: land clearance						I11-2, I11-3, I11-4: fishing/hunting by construction workforce, release of contaminants and sediments, water abstraction	I11-1 to I11-7: all construction impacts	
Receptor & Receptor Sensitivity	**R11-1: wild plants** **Medium**	**R11-2: trees used for memorials and shrines** **Medium**	**R11-3: trees associated with local stories & taboo** **Medium**	**R11-6: croplands and orchards** **High**	**R11-7: pastures** **High**	**R11-8: remaining woody areas** **Medium**	**R11-11: freshwater streams** **Medium**	**R11-12: species** **Low**	**R11-9: habitats** **Medium**
Frequency	Constant	Constant	Constant	Constant	Constant	Constant	Periodic	Periodic or Constant	Periodic or Constant
Likelihood	Certain	Certain	Certain	Certain	Certain	Certain	Possible	Certain	Certain
Extent	Local	Local	Local	Local	Local	Local (carbon sequestration: non-localized)	Local / Regional	Local (to some wider extent beneficiaries)	Local
Duration	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Medium-term	Long-term or Permanent	Long-term or Permanent
Magnitude	Medium	Medium	Medium	Very Small	Very Small	Small	Small	Medium	Medium
Effect	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse
Direct / Indirect	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct and Indirect	Direct and Indirect
Significance	Minor	Minor	Minor	Negligible	Negligible	Minor	Minor	Moderate	Moderate
Mitigation (Y/N)	N	Y	Y	N	N	N	N	Y	Y
Residual Significance	Minor	Negligible	Negligible	Negligible	Negligible	Minor	Minor	Minor	Minor

Table 16-6 - Summary of Ecosystem Services Impacts (Operation)

Impact	I11-8: flooded area *(For R11-1/2/3/6/7/8: impacts are a continuation of I11-1: land clearance impacts in the construction phase)*								I11-8 to I11-10: all operational impacts *(Note: Impacts are a continuation of impacts in the construction phase)*	
Receptor & Receptor Sensitivity	**R11-1: wild plants** **Medium**	**R11-2: trees used for memorials and shrines** **Medium**	**R11-3: trees associated with local stories & taboo** **Medium**	**R11-6: croplands and orchards** **High**	**R11-7: pastures** **High**	**R11-8: remaining woody areas** **Medium**	**R11-10: floodplains** **Medium**	**R11-11: freshwater streams** **Medium**	**R11-12: species** **Low**	**R11-9: habitats** **Medium**
Frequency	Constant	Constant	Constant	Constant	Constant	Constant	Constant	Constant	Constant	Constant
Likelihood	Certain	Certain	Certain	Certain	Certain	Certain	Certain	Certain	Certain	Certain
Extent	Local	Local	Local	Local	Local	Local (regarding carbon sequestration: non-localized)	Local	Local / Regional	Local (to some extent wider beneficiaries)	Local
Duration	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
Magnitude	Medium	Large	Large	Very Small	Very Small	Small	Small	Small	Medium	Medium
Effect	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse
Direct / Indirect		Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct
Significance	Minor	Moderate	Moderate	Negligible	Negligible	Minor	Minor	Minor	Moderate	Moderate
Mitigation (Y/N)	N	Y	Y	N	N	N	N	N	Y	Y
Residual Significance	Minor	Minor	Minor	Negligible	Negligible	Minor	Minor	Minor	Minor	Minor

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State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT – UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Chapter 17: Socioeconomics



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QUALITY CONTROL

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Figure 17-8 - Medical Centre at Yoli Garmoba, Rogun City, (left) and Maternity Unit at Darband, Nurobod District, (right) (September 2024) 17-22

17 SOCIO-ECONOMICS

17.1.1. This chapter outlines the assessment of potential impacts of the Project on socio-economics, in line with the requirements of the World Bank's Environmental and Social Standard (ESS) 1: Assessment and Management of Environmental and Social Risks and Impacts (2016) and ESS 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement (2016).

17.1.2. A comprehensive description of social baseline conditions is presented in **Annex 7.1: Baseline Conditions Report** of this ESIA and a summary is provided in **Chapter 7: Environmental and Social Baseline Conditions** of this ESIA. An assessment of the potential Project impacts on socio-economics is presented in **Section 17.4**. Where necessary, recommendations for the avoidance of impact, impact minimization and/or long-term management are included.

17.2 LEGISLATIVE FRAMEWORK, POLICY AND GUIDANCE

17.2.1. The socio-economic assessment has considered the relevant legislation, policy and guidance framework. The following section sets out the international standards that are relevant to this socio-economic impact assessment.

INTERNATIONAL CONVENTIONS AND STANDARDS

World Bank Environmental and Social Standards

17.2.2. The following environmental and social standards (ESS) addressing social risks and impacts are applicable to this assessment. A full description of each of the standards is included in **Chapter 2: Legislation and Standards** of this ESIA.

- ESS1: Assessment and Management of Environmental and Social Risks and Impacts1;
- ESS2: Labor and Working Conditions;
- ESS4: Community Health and Safety;
- ESS5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement; and
- ESS10: Stakeholder Engagement and Information Disclosure.

TAJIKISTAN LEGISLATION AND REGULATIONS

Land Ownership

17.2.3. All land within the Republic of Tajikistan is owned by the Government, which is responsible for its effective use. The Land Code defines several tenure options for agricultural land, of which the primary use rights and secondary use rights are fundamental. Primary use rights include:

- Perpetual use - has no fixed term and is granted to legal entities such as state and cooperative agricultural enterprises, public and religious organizations and charities, industrial and transportation needs, public enterprises, defense and joint ventures that include foreign entities.

[1] Includes requirements to identify and mitigate impacts on vulnerable groups and definition of vulnerability

- Limited or fixed-term use - may be granted to legal or physical persons for either a short-term (up to 3 years) or long-term (3 to 20 years).
- Life-long inheritable tenure - may be assigned to physical persons or collectives. Physical persons must re-register the right in the case of inheritance. This right applies to land-shares used to organize a dehkan farm, as well as household (garden) plots.

17.2.4. The only secondary use-right recognized under the Land Code is the right to lease. According to the Code, primary rights holders may lease out their plots for a term not exceeding 20 years. The land is used in accordance with the state-established land-use standards.

17.2.5. Land Code Article 37 defines the reason under which the right to use land may be terminated:

- Termination of activities by the land user;
- Non-use for two years; and
- Use of the land differing from the use established in the use-rights document.

Land Acquisition and Resettlement

17.2.6. There is no specific law or policy in Tajikistan that regulates resettlement or land acquisition or expropriation of rights to land and immovable property for state or public needs. Moreover, there is no single law that comprehensively provides norms and mechanisms for the determination of full and fair market value of land or property. The key legislative acts regulating land management relations and the ownership rights to immovable properties in the Republic of Tajikistan are:

- Constitution of the Republic of Tajikistan (1994, as amended in 2003): The Constitution of the Republic of Tajikistan guarantees citizen's rights. The legal basis for state acquisition of private property for public works is outlined in Article 32 which states "…the property of an individual is taken away only on the basis of the law, with the consent of the owner and to meet the requirements of the state and society, and with the state paying full compensation."
- Land Code 1992 amended 2016: The Land Code regulates land relations and provides for "use and protection of land and soil fertility ...". Land is subject to rational use and the Code allows local authorities to make decisions regarding "rational" land use.
- Civil Code (as amended): The Code regulates the legal status of participants in civil transactions and property and non-property relations.
- Civil Procedural Code of the Republic of Tajikistan 2008, as amended: Establishes the procedure, rules and conditions for judicial protection in the event of legal proceedings on issues related to involuntary resettlement.
- Economic Procedural Code of the Republic of Tajikistan 2008, as amended: Protection in case of legal proceedings on matters related to involuntary resettlement.
- Housing Code of the Republic of Tajikistan 2022, as amended: Establishes the right to housing and sets out the conditions upon which people can be evicted or deprived of the right to use a dwelling.
- Land Valuation Act 2001, as amended: Establishes the legal framework for land valuation and the state Land Cadaster.
- Local Government Bodies Act 2004, as amended: Establishes the normative grounds for allocation and redistribution of land.
- Land Management Act 2008, as amended: Regulates relations related to the legal basis for activities in the field of land management.

- Land Administration Act 2016: Obliges the authorities to map and monitor the quality of land, including soil contamination, erosion and logging.
- State Registration of and Rights to Real Estate Act 2008 (No. 3), as amended: Establishes the legal basis for registration of real estate rights and restrictions on these rights.
- Regulation “about compensation of losses to the land users and losses of agricultural products” (approved by the Decree of Government of Republic of Tajikistan, 2000. № 515): Sets out the framework for reimbursement for land users’ losses in the case of expropriation.
- Regulation № 641 “On the order of compensation for losses of land users and damage of the agricultural production process” (30 December 2011): Sets out an order of compensation of losses of land users.
- Resolution of the Government of Tajikistan of January 20, 2009, No. 47, “On the Resettlement from the Flood Zone of Rogun HPP of the Population of Rogun City and Nurobod District,” as amended: Regulates the resettlement of people living within the flooding zone of Rogun HPP (in Rogun city and Nurobod).
- Resolution No. 162 of March 28, 2015, “On modifications and additions to Resolution of the Government of Tajikistan No. 47 of January 20, 2009”: Regulates the compensation process for resettlement from the Rogun HPP flood zone.
- The National Assessment Standards of the Republic of Tajikistan establish the provisions and basic principles of appraisal and set out the requirements for undertaking an appraisal of the value of immovable property, movable property, objects of intellectual property, as well as requirements for appraisal reports. It is recommended by the law that valuations should be carried out no more than 6 months before the transaction for which they are to be used is carried out.

17.3 ASSESSMENT METHODOLOGY

17.3.1. The approach to the assessment has been to review the proposed Project and baseline conditions, including the population characteristics, followed by the identification of risks related to the sector and location of the Project, and the Project activities which could cause an impact.

RECEPTORS

17.3.2. Receptors have been identified as:

- The economy within the Project Area of Influence (AoI) which includes:
  - Settlements within the resettlement zone;
  - Resettlement sites and nearby settlements;
  - Other settlements within the Flood Zone districts;
- Resettled communities, their assets and livelihoods;
- Community assets and infrastructure; and
- Women and vulnerable groups.

RECEPTOR SENSITIVITY

17.3.3. To identify the sensitivity of receptors, categories of relative sensitivity are described in **Table 17-1**, with reference to the baseline information.

Table 17-1 – Criteria for Socio-economic Receptor Sensitivity

Sensitivity	Description
High	A vulnerable[2] community, group or aspect of community life that has very limited ability to adapt to Project changes and maintain quality of life, or with very little access to alternative resources of similar quality. Reliance on one principal livelihood which is unsustainable, fragile or lacks legal rights, or is relatively unproductive and/or highly seasonal, such as reliance on migrant labor remittances. Limited ability to pay for food, key services, resources and infrastructure. Receptor will likely struggle to adapt to adverse changes brought about by the Project without extensive support.
Moderate	A community, group or aspect of community life with some ability to adapt to Project changes and maintain quality of life but has some vulnerability and some access to alternative resources of similar quality. Range of livelihoods present within community which are generally sustainable, relatively productive but which have other risks, such as being highly seasonal or contingent upon other economic sectors. Communities may be able to independently adapt to changes brought about by the Project to a limited extent.
Low	A community, group or aspect of community life with the ability to adapt to Project changes and maintain quality of life. Receptor has minimal vulnerability, is likely to realize opportunities provided by the Project and has good access to alternative resources of similar quality. Diverse range of livelihoods present within the community which are sustainable, productive and provide consistent income throughout the year. Community is relatively affluent, with a good ability to pay for food, key services, resources and infrastructure. Most member of the community are expected to be able to adapt relatively easily.

ASSESSMENT OF IMPACT SIGNIFICANCE

17.3.4. The Project impacts have been assessed against baseline conditions that include management measures already in place. The significance of the effect is the outcome of the interaction of the receptor sensitivity and the impact magnitude and indicates the requirement for mitigation. The post-mitigation outcome has also been assessed to determine the significance of the residual effect.

17.3.5. An evaluation of impacts on receptors considers:

- The sensitivity of the impacted receptor;
- The type of impact (positive or negative);
- The timing and frequency of the impacts;
- The likelihood of the identified impact; and

[2] 'Vulnerability' is further defined in the social baseline provided in **Chapter 7** and **Annex 7.1** of this ESIA.

- The duration and extent of the impact.

17.3.6. The descriptions in **Table 17-2** summarize the categories used to assess the magnitude of the impact in relation to socio-economics.

Table 17-2 - Impact Magnitude Categories

Magnitude	Description
Large	An extensive change from baseline conditions. An impact expected to affect the wellbeing of many people, social groups and/or businesses over a widespread area, irrespective of duration and reversibility. The scale of the impact may be local, regional or national, or could fundamentally and irreversibly impact significant numbers of individuals. The impact is certain or likely.
Medium	A distinct change from baseline conditions. An impact expected to affect the wellbeing of a moderate number of people, social groups and/or businesses and which is likely to be temporary (up to five years) and may or may not be reversible. The scale of the impact may be local or regional. More severe impacts on small numbers of individuals cannot be ruled out. The impact is certain or likely. More severe impacts may be possible but are unlikely.
Small	A perceptible change from baseline conditions. A localized impact expected to affect the wellbeing of a small number of people, social groups and/or businesses, and which is likely to be temporary (up to one year) and reversible. Smaller impacts may be certain or likely. More severe impacts may be possible for a few individuals or in a limited area but are unlikely.
Very Small	A localized change that is not expected to have a detectable effect on the wellbeing of people or businesses. Change remains within the range commonly experienced by households or the community. More noticeable impacts may be possible for a few individuals or in a limited area. Larger impacts affecting more people are highly unlikely.
Beneficial	A detectable improvement in the wellbeing or wealth of people or businesses. The scale of the change is not classified for positive impacts.

17.3.7. The receptor sensitivity category in **Table 17-1** and the impact magnitude category in **Table 17-2** combine to provide a qualitative assessment of the resulting impact.

17.3.8. The matrix for assessing significance of effects in shown in **Chapter 5: Impact Assessment Methodology** of this ESIA and effects that are classified as moderate or major are considered to be significant effects and thus require mitigation to avoid or reduce the impact. Effects classified as minor or negligible are considered to be not significant.

ASSESSMENT OF IMPACT TIMESCALE

17.3.9. Some impacts will be permanent but cause different effects over time. Effects may be initially adverse but become positive over time, or vice versa. In other cases, mitigation may become effective only over time. In these cases, the impact will be assessed at two points in time

- Year 1 – one year after the commencement of the impact for a given receptor
- Year 5 – five years after the commencement of the impact for a given receptor

17.3.10. Impacts that are inherently temporary in nature will not be assessed in this way. It is assumed that, after the cessation of a temporary impact, conditions will return to baseline with no significant effects remaining, unless otherwise stated.

17.4 POTENTIAL IMPACTS

17.4.1. Based on the criteria set out in **Table 17-1**, the sensitivity of Socio-economic receptors are presented in **Table 17-3**.

Table 17-3 - Socio-economic Receptors and Sensitivity

Receptor	Sensitivity	Rationale
Economy within the Project AoI	High	The economy is here defined as the total of economic activities taking place in the area, including business, employment, self-employment, etc. There are high levels of poverty and unemployment /precarious employment in the Project AoI. The main source of livelihoods for many households – the majority in some villages – is remittances from labor migration, pensions, subsistence agriculture and herding and public/private sector employment, which could be disrupted by Project impacts such as resettlement.
Community assets and infrastructure	Moderate	Infrastructure in areas that will be inundated by the reservoir will be permanently lost. Processes for infrastructure replacement are in place, although gaps in provision may occur, e.g., due to construction delays. Infrastructure that will be lost includes schools, healthcare facilities, roads, public administration services, and telecommunications infrastructure, as well as essential businesses (e.g., shops selling food, household supplies, hardware, car parts, etc.). Communities will therefore lose access to key services essential for daily life, wellbeing, and livelihoods.
Women and vulnerable groups	High	Many women in Project-affected communities have no income and limited education, limiting their ability to influence Project outcomes, re-establish their lives after resettlement, and benefit from economic opportunities. Other groups have been identified that are especially vulnerable to adverse impacts, and less likely to experience benefits, without special attention. Further detail regarding these groups is presented in Table 17-6.
Resettled communities, their assets and livelihoods	High	Resettlement can increase vulnerability within communities by temporarily or permanently disrupting livelihoods and social ties. There is a particularly high level of sensitivity associated with the resettlement of vulnerable groups such as elderly people, people with disabilities and households headed by women, whose limited resources or particular limitations decrease their ability to cope with disruption and change during resettlement. For example, individuals and households that rely heavily on informal social support networks will be severely disadvantaged if their communities are separated.
Non-resettled communities within the Project AoI	Moderate	Some communities are not to be resettled but will be impacted in other ways, e.g., changes to the economy and population. This includes communities on the left bank, the upper reaches of the Kamarob Valley, and other settlements (e.g., Rogun City, Gharm). As within the resettled communities, these communities are affected by high levels of poverty and precarious livelihoods.

Receptor	Sensitivity	Rationale
Host communities	Moderate	The resettlement sites are located in populated areas, although in some cases the nearest existing settlements are several kilometers distant. The decision on where to locate resettlement sites by GoT considers the capacity of these areas to accommodate the influx of additional populations and avoidance of conflict with host communities by provision of their access to services such as schools and health facilities in resettlement communities.
Population of Tajikistan	Moderate	The population of Tajikistan will benefit from significantly increased electricity supply, as well as economic benefits from sale of energy internationally. Tajikistan is a lower-middle income country where poor and relatively affluent communities are present, and therefore the population as a whole is considered a moderately sensitive receptor.
Population of countries purchasing energy excess	Moderate	Excess energy will be sold internationally to neighboring countries. Countries where energy from Rogun has been, or may be, purchased, include Kazakhstan, Uzbekistan, Afghanistan and Pakistan. These are low- to middle-income countries where poor and relatively affluent communities are present, and therefore the populations as a whole are considered a moderately sensitive receptor.

CONSTRUCTION

Direct economic impacts of Project employment and procurement

17.4.2. At the peak of the construction phase, later in the 2020s, there will be an estimated total construction workforce of 20,000 personnel. Currently there are approximately 17,198 personnel working on the Project (as of October 2024). A labor audit in 2023 showed that approximately 23% of the workforce come from villages within 50km of the Project. The majority of the remainder come from elsewhere in Tajikistan, with only small numbers of expatriate workers engaged. The Construction phase is assumed to last approximately 16 years and construction related jobs will gradually reduce after their peak.

17.4.3. The Project benefits local business through procurement of goods and services. The Project requires construction materials provided by suppliers, and labor which is provided by contractors and sub-contractors. Businesses also provide accommodation, food and supplies for workers and Project visitors. The Project economically benefits large multi-national and national companies (e.g., construction contractors) as well as small local businesses and sole traders.

17.4.4. The receptor for this impact is the economy within the Project AoI (high sensitivity). This impact is expected to be **beneficial** for the duration of the construction phase. Therefore, the effects associated with direct employment and procurement on the Project are **Positive.**

Indirect Economic Impacts on the Project AoI

17.4.5. Indirect economic benefits occur when spend by workers employed by the Project, or otherwise brought into the area by the Project (e.g., business visitors), generates revenue for other businesses. Construction of the Project has already commenced, and the Project is due to be complete, with the reservoir at full capacity, in 2038. During the construction period, expenditure by Project workers and business visitors provides revenue for the local economy. However, the impact

on the immediate local area is limited, as the majority of workers live on site and return to their hometowns when they are not working, reducing their ability to spend money in local shops, restaurants, etc.

17.4.6. Of the approximately 17,000 workers currently employed, some 12,500 live in accommodation on the construction site (comprised of two rotations of 6,000 people working 15-day shifts, and a further 500 people working 5-day weeks). A further 250 expat workers reside at the WeBuild camp adjacent to Rogun City. The number of workers residing in Rogun City is around 2,100 at any one time; comprised of 1,500 office workers (working 5 day weeks), and two shifts of approximately 600 workers doing 15-day shifts. A further 1,500 workers live in the nearby settlements and commute daily. The number of Project workers living in Rogun City is therefore significant, but a relatively small proportion of the total workers involved in the Project.

17.4.7. This indirect impact on the economy within the Project AoI (high sensitivity) is expected to be **beneficial** throughout the construction phase. The effect is therefore **Positive**.

Physical resettlement and asset compensation

17.4.8. Sixty-nine settlements are scheduled for resettlement by 2032, comprising 6,788 households and 50,267 people at present population levels. The number of households is not expected to change as the construction ban has now been applied to the whole inundation zone, although natural population growth means that the total number of affected people is likely to increase over time[3]. RAP 2 provides information on RAP 1 resettlement (which is completed), as well as the ongoing resettlement process during the second phase, which involves 1,710 PAHs (16,919) people. Another 4,752 households (30,651 people) will be covered by future RAPs (see **Annex 7.1: Baseline Conditions Report** of this ESIA).

17.4.9. All households that are resettled are provided with replacement land and monetary compensation for assets, as described in the 2024 Resettlement and Livelihood Restoration Framework (RLRF) and 2017-2026 RAP 2.

17.4.10. The Project will result in:

- Loss of all structures in 69 villages;
- Loss of common pastureland;
- Loss of crop lands and orchards;
- Loss of land and livelihoods associated with this land;
- Loss of access to natural resources;
- Loss of ethnographic and intangible cultural heritage;
- Loss of public infrastructure, such as schools, roads and healthcare facilities; and
- Impacts on businesses, including the loss of income in the period between business activities ceasing prior to resettlement and income returning to the previous level.

17.4.11. A summary of impacts on land resulting from the various Project components and associated facilities (AFs) is presented in **Table 17-4**.

[3] This number could go up to as many as 60,000 people.

Table 17-4 - Land Impacts of Project components and associated facilities

Project Component	Expected Impacts	Potentially Affected Villages
Reservoir area	A total of 604,735ha will be inundated by the reservoir The main road M41 will be interrupted after Obigarm where short stretches of this road will be submerged in Stage 1 and considerable parts of it, including the only bridge suitable for heavy traffic crossing the Vakhsh river, will disappear at later stages of impoundment.	The reservoir at FSL will affect 69 villages, and over 50,000 people will be resettled. This number is likely to rise due to population growth. Severance impacts are likely to occur on the left bank and in tributary valleys (e.g., Kamarob Valley) due to the loss of bridges and roads into the valleys. Impacts arising from severance are assessed and reported within **Annex 17.3 Severance** of this ESIA.
Dam and HPP construction area	Physical displacement impacts. The construction area (approximately 20 km^2), which is predominantly located within the impoundment area, is already operational. Activities currently at Construction Site 1 will be relocated as the reservoir levels rise. Activities will move to Construction Site 2 and a newly created Construction Site 5. Specific details of what will be moving where, and the specific location of Construction Site 5, are not currently available.	Two villages (Mirogh and Sicharogh) were required to be physically resettled due to safety issues concerning the dam. One village, Pasi Muhraho (Rogun City), comprising 54 households, was identified as being affected by the civil works due to being located within the construction area, in close proximity to Construction Site 2. As it turned out, Rogun HPP made alternative plans and the community did not have to resettle to avoid construction or other impacts.
Transmission lines	Mostly economic displacement impacts.	As the planned route is currently unknown, the impact cannot be assessed.
Access roads (on the right bank in the upper part of the reservoir, on the left bank in the lower part of the reservoir)	No resettlement related impacts expected as new access roads were included during planning of the physical relocation requirements. Impacts arising from severance as the reservoir levels rise are assessed and reported in **Annex 17.3 Severance** of this ESIA.	None identified

17.4.12. In the Flooding Zone within Rogun City and Nurobod District, which has been subject to a construction ban since the 1980s, houses are typically crowded and under-maintained. Site visit observations confirmed that the quality of housing in resettlement sites is significantly better than in the pre-resettlement villages.

Figure 17-1 - A Pre-resettlement House in Mehrobod, Nurobod District



Figure 17-2 - A Post-resettlement House in Toichi, Tursunzoda (inhabited since 2017)



Figure 17-3 - A street in Navobod, Rasht District



17.4.13. Key findings from an assessment of the ongoing second phase of resettlement confirm that overall, the ongoing physical resettlement process is in compliance with the Tajik legislation and largely meeting the requirements of the lenders. During the preparation of the RLRF and RAP 2, DFZ has worked to improve its delivery of the resettlement program, notably by improving their overall systems for tracking the resettlement process, strengthening outreach and the grievance mechanism, eliminating the depreciation of assets, assisting PAPs in building their new homes and structures, transporting their goods to the resettlement sites and supporting vulnerable families. The Project is also benefitting from enhanced efforts at livelihood restoration.

17.4.14. Until July 1, 2024, a 30% depreciation of assets was applied in line with the National Assessment Standards of the Republic of Tajikistan (NASRT). Even with the depreciation, most PAPs (73% to 90%, based on different surveys) reported that the financial compensation for their houses and structures was adequate to purchase or build new houses and structures at the resettlement sites. Almost all PAPs agree strongly that their new homes are superior in quality to their original homes, with important amenities such electricity and water supply, and upgraded or new schools and medical facilities to accommodate the resettled people as well as the host communities. PAPs have been informed that they can make further claims for compensation through the GRM. Some have done so and have received additional support, including in-kind and livelihood restoration measures.

17.4.15. To date, PAPs who cannot, or do not wish to, move promptly have been able to remain in their previous location for extended periods, as the resettlement program has progressed significantly ahead of the rising reservoir level. As the rate of filling the reservoir increases, the speed of resettlement will also need to keep pace. The construction of infrastructure at resettlement sites will need to progress more quickly than it currently is to ensure that all critical facilities are ready for PAPs to relocate. Should delays occur, it is less likely that PAPs will be able to remain longer in their current location, and additional transitional support measures (e.g. temporary accommodation) may need to be provided to enable PAPs to leave their current location ahead of inundation.

17.4.16. Resettled communities are considered to be of a high sensitivity. The scale of resettlement associated with the Project is also very large. The implementation of the 2017-2026 RAP 2, and future RAPs prepared in line with the RLRF (2024) will manage ongoing resettlement in line with Tajik law and the requirements of the lenders. There is evidence that living standards for PAPs, following resettlement, is improving.

17.4.17. **Year 1:** In the short-term, resettlement causes adverse impacts for the majority of PAPs. Some people (especially older people) feel distress at leaving their former homes behind, and the experience of moving is often stressful. Households owning assets of low value, and families who did not own assets (due to living with extended family), will have limited time to save supplementary funds for their house construction, and may need to move into more basic homes initially and improve them over time. Establishing social ties with new neighbors in new communities can also take time, particularly if there are delays to community infrastructure, such as schools, which can be a focus for developing social cohesion. At Year 1, resettlement will result in a **Moderate adverse** impact, causing a **Major** effect.

17.4.18. **Year 5:** Adverse impacts lessen over time as new residents settle into their new homes and communities become more established. Evidence from previous resettlement shows that living conditions typically improve over time as resettlers further develop their homes with extensions or upgraded materials, With the full implementation of the RAPs, and the provision of planned community infrastructure, the impact of physical resettlement from the villages in the flooding zone to the resettlement sites will be reduced. Within 5 years, impacts are anticipated to be **Beneficial**, leading to a **Positive** effect.

Livelihood disruption and restoration

17.4.19. The availability of workplaces and productive land at their new location determines the impacts on PAPs whose livelihoods are lost due to resettlement. The majority of resettled households have primary income sources which are not land-based or dependent on a fixed location and therefore will not be directly affected by resettlement. The most common livelihood amongst adults (16+) in Project-affected communities is labor migration is the main source of income for 54% of households. Pensions are the second most important source of income for 25% of households. Hired labor in the public sector provides income for 23% of households. Farming activities, including cattle breeding, housekeeping and agriculture, are a source of income for 16-20% of households. Five percent of people in PAHs are unemployed and looking for work (exclusive of people who are unemployed but not looking for a job, e.g., full-time home-makers), though this number has fluctuated. A small proportion of the population have agriculture as their primary livelihood (<10%, predominantly arable), although the majority of households practice some subsistence farming around their households. Further data on livelihoods is provided in **Annex 7.1: Baseline Conditions Report** of this ESIA.

17.4.20. Primary data compiled in 2023 and 2024 shows little difference between the employment profiles of communities before and after resettlement, which supports the conclusion that resettlement is having a limited impact on livelihoods for the majority of households, at least in the long term. While household members who undertake labor migration are also involved in construct their new house, this has not been reported as impacting household income to date. This is likely due to the current pace of resettlement being relatively slow, enabling PAPs to align their new house construction with their normal labor migration patterns. The number of resettlers self-reporting losses from labor migration to date is minimal. However, the pace of resettlement will be increased which could affect labor migration income going forward, as labor migrants will either need to stay home to construct their new homes within a set timescale or hire builders. There may be instances where households could live in temporary accommodation (e.g. with family) in order to accommodate current labor migration patterns.

17.4.21. The 0.08 to 0.1 ha household plots enable all households to continue personal small-scale food production, as well as allowing those who did not previously have gardens to begin producing their own food. The practice of splitting households into families also increases land availability per person in the household. Resettled households also have the right to use common pastureland and apply for agricultural land from the Ministry of Agriculture (MoA) at their new locations. Livestock can be transported to new locations and are included within the transportation support provided by DFZ. Although there are detrimental impacts in the short-to medium-term during the transition period, due to the time taken to complete formalities on land use, re-establish trees and adapt to new climatic conditions, in the long-term households are able to restore, or even increase, their food production capacity. Gardens, including those belonging to relatively recent RAP 2 resettlers, were observed to be well established at all sites, and increased productivity was reported in some cases.

Figure 17-4 - Gardens of RAP 2 resettlers in Namuna, Tursunzoda (September 2024)



Figure 17-5 - The garden of an early resettler in Toichi, Tursunzoda with re-established trees (September 2024)

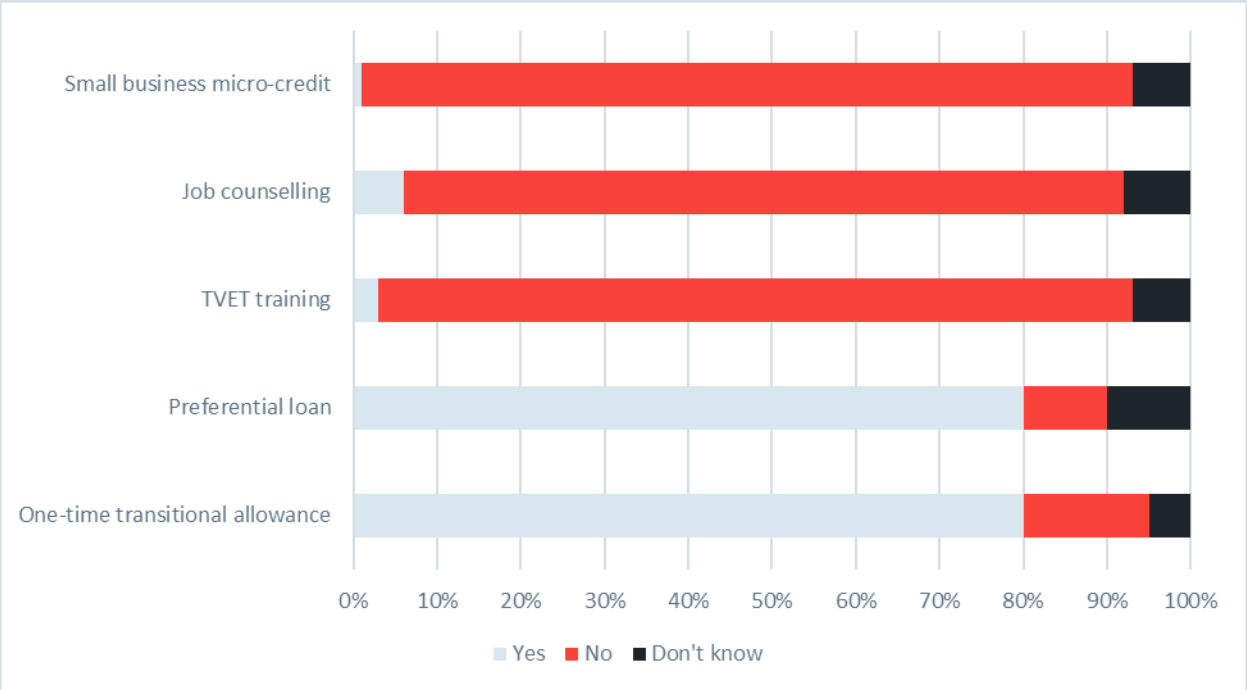


17.4.22. Among the relocated households surveyed during the preparation of the draft ESIA in 2023, 42% reported a perceived loss of income. The June 2024 survey of 363 resettled households indicated that, in general, the average annual income of the resettled persons increased from TJS 26,269 before resettlement to TJS 29,823 after resettlement. This was partly due to PAPs changing livelihoods from agriculture to migrant labor and construction. The proximity of some of the resettlement sites to a large secondary city also made it easier for people to transition from land-based labor to wage-based labor.

17.4.23. For families remaining in commercial agriculture, there have been challenges in obtaining larger tracts of farm- and pasturelands close to the resettlement sites. Losses will also occur during the time taken to re-establish crops and trees. Trees are being re-grown from seeds as transplantation was reported to be ineffective.

17.4.24. Livelihood restoration measures are provided primarily via the Ministry of Labor, Migration and Employment (MoLMEP) and MoA. Full details of the program, as well as baseline data regarding livelihood and employment amongst Project-affected communities, are presented in **Volume 2, Annex 7.1: Baseline Conditions Report** of this ESIA, as well as in the **Livelihood Restoration Plan** for the second phase of resettlement (LRP 2). **Figure 17-6** shows uptake of the livelihood restoration measures amongst RAP 2 PAPs, based on a survey of 523 PAP heads of households in 2023. Some MoLMEP measures are provided automatically to all resettlers – specifically the one-time transitional allowance and the preferential – and, as such, uptake is high. Other measures are available to all registered unemployed people in Tajikistan and are subject to various conditions, leading to lower uptake.

Figure 17-6 - % of 523 surveyed PAPs receiving individual MoLMEP support (2023)



17.4.25. These livelihood restoration measures have been in place since 2009. In 2024, MoLMEP doubled the amount of the one-time transitional allowance to 200TJS per head of household and 100 TJS to

each family member. They also increased the preferential loan from 3000 to 5000TJS. Female FGD participants in Khakimi (RAP 2, Nurobod), who expressed positive attitudes towards resettlement, were aware of the preferential loans and small business micro-loans and anticipated that these measures would help them to improve their livelihoods or begin earning an income for the first time. Total numbers of resettlers accessing MoLMEP programs (across all RAPs) is presented in **Volume 2, Annex 7.1: Baseline Conditions Report** of this ESIA and **LRP 2**.

17.4.26. The above evidence shows that livelihood restoration to date has been partially successful. Uptake of some livelihood restoration measures has been rather low, and 8% of post-resettlement households indicated in the 2023 survey that someone within the household who had a permanent job prior to resettlement had become unemployed. However, there have been examples of positive livelihood outcomes, such as women entering the workforce for the first time. LRP 2 was produced in 2025 to mitigate livelihood impacts by increasing awareness of, and facilitating access to, programs that are in place in Tajikistan to assist people to gain or improve their livelihoods. Additional LRPs will be prepared to accompany each future RAP. The full timeline of preparations of future RAPs and LRPs is presented in the RLRF (2024) and RAP 2.

17.4.27. Resettled communities are considered to be of high sensitivity. However, the majority have sources of primary income that are not land-based or tied to a particular location, or no income at all, and will therefore not be impacted. Disruption to livelihoods is further limited by the implementation of existing management measures, including the RAPs, LRPs, and MoLMEP and MoA programs.

17.4.28. **Year 1:** In the short term, resettlement is highly disruptive to livelihoods even with support measures in place. Agricultural activities and businesses take time to re-establish, and increasing the pace of resettlement will require more PAPs to reduce time spent on labor migration in order to construct houses, which will result in income losses. The impact is assessed to be of **Moderate** magnitude, and the effect is therefore considered **Major adverse**.

17.4.29. **Year 5:** In the medium- to long- term it is anticipated that the measures in place, as well as the improved infrastructure at new settlements, will lead to a **Beneficial** impact and a **Positive** effect on livelihoods. The full impact of LRP measures, as well as general social and economic development at the resettlement site (e.g., re-establishing community networks with new neighbors and host communities, indirect benefits of new businesses developing) will be felt only after several years.

Loss and Replacement of Infrastructure for Resettled Communities

17.4.30. All community assets and infrastructure within the Flooding Zone will be lost as the reservoir is filled, which will affect the economy and social lives of communities. Some of these assets, particularly within larger settlements such as Mehrobod and Navobod, are also used by surrounding communities that are not scheduled for resettlement.

17.4.31. The large resettlement operation associated with the Project has necessitated the construction of new settlements. RAP 2 resettlers have moved to sites across five districts (Nurobod, Faizobod, Rogun, Tursunzoda, and Danghara). New settlements provide residents with improved infrastructure in terms of new schools, kindergartens, healthcare facilities, and sports and recreational facilities, which affected people welcome. Site visits in 2023-4 confirm that the standard of the new facilities at resettlement sites such as Darband (Nurobod District) and Yoli Garmoba (Rogun City) is high when complete, although in some cases infrastructure completion has been delayed (Namuna, Tursunzoda).

17.4.32. Existing community assets and infrastructure within existing settlements situated close to the resettlement sites may be affected by an increase in users, if new infrastructure is not completed in time. However, host communities are experiencing benefits from new infrastructure provided at resettlement sites, which they will be able to access, even if it is initially delayed.

Figure 17-7 - School No. 28 at Darband, Nurobod District (September 2024)



Figure 17-8 - Medical Centre at Yoli Garmoba, Rogun City, (left) and Maternity Unit at Darband, Nurobod District, (right) (September 2024)



17.4.33. FGDs and household survey data raised the issue of availability of water in new settlements (in Faizobod and Nurobod), but indicated that these issues had been resolved, or will be resolved, before resettlers move. Interviews with Jamoat representatives confirmed that upgrades to electricity and water infrastructure have been implemented in Faizobod and Tursunzoda. Site visit observations in 2024 and 2025 confirmed that water was available in all resettlement sites, but in

some cases the amount needs to be increased by establishing reservoirs or piping water from areas near the resettlement sites.

17.4.34. Infrastructure replacement falls within the remit of DFZ and the above-described evidence shows that, overall, this has been implemented to a standard adequate to maintain and improve living standards for the majority of resettled households. There have been delays in infrastructure replacement, but DFZ has been working with PAPs to ensure that new homes and structures are built more quickly. Both household survey and FGD responses confirm that a large majority of people are positive about the improvements in infrastructure in new settlements, both in terms of what has already been achieved and what is anticipated for the future. There are anecdotal reports of people voluntarily moving to the new settlements in order to take advantage of improved infrastructure, although not in sufficient numbers to cause a strain on resources.

17.4.35. The impact of resettlement on community infrastructure (moderate-sensitivity) is therefore, overall, anticipated to be **Beneficial**, assuming full implementation of the future RAPs. Effects are considered **Positive**, despite the losses of facilities in the Floozing Zone. In line with the RAPs, all essential infrastructure will be in place before resettlement into a site commences, and new infrastructure will be maintained once it is handed over to local jamoat control after the completion of resettlement.

Impact of resettlement on non-resettled communities

17.4.36. The majority of settlements within the flooding zone are small, but social and economic ties between neighboring villages, and between small settlements and local hubs, is high. The resettlement of communities situated within the Flooding Zone will affect the non-resettled communities socially and economically. Businesses will lose customers who are resettled far away, and family and friends may become separated by large distances. Villages located in the upper reaches of tributary valleys will become increasingly remote, although this will be mitigated by the construction of the left- and right-bank roads, which will increase connectivity to hub settlements such as Rogun and Darband, as well as between tributary valleys (provided that slip roads are constructed to connect each valley) (See **Volume 2, Annex 17.3 Severance** for more details). Some villages may also lose access to infrastructure, if facilities such as schools and medical centers are shared with other villages that are resettled.

17.4.37. In Rogun City and Nurobod, this impact is being mitigated by the presence of resettlement sites in the district. Nurobod will be impacted by the highest proportional population loss (31% of the population), but the presence of the large and growing resettlement site at Darband will help to retain and attract people and businesses in the area. Proportional population loss due to resettlement in Rogun City is much smaller (5%), and resettlement sites are also present at Saidoni Nav and Yoli Garmoba. These sites help to add, and retain, potential customers in the area, but additional businesses that develop will also compete with pre-existing businesses.

17.4.38. Rasht currently stands to be the most affected district in terms of population loss. The to-be-resettled population of Rasht currently stands at 21,048, out of a total population of 139,848, equivalent to 15% of its population, with no new resettlement sites currently planned within the district. The district capital Gharm, which has a population of 8,857 (2020 census) and is located approximately 7.5km from the maximum extent of the flooding zone, stands to be particularly impacted. Many residents of the to-be-resettled communities travel regularly to Gharm, some daily, for shopping and public services. The resettlement of these communities will impact shops and other

businesses that receive custom from these villages. Local taxi drivers who provide services connecting the more remote villages to Gharm, and some salespeople who travel to the smaller settlements selling goods that are not readily available will be particularly affected.

17.4.39. The non-resettled communities in the wider Project-affected area have a similar profile to the resettled communities and are a Moderate-sensitivity receptor. The impact of population changes will vary significantly between settlements. Some villages will lose close neighbors and some social and other types of infrastructure may need to be adjusted or replaced; more remote and self-contained settlements will be minimally impacted, and those close to new resettlement sites such as Darband will find the character of the area transformed in both positive and negative ways, depending on their perspective. This is considered a **Moderate** adverse impact, leading to a **Moderate** effect. However, it should be noted that this will not be the case in all settlements and the impact will even be beneficial in some cases.

Demographic and economic impacts on host communities

17.4.40. The in-migration of large numbers of resettlers into an area can have both positive and negative impacts on host communities. On one hand, the increased population can bring social and economic opportunities, but it can also put pressure on shared resources and reduce community cohesion if the new arrivals differ significantly from the host communities. Adverse impacts may also arise if land acquisition to make space for resettlers is not implemented in line with good practice. A full list and maps of the resettlement sites and surrounding areas can be found in **Volume 2, Annex 7.1: Baseline Conditions Report** of this ESIA.

17.4.41. All of the resettlement sites are located in populated districts. However, with the exception of Darband, all of the resettlement sites are located at some distance from existing settlements (100m-1km). Darband is contiguous with the previous settlements of Tirgar, Obilurd and Khumdon, which will become less remote and more peri-urban in character.

17.4.42. The capacity of the areas to accommodate additional population is a key consideration in the selection of resettlement sites. The resettlement sites have been designed to be self-contained in terms of critical infrastructure such as schools and medical centers, and to avoid straining the resources of host communities. There is no evidence to date of negative impacts on host communities' resources due to additional population pressure. Host communities have been consulted through the local jamoats, and FGD participants and jamoat leaders were generally positive about resettlement, due to the increased investment in infrastructure in the area. Some resources (e.g., the school at Toichi in Tursunzoda) have been planned to be shared with host communities. Members of host communities have also begun to find jobs in the new settlements (e.g., a nurse and a teacher in Namuna, who were from host communities).

17.4.43. It was reported that there were some integration issues with the community in Tursunzoda when resettlement commenced, however engagements were carried out to improve community relations, and the issue was resolved. Evidence gathered during the preparation of this ESIA indicated no significant issues with community relations, and relations between resettled and host communities, where they occurred, were found to be positive.

17.4.44. It has been reported at some sites, particularly Darband, that the improved infrastructure has attracted additional households to move voluntarily to the site. While contributing to the economic and social life of the new settlements, additional population also adds pressure on shared resources such as schools, medical centers and roads. The continued management of these settlements after

the completion of resettlement to ensure adequate infrastructure provision for the whole settlement will be the responsibility of the local authorities.

17.4.45. Evidence to date shows that the selection of sites for resettlement has been well planned according to the protocols in place, including cooperation with local jamoats, and there is no evidence of forced eviction. This has been verified to the extent possible. However, the majority of people within the Flooding Zone are yet to be resettled. Additional resettlement sites have been identified: Darband, Obi Lurd, Tukhchi, Hufak and Roghuni Bolo.

17.4.46. will therefore be required. It is undetermined where these will be located.

17.4.47. This is considered to be a **beneficial** impact for the host communities, and the effect is **Positive**. It is assumed that all future sensitization works with host communities before the creation of new resettlement sites will be completed before in-migration of resettlers commences.

Economic displacement

17.4.48. Resettlement will lead to the economic displacement of people working within the Flooding Zone who live in non-resettled communities. As the majority of affected settlements are small villages consisting of residential housing and small facilities (e.g., village schools, medical centers and shops) staffed by residents, this impact will be limited in most cases. The heavy reliance on labor migration for income amongst the affected communities also mitigates this effect. However, there are some larger settlements such as Mehrobod and Navobod, which will likely lead to some job losses when they are resettled. Similarly, significant quantities of agricultural land will be lost (see Table 17-6), though many resettled PAPs will not resume commercial agriculture. Those who do farm commercially have been applying to the MoA for new lands, most of which are available near the resettlement sites. In some cases, agricultural land in the affected districts (particularly Nurobod) is limited due to the terrain and thus some of the plots will be in areas that are further away from the resettlement sites.

17.4.49. **Year 1:** This impact is considered to be of **Medium** magnitude as a relatively small number of people will be impacted, and these will be spread over a large area rather than concentrated in one community. It is not anticipated that any communities will become unviable due to this effect. As the affected people are a high-sensitivity receptor, this is a **Major adverse** effect.

17.4.50. **Year 5:** The affected communities have some adaptive capacity and it is likely that alternative livelihoods will be found over time. The development of Darband may also provide opportunities for those able to commute or move there. Those living in large households with several working adults may also leave the workforce and rely on wider family income, if they can afford to do so. Others may choose to relocate out of the area. It is unlikely that this impact will be a significant driver of poverty in the medium- to long-term, although quality of life will decrease for some. This impact is therefore considered **Small**, leading to a **Moderate adverse** effect in the absence of mitigation.

Loss of agricultural production in the flooding zone

17.4.51. As the land to be inundated is low-lying, agricultural land will be disproportionately affected. Nurobod, which will lose 11,684ha, equivalent to 12.6% of its total area, but this includes 59.7% of fields, 46.3% of perennial crop land, and 22.9% of Presidential land, as well as 26.3% of forest and scrub land. Rasht and Rogun City will lose a much smaller proportion of their land area, but the land that will be lost is disproportionately agricultural. Rogun City has no fields or perennial crop lands but will lose 13.6% of Presidential land. Rasht will lose 9.4% of perennial crop lands and 8.2% of fields

(but just 1.3% of Presidential land). A full summary of land types to be lost is provided in **Volume 2, Annex 7.1: Baseline Conditions Report** of this ESIA.

Table 17-5 – Losses of agricultural land and population in the Project-affected districts

Land type	% loss by district		
	Rogun City	**Nurobod**	**Rasht**
Fields	-	59.7	8.2
Perennial crops	-	46.3	9.4
Presidential land	13.6	22.9	1.3
Total land	1.4	12.6	1.0
Population affected by resettlement (excluding in-migrants)	5	31	15

17.4.52. This loss of agricultural land could affect commercial food production. As agricultural land is state-owned, people losing their commercial plots who wish to continue farming are able to apply to be allocated a new plot through the MoA, although, given the geography of the affected area with steep mountains surrounding the affected area, some equivalent plots will not be readily available in the resettlement areas, but in nearby areas. The reduction of commercial food production may require more food to be brought in from other areas, which may incur price rises or a reduction in the availability of fresh produce. The profitability of smaller food retailers will also be affected if their costs are increased by a reduction in local supply. Resettlement will decrease the population of some of the affected districts, and thus total food demand. In Nurobod and Rogun City the loss of agricultural land is larger than proportional population loss, even before in-migration to resettlement sites is considered. This is a **Large** impact on a high-sensitivity receptor, leading to a **Major** adverse effect. The change is permanent and irreversible, in the absence of mitigation (see Section 17.5).

Retrenchment

17.4.53. The Project has been one of the largest employers in the area for many years due to the very large construction workforce required. The Project impacts on workers are assessed in **Chapter 19: Labor and Working Conditions**.

17.4.54. Following the employment peak later in the 2020s, the workforce will reduce gradually. This reduces the impact of reduced employment opportunities on the community as a whole, as there will not be a sudden rise in unemployment, but rather a transition over several years. As the majority of the workforce live more that 50km from the Project (77%) the impact will also not be entirely concentrated in one geographic area and will be felt to some extent throughout Tajikistan, although it will be most acute in the immediate vicinity of the Project.

17.4.55. There may be an increased need for labor migration outside of Tajikistan amongst former Project workers if suitable alternative employment opportunities are not available locally. There are additional HPPs planned for the Vakhsh cascade (e.g., at Shurob which is planned to commence

construction after Rogun), but these plans are in the early stages of development, and the timeline and size of the required workforce are yet to be determined.

17.4.56. The receptor sensitivity is moderate-high, and the impact magnitude is assumed to be **Large** on a precautionary basis. The effect is therefore **Major adverse**.

Impacts on Gender and Vulnerable Groups

17.4.57. This section presents any differentiated and additional effects (positive and adverse) on women and vulnerable groups, resulting from the impacts identified above. The justification for why certain groups are considered vulnerable is presented in **Annex 7.1: Baseline Conditions Report** of this ESIA. These can be groups who suffer additional or more severe adverse impacts or are less able to benefit from beneficial impacts (even if no adverse impacts occur). Further detail on specific issues affecting women, and measures to be put in place to manage these, are found in the **Gender Action Plan (GAP)** and **Volume 2, Annex 17.1: Gender** of this ESIA.

Direct economic impacts of Project employment and procurement

17.4.58. Women and other vulnerable individuals will gain some benefits from employment on the Project if they are able to find work. Women comprise approximately 5% of the total workforce at the dam, the majority of whom work in domestic roles such as cooks and cleaners, as well as a minority in professional roles such as nurses or Human Resources (HR) specialists. The Project has also led to legal changes to reduce the number of professions which are banned for women, and a training centre in Rogun City has opened which has residential accommodation space for women with children. Some jobs are available that are suitable for other groups identified as vulnerable, such as people with disabilities, the illiterate, and young people lacking skills or education.

Indirect Economic Impacts on the Project AoI

17.4.59. Women and other vulnerable individuals will benefit from indirect economic impacts. Indirect Project spend by workers and visitors supports a range of businesses in Rogun city and nearby settlements, including those that are more readily accessible to those unable to undertake heavy manual labor (e.g., shops, guest houses). Additionally, all members of a workers' household benefit from the relatively high salaries and reduced need for labor migration due to employment with the Project, regardless of whether or not they are themselves working.

Physical resettlement and asset compensation

17.4.60. All key resettlement decisions are the responsibility of the Head of Household (HoH). Women comprise 18% of HoH within the resettled population. For women who are not HoH, their influence varies greatly between households, depending on household dynamics, age, and other factors. This leaves them vulnerable to resettlement decisions being made that are not in their interest, including being separated from friends and family. However, very few instances have been identified of women stating that they were resettled to a site chosen by their parents or husbands with no input from themselves or against their wishes, beyond a small number of anecdotal reports from the household survey. DFZ have also organized consultations with women, although these were sometimes informal.

17.4.61. Households with no able-bodied adult men within the household face additional challenges with house reconstruction. Typically, women, elderly people and people with disabilities will be unable to carry out the reconstruction themselves and have to spend money on laborers. However, it is possible for those who apply to their jamoat to be provided with laborers at no cost. The entitlement

is formalized in the Entitlement Matrix of the RLRF (2024), which is reflected in the 2017-2026 RAP 2 and will be included in future RAPs.

17.4.62. A Head of Family (HoF) – male or female – can receive a land plot. This benefit is supported by resettled communities and has been confirmed in the Entitlement Matrix (RLRF (2024)). This measure benefits female-headed households, granting additional independence and financial security, as they can independently construct their new homes and cultivate gardens.

17.4.63. Very poor households will benefit from physical resettlement, as the uniform 0.08h size of plots will increase the land available for those who previously had the smallest plots. Households that split into several families (each provided with new land plots once resettled) will significantly increase the total land available to them.

17.4.64. HoH who face difficulties completing the administrative processes associated with resettlement, for example illiterate HoH, recently divorced or widowed women who are newly HoH, or elderly HoH, may experience worse outcomes in resettlement, for example if they do not understand the compensation calculation process and are unable to negotiate. Support for those who are not legally or financially literate is included as an entitlement in the 2017-2026 RAP 2, and the RLRF (2024) which will guide the development of future RAPs.

17.4.65. People living in residential care institutions are among the most vulnerable in society, as they are unable to live independently and require care from specialist professionals. The Project will require orphans and psychiatric in-patients to be resettled. This includes an orphanage in Navobod which accepts children from throughout the Rasht District, and the psychiatric hospital in Navobod which accepts in-patients from across Tajikistan. Current staff may not be able to continue working at the reconstructed facility if they are not also resettled to the same location as the facility. Even if suitable replacement staff can be found for a reconstructed facility, the personal bonds between carers and the vulnerable residents at these facilities will be lost, which may result in psychological distress and a reduced quality of care, at least temporarily.

17.4.66. The effects of physical resettlement will differ significantly between the affected vulnerable groups. Some, such as women gaining additional independence by becoming HoF and having their own land plot for the first time, or poor households gaining larger plots than they had previously, will benefit. Measures are already in place through DFZ, the jamoats and the RAPs to assist certain groups requiring additional support. Significant risks are, however, present for residents in residential care institutions, whose care will be severely disrupted if not carefully planned.

Livelihood disruption and restoration

17.4.67. People and families who are already living in poverty are less able to manage any additional hardship caused by resettlement or loss of livelihood, even a relatively small or temporary loss of income. Physical resettlement can break kinship networks which these households and individuals often rely on.

17.4.68. Women, and other groups whose employment options are more restricted, will also take longer to restore their livelihoods if they are lost. However, they are less likely to be impacted due to lower labor force participation – just 12% of women in the Project AoI have an income, and, of those, more than half obtain this income from pensions. Pre-resettlement female Focus Group Discussion (FGD) participants, and some men from the communities, expected increased opportunities for women to enter paid employment after resettlement, and some post-resettlement FGD participants stated that some had succeeded in doing so.

17.4.69. LRP 2, and future LRPs, will help women and other vulnerable groups to access support to improve their livelihoods. MoLMEP provides targeted support to women and disabled people. National welfare programs are also available to the very poor and those unable to work, which can be accessed by self-reporting to the jamoat.

Loss and Replacement of Community Assets and Infrastructure

17.4.70. Where social infrastructure is not replaced in time or adequately, this can result in women compensating by taking on additional responsibilities. For example, when schools or residential care facilities are not operational, women care for children or sick/elderly relatives at home and are prevented from working outside the home. Elderly and disabled people requiring care from outside the home will suffer deteriorating health and/or quality of life if these services are not restored adequately or on time. DFZ is working with relevant ministries and jamoats to ensure that key facilities, such as medical facilities, are established early in the resettlement communities.

Impact of resettlement on non-resettled communities

17.4.71. Disruption to community networks due to resettlement will have more severe impacts for more vulnerable individuals, who are more likely to rely on informal kinship networks for support. Some individuals are likely to be impacted in the non-resettled communities identified with close links to a resettled village. Over time, social networks can be restored to some extent, and people who cannot manage independently may also have the option to voluntarily relocate, for example moving in with family members, which will mitigate this impact to some extent.

Demographic and economic impacts on host communities

17.4.72. No differentiated impacts on women or vulnerable groups within host communities are anticipated. As with other groups, any impacts are likely to be beneficial provided good practice in line with the RAPs is implemented; employment opportunities and improved infrastructure.

Economic displacement

17.4.73. Economic displacement is anticipated to impact a small number of people, some of whom will be women or members of vulnerable groups. These groups have less adaptive capacity than other community members, as they typically have a more restricted range of possible livelihoods. Targeted programs for vulnerable groups are included in the LRP.

17.4.74. MoA currently provides the following:

- A seed and seedling program for female-headed households, people with disabilities and the elderly.
- Free farming equipment for vulnerable families.
- Support for female-headed households with less the 5ha of land.

17.4.75. MoLMEP also provides support for women, female-headed households and people with disabilities. However, this support is predicated on self-reporting to the jamoat. DFZ has been working to ensure vulnerable groups are aware of these programs.

Loss of agricultural production in the flooding zone

17.4.76. Impacts of food availability, price and quality will impact all within the affected districts, but those with the fewest resources have the least capacity to adapt and will therefore be worst affected.

Retrenchment

17.4.77. The direct impact of retrenchment will be smaller for women and other vulnerable groups that are less likely to be employed on the Project (e.g., people with disabilities). However, indirect impacts on other household members will occur when employment on the Project is no longer available. This will include wives, children and other dependents, such as elderly and disabled family members who are unable to work. If large job losses amongst the male population result in increased labor migration, adverse impacts will occur for women remaining at home, whose household and agricultural responsibilities increase, and whose opportunities outside the home decrease. In the absence of new employment sources in the area, this impact could be permanent.

Summary of effects on women and vulnerable groups

17.4.78. A wide range of impacts will be experienced by women and other groups considered vulnerable from the point of view of the Project. These impacts will range from **Large** to **Beneficial**, causing effects ranging from **Major Adverse to Positive**.

OPERATION

Direct economic impact of Project operational employment and procurement

17.4.79. It is estimated that, after commissioning, Rogun HPP JSC will employ around 800 people at the fully operational HPP. Some operational workers (both technical and administrative) are already in place, most of whom currently live in on-site accommodation and who are working the same shift pattern as construction workers. The operational phase will generate long-term employment opportunities mainly for HPP operation and maintenance, and environmental, health and safety, and monitoring activities. A significant proportion of these operational roles will be permanent positions. It is unlikely that all operational workers will reside on-site and will instead settle permanently in established local communities such as Rogun City. Employment on the Project will be managed by JSC Rogun plans, policies and procedures.

17.4.80. The Project will continue to procure goods and services from businesses of different scales during operation, e.g., parts for maintenance. This will continue to benefit the affected businesses, although on a much smaller scale than during construction.

17.4.81. The local economy is a high-sensitivity receptor, and the impact is expected to be **beneficial**. The effect is therefore **Positive**.

Indirect economic impacts of the operational HPP

17.4.82. Operational employment will provide indirect benefits to the local economy, although on a much smaller scale than provided during the construction phase. Due to the anticipated **Beneficial** impacts arising from the indirect employment, effects are considered **Positive**.

Indirect economic impacts of the completion of construction

17.4.83. Rogun City has been economically reliant on the Project since its inception in the 1980s. The HPP is the largest employer in the town, and the majority of other businesses and livelihoods are directly or indirectly supported by it due to the high wages paid, and workers and business visitors being attracted to the town. The construction workforce will reduce gradually up until the Project is operational, therefore the impacts of a reduced population size will also affect locally businesses progressively. Total spending in the local economy is anticipated to reduce as the Project construction comes to a conclusion, which will affect businesses and livelihoods locally.

17.4.84. Given the number of people employed on the Project and the long timescale over which people have become reliant on it, this impact will be **Large**. The effect is therefore **Major Adverse**.

Improved energy supply in Tajikistan and the wider region

17.4.85. The primary purpose of the Project is to improve energy supply in Tajikistan. Currently, shortages are a significant problem for the country and blackouts are a regular occurrence, particularly in the winter. This negatively impacts quality of life and economic development. The additional power generated by the fully operational Project is expected to resolve these shortages and provide additional energy for export in the summer. Sale of excess will also generate revenue for the economy of Tajikistan. Furthermore, the GoT has committed to allocate 3% of the revenue from energy sales to support measures to assist the poor and vulnerable and improve social safety nets, increasing to 5% after the completion of construction, to be allocated at a national level.

17.4.86. The partially-operational Project has already generated sufficient excess to enable international sale to nearby countries, including Kazakhstan, which signed a PPA, Uzbekistan, and Afghanistan and Pakistan, which benefit from the CASA-1000 project. It is estimated that around 70% of the energy will be exported. While this will be sold for profit, it is anticipated that the price will be affordable and that polluting, expensive fossil fuel generation will be displaced.

17.4.87. This is a **beneficial** impact, leading to a **Positive** effect for both Tajikistan and other countries where the power is used.

17.5 MITIGATION AND ENHANCEMENT MEASURES

17.5.1. This section presents measures to enhance positive effects, and mitigate adverse effects, from the impacts identified above. Where no mitigation is required, or no enhancement is possible, the impact will not be further discussed in this section.

CONSTRUCTION

Physical resettlement and asset compensation

Livelihood disruption and restoration

Loss and Replacement of Infrastructure for Resettled Communities

17.5.2. All aspects of resettlement and livelihood restoration will be mitigated to the extent possible through the implementation of RAPs and LRPs. The RAPs and LRPs define and quantify the entitlements of PAPs to compensation, livelihood restoration support, and other benefits, and are publicized to maximize awareness of these entitlements.

17.5.3. In order to ensure sufficient budget allocation, DFZ and the GoT are preparing future RAPs and LRPs in advance of resettlement commencing in the affected districts, in line with the RLRF (2024). When resettlement in Rasht commences, preparations will be made to allocate additional budget for asset compensation than in previous RAPs, due to the improved quality of housing in that District relative to Rogun and Nurobod.

Impact of resettlement on non-resettled communities

Economic displacement

Loss of agricultural production

17.5.4. The type and scale of the impact on non-resettled communities will determine the appropriate mitigation. People residing in settlements which remain viable overall, but whose livelihoods are affected by the loss of productive assets or business customers, will benefit from access to national programs which assist people to improve their livelihoods. To mitigate impacts on non-resettled communities in the Project AoI, the LRPs will be shared widely with host and nearby communities in the Project-affected districts by MoLMEP. This will raise awareness of the programs that are available to all Tajik citizens and will assist affected people to adapt or find new livelihoods.

17.5.5. Particular issues exist for some settlements that are losing access to shared infrastructure with villages that are being resettled. Ensuring infrastructure provision is the responsibility of the relevant Ministries (e.g., Ministry of Health, Ministry of Education) and local authorities. Adequate coverage must be ensured by either providing replacement infrastructure at the remaining village, or, if this is not practical, increasing capacity at facilities in nearby settlements.

17.5.6. **Chapter 12: Soils and Geology** of this ESIA contains plans for high-quality agricultural soils that will be lost to be stripped and moved further up the slopes. A protocol will be developed to re-establish the soils and prevent erosion. It is estimated that productivity will be restored within 3 years, although there will be a need to ensure that the soils are maintained, e.g., replenishment with compost, in the intervening years. As agricultural land belongs to the government, an application to the MoA will have to be made by those wishing to commence farming on the new soils.

17.5.7. The restoration of livelihoods, social networks and agricultural production takes time, and these mitigation measures will take several years to be fully effective. However, if they are implemented in full, the impact size will be reduced to **Small** by Year 1, leading to a **Moderate Adverse** effect as economically displaced people adapt to new livelihoods, and **Very Small** by **Year 5**, leading to a **Minor Adverse** effect. Psychological impacts of the loss of friends and neighbors will remain, and farming on the steeper slopes will be more challenging, e.g., due to the increased need for erosion prevention. Communities will continue to adapt over time, further reducing the impact.

Demographic and economic impacts on host communities

17.5.8. To date, resettlement has brought benefits to host communities, with no significant adverse impacts identified. Good practice must therefore be maintained when additional sites are identified. The 2024 RLRF contains requirements for land acquisition and community consultations when new resettlement sites are identified. These requirements will be included in future RAPs.

Retrenchment

17.5.9. A Retrenchment Plan should be completed and implemented to mitigate the impacts of the Project reducing its workforce, and the changing skills demand, during the shift to operation.

17.5.10. Retrenched Project workers also have the right to access MoLMEP support available to all Tajik citizens. The Retrenchment Plan will include information about these programs as identified in the most LRP which is most current at the time when the full Retrenchment Plan is due to be implemented. This will enable workers to access training and alternative livelihood opportunities.

The types of livelihoods that are available will depend on wider efforts to develop Rogun City in the absence of Project construction work.

17.5.11. The implementation of a full Retrenchment Plan will reduce the impact magnitude from Large to **Small**, leading to a **Moderate Adverse** effect.

Impacts on Gender and Vulnerable Groups

17.5.12. Many of the identified impacts on women and vulnerable groups that have been identified are either beneficial or are mitigated to the extent possible by existing management measures or general mitigation measures, but a few unmitigated adverse impacts remain. Targeted mitigation measures for these specific impacts, as well as additional enhancement measures that can be implemented, are presented below.

Impact from physical resettlement on people living in residential care

17.5.13. The impacts on these groups can be mitigated by minimizing the physical distance over which they are moved. This may also enable some key staff to remain working in the institutions, provided that they too remain living locally. It is recommended that DFZ consider measures to encourage any resettlers working at these facilities to remain local; for example, in the event that a to-be-resettled worker is HoF, giving them the option to choose a land plot in the area where the new facility is located. Of the current resettlement sites, the most suitable location for the relocated psychiatric hospital and orphanage is Darband, given its relatively accessible location (after the completion of the new roads), and large size, which will maximize the number of potential replacement workers within the community. It is also recommended that DFZ gain external advice from international resettlement specialists in order to plan the resettlement of these facilities.

Impact of resettlement on vulnerable individuals within non-resettled communities, including loss of kinship networks and economic displacement

17.5.14. Wider publicizing of the existing support measures through the LRP, to be shared in all potentially impacted settlements, will enable individuals or households who are eligible for support to access it.

17.5.15. DFZ, with the help of national and local authorities (Hukumats/jamoats) will conduct an information campaign to raise awareness of benefits available to those who are unable to work. Increased funding for these programs through the benefits-sharing mechanism will mitigate the budgetary impact of increased numbers of applicants.

Summary of mitigation and enhancement measures for women and vulnerable groups

17.5.16. The targeted mitigation measures to reduce particular additional impacts for women and vulnerable groups will reduce the magnitude of these adverse impacts from Large to Small. The range of impacts for women and vulnerable groups will therefore be **Moderate Adverse to Positive**.

OPERATIONAL

Indirect economic impacts of the completion of construction

17.5.17. In order to ensure that Rogun, and other settlements that are heavily reliant on Project employment, remain viable, the area must be re-oriented towards new economic sectors. This can only be achieved with careful planning and investment, led by the GoT, in cooperation with local authorities, MoLMEP, and Rogun JSC. Work on the future development of the town must commence as soon as possible, in order for plans to be ready to come into effect when the Project construction workforce

begins to decrease. The relevant authorities must also consult with affected communities to identify their preferences with regard to future development, and possible solutions for implementation. In order to maximize long-term resilience of affected communities, any future plans must consider a range of possible livelihoods.

17.5.18. It is recommended that planning for the economic re-orientation of the area be combined into a comprehensive Regional Development Strategy to be led by the GoT. This should:

- Identify community, local and national priorities for the long-term development of the Project AoI;
- Develop detailed objectives;
- Provide a roadmap of realistic steps to meet these objectives; and
- Allocate funds to support the desired outcomes.

17.5.19. Strategic economic planning for a large population is a complex undertaking to be carried out in conjunction with affected communities. However, some recommendations are provided for consideration, based on data gathered during the preparation of this ESIA.

17.5.20. The GoT is interested in using the Project to support the development of tourism as an alternative source of livelihoods and income after the completion of construction. This was mentioned by several FGD participants, some of whom hoped to open hospitality businesses, showing that the public is aware of this interest. The LRP and Benefit-Sharing Program provide opportunities to develop proposals by the communities around the reservoir.

17.5.21. The GoT lists as its priorities for tourism development:

- Ecological and nature tourism;
- Medical and health tourism;
- Recreational, historical and cultural tourism;
- Mountaineering; and
- Recreational hunting.

17.5.22. Any plan to increase tourism should include, as a minimum, the following elements:

- An assessment of the carrying capacity of the area to support tourists, without causing unacceptable disruption to local communities or environmental damage;
- Types of tourism that are most practical and acceptable in the region (e.g., mountaineering, water sports);
- Possible hubs for tourist infrastructure (e.g., Obigarm, Darband, Gharm);
- Measures to support equal opportunities and inclusion, particularly for women and vulnerable groups;
- Community sensitization to help them to adapt to the changing economy; and
- Required tourist infrastructure (e.g., hotels, chalets, transport infrastructure from Dushanbe, as well as basic infrastructure such as constant water supply and good quality roads) and skillsets (e.g., tour guides, hospitality work, language skills) to be developed in local communities, and the investment that is required to develop these.

17.5.23. While fewer PAPs will engage in commercial agriculture, it is an important part of the Tajik economy. It is recommended that MoA plan for future agricultural development in the area. This could include plans for modernization and increased efficiency of agricultural techniques, while avoiding environmental damage. The remote rural setting, relatively clean environment and availability of fresh produce also supports the objective of developing tourism in the area.

17.5.24. Many PAPs interviewed during the household surveys expressed an interest in small businesses and self-employment. MoLMEP currently offers, and is expected to continue to offer, various programs to help people to find new livelihoods and start businesses. It is recommended that MoLMEP continue information campaigns in the Project area after the completion of construction, resettlement and LRP implementation, in order to assist those remaining in the area to identify support to re-orientate their livelihoods.

17.5.25. With sufficient planning and investment, it is anticipated that Rogun could be transformed from a town supported by construction, to a more diverse and resilient community with a range of livelihoods available. This will be a **Positive** effect for the community.

17.6 RESIDUAL EFFECTS

17.6.1. Residual impacts are impacts that remain after the implementation of mitigation and reflect the efficacy of the specific mitigation measure. The mitigation measures are implemented by the relevant party to manage the social performance of the Project and monitoring of the mitigation measures provides the data required to report to the regulatory authorities, Lenders and other stakeholders.

17.6.2. The periodic review of the mitigation measures must consider the residual impacts of the impact assessment to benchmark implementation performance.

CONSTRUCTION

17.6.3. Most socio-economic construction impacts result in effects that are either positive, or adverse in the short term but positive after several years as existing management measures take effect. These beneficial impacts do not require mitigation and fall mainly to those working for the Project directly or indirectly or resettlers. Adverse impacts could be felt by some non-resettled communities due to the loss of social and economic infrastructure located within the flooding zone. These impacts can be mitigated and the significance of the effects reduced to Minor-Moderate Adverse.

OPERATION

17.6.4. The operational impacts of the Project will lead to Positive effects, assuming effective measures can be implemented to support the future development of the area.

17.7 SUMMARY

17.7.1. During the construction phase, positive effects are anticipated to arise from direct employment, indirect economic impacts, and through the implementation of the RAPs and LRPs. Significant adverse effects are expected to be experienced as a result of short-term impacts of resettlement and livelihood disruption and impacts on non-resettled communities that are socially and economically linked with resettled villages.

17.7.2. Once operational the Project is expected to bring positive effects resulting from direct and indirect economic impacts, and improved energy supply for both Tajikistan and nearby countries purchasing excess power. Significant adverse effects may occur as Rogun adjusts to the completion of construction and associated decrease in employment and spend in the local economy, but this can be mitigated with effective planning led by the GoT to re-orient the town towards new economic sectors.

Table 17-6 – Summary of Socio-economic Impacts (Construction) – Section 1

Impact	Direct economic impacts of employment and procurement for the Project	Indirect economic impacts on the Project AoI	Physical resettlement and asset compensation	Livelihood disruption and restoration	Loss and Replacement of Infrastructure for Resettled Communities	Impact of resettlement on non-resettled communities
Receptor sensitivity	High	High	High	High	Moderate	Moderate
Frequency	Constant	Constant	Constant	Constant	Constant	Constant
Likelihood	Certain	Certain	Certain	Certain	Certain	Certain
Extent	National	Regional	Regional	Regional	Regional	Regional
Duration	Medium-term	Medium-term	Permanent	Permanent	Permanent	Permanent
Magnitude	Beneficial	Beneficial	Medium (Year 1) to Beneficial (Year 5)	Medium (Year 1) to Beneficial (Year 5)	Beneficial	Medium
Effect type	Positive	Positive	Adverse and Positive	Adverse and Positive	Positive	Adverse
Direct / Indirect	Direct	Indirect	Direct	Direct	Direct	Direct
Significance	Positive	Positive	Major (Year 1) Positive (Year 5)	Major (Year 1) Positive (Year 5)	Positive	Moderate
Mitigation (Y/N)	N	N	N	N	N	Y
Residual Significance	Positive	Positive	Major (Year 1) Positive (Year 5)	Major (Year 1) Positive (Year 5)	Positive	Moderate (Year 1) Moderate (Year 5)

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Table 17-7 - Summary of Socio-economic Impacts (Construction) – Section 2

Impact	Demographic and economic impacts on host communities	Economic displacement	Loss of agricultural production	Retrenchment	Impacts on gender and vulnerable groups
Receptor sensitivity	Moderate	High	High	ModerateHigh	High
Frequency	Constant	Constant	Constant	Once	Constant
Likelihood	Certain	Certain	Certain	Certain	Certain
Extent	Regional	Local	Regional	National	Regional
Duration	Permanent	Permanent	Permanent	Permanent	Medium-term and permanent
Magnitude	Beneficial	Medium (Year 1) to Small (Year 5)	Large	Large	Large to Beneficial
Effect type	Positive	Adverse	Adverse	Adverse	Adverse and Positive
Direct / Indirect	Indirect	Direct	Direct	Direct	Direct and indirect
Significance	Positive	Major (Year 1) Moderate (Year 5)	Major	Major	Major to Positive
Mitigation (Y/N)	N	Y	Y	Y	Y
Residual Significance	Positive	Moderate (Year 1) Minor (Year 5)	Moderate (Year 1) Minor (Year 5)	Moderate	Moderate to Positive

Table 17-8 - Summary of Socio-economic Impacts (Operation)

Impact	Direct economic impact of Project operational employment and procurement	Indirect Economic Impacts of the operational HPP	Indirect economic impacts of the completion of construction	Improved energy supply in Tajikistan and the wider region
Receptor sensitivity	High	High	Moderate-High	Medium
Frequency	Constant	Constant	Constant	Constant
Likelihood	Certain	Certain	Certain	Certain
Extent	Local	Local	Local	International
Duration	Long-term	Long-term	Long-term	Long-term
Magnitude	Beneficial	Beneficial	Large	Beneficial
Effect type	Positive	Positive	Adverse	Positive
Direct / Indirect	Direct	Indirect	Indirect	Direct
Significance	Positive	Positive	Large	Positive
Mitigation (Y/N)	N	N	Y	N
Residual Significance	Positive	Positive	Positive	Positive



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State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT – ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Volume 1, Chapter 18: Community Health, Safety and Security



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18 COMMUNITY HEALTH, SAFETY AND SECURITY

18.1.1. This chapter outlines the assessment of potential impacts of the Project on community health, safety and security (CHSS), in line with the requirements of the World Bank's Environmental and Social Standard (ESS) 4: Community Health and Safety (2016).

18.1.2. A comprehensive description of social baseline conditions is presented in **Annex 7.1: Baseline Conditions Report** and a summary is provided in **Chapter 7: Baseline** of this ESIA. An assessment of the potential Project impacts on CHSS is presented in **Section 18.4**. Where necessary, recommendations for the avoidance of impact, impact minimization and/or long-term management are included.

18.1.3. Previous assessments of the Project have been undertaken including an ESIA completed in 2014, and reports prepared by the Environmental and Social Panel of Experts (ESPoE).

18.2 LEGISLATIVE FRAMEWORK, POLICY AND GUIDANCE

18.2.1. The CHSS assessment has taken account of the relevant legislative, policy and guidance framework. **Table 18-1** sets out international guidance documents that are relevant to this CHSS impact assessment.

Table 18-1 – International guidance relevant to the CHSS assessment

International Conventions and Standards	Requirements
World Bank Environmental and Social Standard (ESS)1: Assessment and Management of Environmental and Social Risks and Impacts	ESS1 outlines the responsibilities of the borrower to assess, manage, and monitor the environmental and social risks and impacts of a project throughout its lifecycle. Under ESS1, the Borrower must develop an Environmental and Social Commitment Plan (ESCP) setting out material measures and actions for mitigation, monitoring agreements and other follow-up actions.
World Bank ESS4: Community Health and Safety	ESS4 addresses the health, safety, and security risks and impacts on project-affected communities and the requirements to avoid or minimize such risks and impacts, with particular attention to people who may be more vulnerable.
ADB Safeguard Requirement 1: Environment	Safeguard Requirement 1 includes the requirement to identify and assess the risks to, and potential impacts on, the safety of affected communities during the design, construction, operation, and decommissioning of the project, and establish preventive measures and plans to address them in a manner commensurate with the identified risks and impacts.
ADB Environment Safeguards: A Good Practice Sourcebook	Identifies key aspects of preventing communities from project-relates hazards, including: • Risk identification and assessment • Establishment of preventive and protective measures • Due diligence regarding contractors and subcontractors

International Conventions and Standards	Requirements
	• Management of natural hazards which could be caused or exacerbated by the Project • Community emergency prevention, preparedness, and response arrangements • Information sharing with communities, local authorities and emergency services regarding key hazards • Requirements for carrying out an independent review of high-risk structural elements or components, such as dams which pose potential risks to downstream communities. In these cases, in addition to local engineering certification requirements, a risk assessment should be undertaken by qualified and experienced external experts.
World Bank ESS4 Annex on Dam Safety	World Bank ESS4 stipulates that 'where the project involves a new or existing dam, the Borrower will provide sufficient resources to apply the requirements on safety of dams, as set out in Annex 1.' ESS4 Annex 1 intends to address dam safety risks and impacts on project-affected communities in a way that is consistent with the mitigation hierarchy that underpins the World Bank Environmental and Social framework (ESF). This applies to all dams over 5m in height with over 3 million m3 retention capacity, as well as smaller dams that may pose safety risks.
Canadian Dam Association (CDA) Guidelines for Public Safety Around Dams (2011)	The terms 'public safety around dams' refers to the risks of accidents or incidents in which a member of the public encounters a hazard created by the presence or operation of a dam. This document is considered Good International Industry Practice (GIIP) for the purposes of this Chapter.
Voluntary Principles on Security and Human Rights	The principles guide companies in conducting a comprehensive human rights risk assessment in their engagement with public and private security providers, to ensure human rights are respected.
The Labor Code of the Republic of Tajikistan (adopted on May 12, 1997)	The law sets down the main principles of government policy in the labor field, provides state guarantees for the rights of citizens, and aims to ensure the legitimate interests of employees, employers, and the state.
The Law of the Republic of Tajikistan on Occupational Safety in the Republic of Tajikistan (adopted on December 24, 1991, with amendments and additions of 22, 1998 and March 5, 2007)	The law lays down the main provisions for ensuring citizens' constitutional rights to occupational safety and guarantees the right to safe labor. It also sets down the main principles of occupational safety in the workplace and envisages economic mechanisms for ensuring occupational safety.
The Law of the Republic of Tajikistan on Public Health (passed on May 15, 1997, No. 419)	The law sets down and regulates the relations between government bodies, officials, citizens, non-governmental organizations and enterprises of any form of ownership in the field of public health.

International Conventions and Standards	Requirements
The Law of the Republic of Tajikistan on State Social Insurance (passed on May 15, 1997, No. 419)	The law provides the legal, economic, and organizational framework of state social insurance for individuals. It does not cover voluntary social insurance. The law provides state guarantees for the insured persons in case of loss of livelihood or income due to illness, occupational accident or disease, disability, pregnancy and childbirth, old age, unemployment, loss of breadwinner, death, and other cases stipulated under the law.

TAJIK LEGISLATION AND REGULATIONS

18.2.2. The Constitution of the Republic of Tajikistan guarantees and protects fundamental rights and freedoms, including those set out in the following Articles:

- Safeguarding nature (Article 22) protects the right to a favorable environment and states that everyone has a duty to protect nature and the environment.
- Right to Health (Article 39) recognizes the right to healthcare and medical assistance and highlights the importance of providing healthcare services to the population. It also indicates the government's responsibility to promote and protect public health.

18.2.3. The following laws are applicable to the Project:

- Law of the Republic of Tajikistan on Air Protection (2012);
- Law of the Republic of Tajikistan on Production and Consumption Waste (2005, last amended in 2011);
- Law of the Republic of Tajikistan on drinking water and drinking water supply (December 29, 2010);
- Healthcare Code of the Republic of Tajikistan of May 30, 2017. No. 1413 (as amended by the Law of the Republic of Tajikistan of 29.01.2021 No. 1762);
- Law of the Republic of Tajikistan on the protection of population and territories from emergency situations of natural and human-made character (July 15, 2004);
- Law of the Republic of Tajikistan on the Safety of Hydraulic Structures (2010 as amended in 2018);
- International Covenant on Economic, Social and Cultural Rights (1976); and
- Occupational Safety and Health Convention (1981).

18.3 ASSESSMENT METHODOLOGY

18.3.1. The approach to the assessment has been to review the proposed Project and baseline conditions, including the characteristics of the population, followed by the identification of risks related to the sector and location of the Project, and the Project activities which may cause an impact.

RECEPTOR SENSITIVITY

18.3.2. To identify the sensitivity of CHSS receptors, categories of relative sensitivity are described in **Table 18-2**, with reference to the baseline information.

Table 18-2 – CHSS Sensitivity Criteria

Sensitivity	Description
High	No or limited access to health services and infrastructure due to factors such as limited or no access to bridges or roads, increased travel cost and danger of using reduced quality roads. No or limited access to critical services such as communication, transportation, power supply, water supply, sanitation because of impacts on available infrastructure. Communities where a high proportion constitutes vulnerable groups, e.g., disabled people and elderly people who require community support. Communities being impacted because of reduced road access and extended journey travel. Communities vulnerable to endemic or non-endemic diseases, and other factors for poor health who require access to health centres. Community dependent on resources shared with the Project that would affect the person but also the project (e.g., water, natural resources). Community members who are highly vulnerable to external shocks or stresses, and who would have very limited ability to adapt to Project changes and maintain their health and wellbeing status.
Medium	The health and wellbeing of the receptor is relatively good but with some sensitivities that make them vulnerable to external shocks or stressors. Health services and infrastructure is accessible and is of medium to good quality. Majority of community have access to critical services such as communication, transportation, power supply, water supply, sanitation, etc. Much of the population is generally in good health and the prevalence of diseases is moderate but vulnerability to diseases is low. Receptors share resources with the Project but are not dependent upon them or alternatives are available. Community members who have some ability to adapt to external shocks or stresses, and maintain their health and wellbeing status, but have some degree of vulnerability.
Low	The receptor is generally healthy and resilient to external shocks or stressors. Health services and infrastructure is accessible, with available capacity, and is of good quality. Community has access to critical services such as communication, transportation, power supply, water supply, sanitation, etc. The majority of the population is in good health and prevalence and vulnerability to diseases is low. Receptors do not share resources with the Project. Community members with effective coping mechanisms who are likely to comprehensively adapt to any Project-induced changes with minimum long-term impact on their health and wellbeing status.

18.3.3. The sensitivity of the identified receptors is defined in Table 18-3:

Table 18-3 – Receptor sensitivity for CHSS impacts

Receptor	Sensitivity	Justification
Residents in Rogun City and nearby settlements in the Project-affected Districts (Nurobod, Rasht) Residents of Pasi muhraho, a village within the construction site Host communities living near resettlement sites	Medium	Tajikistan has a relatively young and healthy population, and basic healthcare services are widely available. Basic primary healthcare is available to the majority of households through the medical centers provided at village level, although more specialist services are less widely available. Basic infrastructure and utilities are available to the majority of the population. Tajikistan has a high birth rate, particularly in rural areas, with a high proportion of young children within the population (40-50% under 18). Vulnerable individuals (e.g., elderly and disabled people) are present in the population, but the proportion is relatively small. The Project's duration is over four decades, and host communities have become accustomed to the arrival of resettlers.
Downstream communities in Tajikistan, Uzbekistan, Turkmenistan and Afghanistan	Medium	Downstream of the Rogun dam, the River Vakhsh flows through Tajikistan for approximately 300km. Much of this area is sparsely populated, although some larger settlements are present, particularly towns adjacent to the downstream HPPs and the city of Bokhtar. The river then flows along the Tajikistan-Afghanistan border, and Uzbekistan-Afghanistan border. Significant populations are present in the border areas, including extensive agricultural settlements on the Afghan side, and the city of Termez in Uzbekistan. These communities comprise low- (Bokhtar and Termez), medium- (rural Tajikistan and Uzbekistan) and high- (rural Afghanistan) sensitivity receptors, considering the health and resources of the population. In aggregate, they are therefore considered a medium-sensitivity receptor.
Vulnerable groups	High	Individuals with particular vulnerabilities to CHSS impacts are considered to be of high sensitivity
Non-residents who are present in the Project AoI	Low	This group includes road users passing through the area on route to another destination, tourists, personal and business visitors, and any other person who is present temporarily in the Project AoI. The sensitivity of this group of receptors to Project-related impacts is low, as they reside elsewhere and their health and wellbeing status is only weakly impacted by the Project. Furthermore, due to the physical difficulty and expense of traveling long distances, it is likely that the majority of visitors maybe relatively healthy and/or affluent people.

ASSESSMENT OF IMPACT SIGNIFICANCE

18.3.4. The Project impacts have been assessed against baseline conditions. The significance of the effect is the outcome of the interaction of the receptor sensitivity and the impact magnitude and indicates

the requirement for mitigation. The post-mitigation outcome has also been assessed to determine the significance of the residual effect.

18.3.5. An evaluation of impacts on receptors takes into account:

- The sensitivity of the impacted receptor;
- The type of impact (positive or negative);
- The timing and frequency of the impacts;
- The likelihood of the identified impact;
- The duration, and extent of the impact; and
- The ability of the affected receptor to recover from temporary impacts (resilience).

18.3.6. The description provided in **Table 18-4** summarizes the categories used to assess the magnitude of the impact in relation to community health, safety and security.

Table 18-4 – Impact Magnitude Categories

Magnitude	Description
Large	Impact affects the majority of the area or population in the Area of Influence and/or persists over many years. The impact on the natural and socio-economic environment may be experienced over a regional or national area. Fatal accident, caused by the Project to a member of the community. Project security staff engages in serious inappropriate conduct towards local communities such as unsanctioned and/or aggressive use of force. Serious breaches of applicable law and relevant guidelines such as the United Nation's Code of Conduct for Law Enforcement Officials occur. A large labor force is required which cannot be supplied by the local workforce due to the quantity of workers required, and / or skill levels available locally, therefore the majority of workers are hired from elsewhere. Frequency of conflicts between workers and community members. The overtax of local resources for example medical care, water, sewer and road infrastructure.
Medium	Change is a clearly evident difference from baseline conditions. Impact affects a substantial area or number of people and/or is of medium duration. Frequency may be occasional, and impact may be regional in scale. Severe injury caused by the Project to a member of the community. Minor abuses of authority by Project security staff occur, and relationships with local communities are poor. The local workforce are able to supply most unskilled labor requirements for the Project, with a smaller number of unskilled and specialized staff hired from elsewhere.
Small	Change is a perceptible difference from baseline conditions. Impact is local, rare and affects a small proportion of households, and is of a short duration. Minor accident caused by the Project, or potential safety hazard present (e.g. unattended plant, unfenced equipment dump) experienced by a member of the community. Project security staff act within applicable law and relevant guidelines such as the United Nation's Code of Conduct for Law Enforcement Officials, but the presence/activities of security staff cause inconvenience to local communities.

Magnitude	Description
	Workers required for the Project can be found within the existing local workforce, and most, but not all, skill gaps can be filled by training these local workers.
Very small	No expected measurable effect on the health, safety and security status of people or communities, change imperceptible from baseline situation. No labor migration is required to fill the employment requirements for the Project.
Beneficial	Improvement on baseline conditions e.g. improved access to healthcare or sanitation.

18.3.7. The receptor sensitivity category in **Table 18-2** and the impact magnitude category in **Table 18-4** combine to provide a qualitative assessment of the resulting impact.

18.3.8. The matrix for assessing significance of effects is shown in **Chapter 5: Impact Assessment Methodology** of this ESIA and effects that are classified as moderate or major are considered to be significant effects. Effects classified as minor or negligible are considered to be not significant.

18.4 POTENTIAL IMPACTS

18.4.1. CHSS impacts will mainly affect the settlements that are in close proximity to or within the construction area for the Project, and roads used to access these areas. Impacts may also be experienced by villages affected by resettlement (out- and in-migration, as well as infrastructure impacts). Residents of these areas may experience potential health, safety and security impacts during the construction period.

18.4.2. Once operational, health, safety and security impacts may affect settlements in proximity to the edge of the reservoir area.

CONSTRUCTION

Drowning

18.4.3. The partially-filled reservoir poses a risk of drowning, primarily to local communities (medium-sensitivity receptor).

18.4.4. Although the reservoir is not in use by communities for daily activities, the risk of community members entering the reservoir voluntarily or accidentally may increase as the extent of the reservoir expands. The most significant risk at present arises from accidents (fall from a bridge or road traffic collision on the right bank road), although it is possible that interest in using the reservoir recreationally (swimming, fishing, boating) may increase as it rises and approaches settlements, and the volume of construction activities decreases. There is also a risk of drowning for animals, which poses a secondary risk to people who may enter the water to rescue pets or livestock. There are no known incidents in which members of the public have drowned, although several incidents involving drowned livestock are documented.

18.4.5. There are currently no settlements directly at the reservoir water level. The most likely risk is therefore present on the bridges, as well as sections of the right-bank public road which are located on steep slopes directly above the reservoir. As the reservoir rises, it will approach and submerge the villages to be resettled. The resettlement program is currently progressing significantly above the water level. The Resettlement Action Plans (RAPs) set a pace of resettlement which will assume that all resettlers vacate their villages long before the water level is close enough to be a hazard.

Some settlements will, however, be on the shoreline at full operation level (e.g., the resettlement site Saidoni Nav).

18.4.6. Responsibility for reservoir safety lies with the Military Mining and Rescue Service (MMRS), which includes monitoring and clearing the reservoir. In line with Order No.161 of the Chairman of the Committee for Emergency Situations and Civil Defense of the Republic of Tajikistan (dated 12th June 2023), the MMRS monitor the reservoir continuously and have a permanent presence on site. The MMRS, jointly with Rogun JSC, have also undertaken training sessions with Project workers regarding safety, and have installed 'No fishing or swimming' signs in dangerous areas.

Figure 18-1 - Reservoir clearing by the MMRS



18.4.7. The receptors affected by this impact are likely to be predominantly residents in Rogun City and nearby settlements in the Project-affected Districts (Nurobod, Rasht), as well as non-residents who are present in the Project AoI (medium/low sensitivity). This risk is assessed to be of **Medium** magnitude, considering the potentially serious consequences of an incident, as well as the measures currently in place to manage the risk and the absence of any known human drowning incidents to date. The effect is therefore **Moderate** adverse.

18.4.8. Discharge patterns from the project and downstream fluctuations in water level also present a drowning risk, however this is not considered to be significant given the absence of residential settlements, or any other sites likely to attract members of the public, between Rogun and Nurek. Discharge patterns from Nurek will not change (see **Volume 1, Chapter 13: Water**) therefore there will be no increased risk of drowning in communities downstream of Nurek as a result of the Project.

Collision Risk with Construction Vehicles

18.4.9. Construction vehicles may collide with people, livestock, property, or other vehicles, causing injuries and damage. In a serious incident, fatalities or debilitating injuries may occur. Heavy vehicles can also cause damage to local roads, making journeys by local route users more difficult and hazardous. This risk occurs on local roads shared between construction and local traffic, especially within the site for residents of Pasi muhraho.

18.4.10. Routes to the construction area do not have segregated paths for pedestrians, resulting in roads being shared by local road traffic and heavy vehicles accessing the Site. In more built-up areas, particularly Rogun City, roads are also used by pedestrians, including young schoolchildren. Within the Project construction site, access to Pasi muhraho is also via a road which is shared with construction traffic and villagers, both in cars and on foot. Children from this village are most at risk from these vehicles.

18.4.11. Roads without paved, or hard-standing, surfaces that are used to access the Site are vulnerable to damage, with some currently in poor condition. Poor road conditions result in erratic driving patterns, as drivers avoid large dips and bumps.

18.4.12. The receptors affected by this impact include residents in Rogun City and the Project-affected districts (medium-sensitivity), non-residents present on transport routes in the Project AoI (low sensitivity), and residents of Pasi muhraho (medium sensitivity). The magnitude of this impact is assessed as **Medium** for local communities and road users, due to the consequences of an accident and limited safeguards in place (e.g. pedestrian segregation), and **Large** for Pasi Muhraho residents due to their higher exposure. The effect is therefore **Moderate** adverse, rising to **Major** adverse for residents of Pasi muhraho.

Unauthorized Access to Construction Areas

18.4.13. Construction sites can attract trespassers from the local community, such as curious children or people hoping to steal construction materials. These people could be exposed to hazards such as machinery and hazardous substances.

18.4.14. The Project construction site is fenced at accessible points, and there is one entry point to the site which includes a checkpoint with security forces. Due to the location of construction works within the site, and its distance from most residential areas, the potential for community members to either deliberately or spontaneously enter the construction site is limited. There is one exception however, as the settlement of Pasi muhraho is situated within the construction site, behind the main entrance gate of the construction site. Pasi muhraho is a small settlement comprised of residential properties (approximately 50 households) and a community hall. There is no physical barrier between the settlement and the wider construction site, or segregated access to the settlement from the main entrance gate of the construction site. Children from this village, who have been seen walking to and from school alongside the main route out of the construction site, are most at risk of wandering into areas which are unsafe.

18.4.15. For all settlements apart from Pasi muhraho, the magnitude of the impact is assessed as **Small**, the effect is therefore **Minor adverse**. Due to their proximity to construction activity, and the absence of any segregation between the settlement and the construction site, for the residents of Pasi muhraho the impact is assessed as **Medium**. The effect on this settlement is therefore **Moderate adverse.**

Air Quality

18.4.16. Poor air quality can be caused by dust, generated from driving heavy vehicles/plant along tracks with loose and/or dry soil, blasting grounds works and excavations, or by emissions from construction vehicles, including idling plant. Poor air quality poses a health hazard to the local population, particularly those in close proximity to construction activity, including construction traffic routes. Community members who are more vulnerable to poor air quality due to existing health conditions, such as chronic obstructive pulmonary disease (COPD) or asthma, are most at risk of experiencing impacts to their health from construction activity.

18.4.17. **Volume 1, Chapter 8: Air Quality** of this ESIA has assessed the potential impacts of fugitive dust and particulate matter (PM10 and PM2.5) emissions from construction activities and from exhaust emissions (NO_2 and CO) from on-site plant and traffic.

18.4.18. Due to the distance of community residential settlements from construction activity, and the intermittent nature of construction road traffic, the magnitude of this impact is assessed as **Small**, the effect is therefore **Minor adverse**.

Water Pollution

18.4.19. Spills and leaks of hazardous substances could affect nearby watercourses, or groundwater used for the local water supply. There are no nearby watercourses although a few drainage channels that convey runoff from the site exist. The groundwater-to-reservoir recharge would be small and insufficient to convey enough pollutants to cause a problem in the reservoir.

18.4.20. The health of local residents could be impacted by drinking contaminated groundwater, which could occur at Construction Camp 1, however there is no use of groundwater at this site, and no regional aquifer, therefore this risk is negligible.

18.4.21. The magnitude of this impact is assessed as **Very small**, the effect is therefore **Negligible**.

Noise and vibration

18.4.22. Noise can negatively impact community members' health and wellbeing by disturbing sleep, damaging hearing or reducing the amenity of the local environment. Construction activities, including vehicle/plant movements, blasting, ground works and excavations, have the potential to generate noise disturbance.

18.4.23. **Volume 1, Chapter 11: Noise and Vibration** of this ESIA has considered construction noise impacts on off-site receptors. Due to their distance from the construction Site and its activities, the magnitude of impact on receptors is assessed as **Very small**, the effect is therefore **Negligible**.

Labor Influx

18.4.24. Labor influx refers to the large in-migration of workers which often occurs for major projects. Typically, this additional workforce consists of young men travelling without their families from other regions or countries. Currently, the majority of Project workers are from Tajikistan, with expatriates, predominantly from Russia, Iran and Uzbekistan, comprising approximately 5.1% of the workforce. 23% of the local workforce are sourced from within 50km of the Project, many of whom commute to the Project site daily. 'Labor influx' in the context of the Project therefore refers both to the non-local workers residing in worker accommodation compounds on site or rented accommodation in Rogun City, and the large numbers of daily commuters from nearby settlements.

18.4.25. Approximately 14,000 of the current 17,200 workers on site (as of May 2025) work 12-hour shifts in construction, on a 15-day or night on/off schedule. Approximately 2,800 office workers work 8am to 5pm shifts. The majority of construction workers remain on site during their 15 days of consecutive 12-hour shifts, and return to their homes for their 15 days of rest. Catering, healthcare and recreational facilities are provided on site for workers, further reducing their need to travel outside the Project site. Around 1500 workers commute daily from the Project site to their homes in nearby settlements.

18.4.26. Labor influx can put pressure on local resources, infrastructure and services, particularly in underserved areas. There is currently some evidence that water services in Rogun City are overburdened as a result of the activities associated with the Project.

18.4.27. Cultural misunderstandings can occur when an in-migrant workforce comes from abroad, and could stem from things such as the consumption of alcohol, hygiene standards, or language barriers. In small communities, a large number of construction workers can overwhelm the local population and lead to a large over-population of young men. This can have implications for safety and security, particularly for local women.

18.4.28. Labor influx can also be associated with violence and crime. Young men away from their families are more likely than other populations to engage in violent behaviors, particularly if they are under-stimulated or consume alcohol.

18.4.29. Both PMG and JSC report that there have been very few incidents of conflict or other adverse interactions between workers and the local communities, including the foreign workers who live in communities near the construction site. The current construction workers' accommodation includes amenities for workers including health, catering and recreational facilities. It is not anticipated that there may be significant impacts on the existing community facilities and infrastructure, as the majority of services for workers are provided within the construction compounds.

18.4.30. The magnitude of the labor influx impact on receptors has been assessed as **Medium** as while there have not been any reported incidents or conflict, there is evidence that the large construction population is impacting local services, resulting in a **Moderate adverse** effect on the local community of Rogun City (medium-sensitivity).

Communicable Disease

18.4.31. Labor influx increases population mixing, which can increase the spread of infectious diseases, particularly if large numbers of people are brought in from outside of the local area. Diseases may spread through regular interactions (e.g., shops or hospitality venues), sexual relationships, or sex work. Overcrowded or unhygienic living conditions in workers' accommodation can also lead to disease outbreaks which spread into the community.

18.4.32. Medical facilities equipped with basic medicines are available on site for workers. Washing facilities are provided in worker accommodation, although substandard sanitary conditions have been observed on site in previous labor audits (see the **Labor Management Procedures**, 2024). It should be noted that most of the current accommodation provision will be demolished and cleared as reservoir levels rise. New accommodation will be provided downstream of the dam and will be required to meet international standards (set out in the IFC/EBRD guidance note "Standards and processes for workers' accommodation: processes and standards") from the outset, and any existing sub-standard accommodation will need to be improved meet the same standards (see **Volume 1, Chapter 19: Labor and Working Conditions** for a further assessments of worker accommodation).

18.4.33. The majority of workers, who live in on-site accommodation and work 12-hour, 15-day shifts, have limited opportunities to interact with the local community. Some workers live in Rogun City where there is the potential for interactions with local residents and the possibility for the spread of disease, however these constitute a relatively small proportion of the population and pose no greater risk that other residents. No significant disease outbreaks have been associated with the Project to date. The magnitude of this impact is assessed as **Small**, and the significance of the effect is **Minor** adverse for the local community of Rogun City (medium-sensitivity).

Gender-based Violence (GBV)

18.4.34. Possible GBV scenarios impacting local communities have been categorized in **Table 18-5**.

Table 18-5 – Potential types of GBV arising from the Project

Type of GBV	Relevance to and impact of the Project
A Project worker targets a member of the local community	The Project has introduced a large and predominantly male workforce to the area, which will continue to increase for several years before slowly decreasing. Settlements located near to the construction compound are most at risk of impacts. Similarly, any public spaces where Project workers and community members mingle, such as shops, streets, hospitality venues, and transport routes (including public transport) used by commuting workers, could also be at risk for impacts. As well as harming the individuals who are targeted, GBV perpetrated by Project workers to community members can harm community relations and even make the Project unacceptable to the community. Women and girls who are targeted may also be re-victimized by their husbands or families if it is believed that they provoked the perpetrator. This is a particular risk in conservative, religious communities, such as the Project area, where stigma around experiencing GBV is high. Particular sensitivities exist for underage girls, who are both more vulnerable in themselves, and also have less power within communities and households to raise grievances and influence outcomes. Tajikistan has a young population, and young girls under 20 constitute around 23% of the population.
Interactions between Project workers and local women indirectly leading to GBV	Project workers may engage in consensual relationships, friendships, or innocuous interactions with female community members which evoke negative reactions amongst local men. Husbands and fathers may feel jealous or insulted by interactions they believe to be inappropriate, and become aggressive or controlling towards the woman in question. Women and girls in conservative communities, such as the Project AoI, are more vulnerable to this impact, as interactions between men and women are more scrutinized and controlled. Women in these areas typically have less power within communities and households.
A Project worker becomes aware of GBV in the community	Workers may become aware of GBV occurring between community members unrelated to the Project, for example through witnessing events or verbal reports from family, friends and acquaintances. This is particularly relevant for community-facing workers, such as Community Liaison Officers (CLOs), who are in regular contact with the community. Witnessing or becoming aware of GBV can be very distressing, particularly if the witness is unsure how to respond, or concerned that any actions they take may make the situation worse for the victim.

18.4.35. A detailed assessment of GBV risks associated with the Project are presented in **Annex A17.1: Gender** of this ESIA. The GBV risk to women in the local community, who are considered a high-sensitivity receptor, resulting from labor influx and the presence of worker accommodation is assessed as **Medium**, resulting in a **Major adverse** effect before mitigation.

Violence perpetrated by Security Workers

18.4.36. Security workers are present at the main entrance gate to the Project site and are responsible for checking vehicles, passengers and pedestrians to ensure they are authorized to access the

construction site. Armed military personnel and police also provide security at the main gate to the construction site, and private security are also present in places. Based on discussions during community engagement activities, there is no evidence of, or issues with, the use of security forces amongst affected communities.

18.4.37. The majority of local residents do not enter the site except for work or business purposes. For residents of Pasi muhraho, who must pass through site security to enter and leave their village and interact with security forces, the risk of a potential incident is higher. The presence of children amongst the community, who are also subject to security checks when entering the site, further increases the risk. Lone children have been observed passing through the security checkpoint and undergoing back and pocket searches (non-contact) and ID checks. The searches were conducted by teams of security personnel at the checkpoints at the site entrance. No body searches or private searches were observed. The children appeared familiar with the process and did not appear to be distressed by it.

18.4.38. The magnitude of this impact is assessed as **Small**, resulting in a **Minor adverse** effect for the local population of Rogun City (medium-sensitivity). For Pasi muhraho, the magnitude is assessed as **Medium**, resulting in a **Moderate** adverse effect.

Physical and economic displacement

18.4.39. The Project will result in very large physical and economic displacement impacts:

- Over 50,000 Project-Affected People (PAPs) will be physically resettled from the villages within the Flooding Zone. Physical resettlement is currently planned to be complete in 2032, with full operation being reached in 2038.
- People in the non-resettled villages may lose some access to workplaces, agricultural land and other facilities located in the Flooding Zone.
- Residents of villages close to resettlement sites (host communities) may be impacted by the in-migration of resettlers.

18.4.40. An assessment of impacts on the local economy, livelihoods, agricultural production, and access to infrastructure for resettled, host, and non-resettled communities are presented in **Volume 1, Chapter 17: Socio-economics** of this ESIA.

18.4.41. From a CHSS perspective, this displacement could result in a number of potential impacts for the three community types (resettled, host, and non-resettled) presented in Table 18-6. It should be noted that these categories are not mutually exclusive. For example, villages to be resettled towards the end of the resettlement period may be temporarily impacted as non-resettled communities if their closest neighbors resettle earlier.

Table 18-6 – CHSS impacts due to physical and economic displacement

Impact	Description
Resettled communities	
Natural hazards at resettlement sites	Tajikistan is affected by numerous natural hazards which pose a risk to communities, such as landslides, earthquakes and flooding. The villages within the Flooding Zone are located at the base of or on steep slopes, where landslides frequently occur after earthquakes or heavy rain and damage homes and roads.

Impact	Description
	Natural hazards, particularly seismicity and flooding, are considered in the selection of sites. 4 of the current sites (Namuna and Toichi in Tursunzoda, Chorsada-2 in Danghara and Sebiston in Faizobod) are located on flat ground where landslide risk is negligible. Newly constructed residential housing may also be more structurally resilient than previous houses, which are old and under-maintained. A full assessment of natural and man-made hazards at the Project site and resettlement sites is presented in Volume 1, **Chapter 23: Major Accidents and Disasters** of this ESIA. It is considered that the overall risk profile of resettlement sites is, overall, lower than at the pre-resettlement villages.
Demolition and salvage	Demolition of previous housing is carried out by DFZ contractors and therefore poses no risk to communities. However, PAPs are allowed to gather salvage materials for use in house reconstruction. While this is a benefit that helps communities by reducing the cost of construction, risks are present at the demolition site, in particular due to the disturbance of asbestos, which is legal and widely used in Tajikistan. Asbestos is highly toxic and carcinogenic, and exposure leads to a number of health conditions including asbestosis (scarring of the lungs) and mesothelioma (an aggressive cancer). PAPs may be exposed to asbestos fibers when gathering or transporting asbestos, and suffer negative health impacts. No asbestos surveys have been carried out in the resettled villages, hence it is not possible to quantify this impact. While no cases of asbestos-related illness have been reported, these conditions develop over years or decades and therefore may not be currently in evidence.
House reconstruction	PAPs are responsible for their own house reconstruction. Risks are present on construction sites, such as hand and power tools, working at height, etc. A house specification is provided, and the payment of asset compensation to households is linked to achieving construction milestones. Many people (particularly men) in Tajikistan have construction skills and prefer to manage construction themselves, although some hire laborers, and for vulnerable households, laborers can be provided through the jamoat. All construction will therefore be carried out by people with appropriate skills and experience and the risks will be minimal. However, risks arising from the use of asbestos remain, as it is still used in some construction throughout Tajikistan.
Physical transportation of people and belongings	Resettlement involves the physical transportation of people and their belongings (livestock, salvage materials, personal belongings, transplanted trees), sometimes over long distances. Transportation is provided by DFZ at no cost to PAPs. Currently, the most distant resettlement sites, Namuna and Toichi in Tursunzoda, are over 180km from the Project site. Road safety in Tajikistan is rather poor, with road accidents the 5th most common cause of death in the country. As resettlement is occurring relatively slowly over several years, and is spread over a large geographical area, it will not result in a significant increase in traffic in any specific area. The PAPs and DFZ drivers are also accustomed to driving in the local conditions, so will not be exposed to increased risks relative to baseline.
Infrastructure and utility provision	Infrastructure and utility provision at resettlement sites is significantly improved relative to that at resettlement villages, although historically there have been some temporary gaps in provision (see **Chapter 17: Socio-economics** of this ESIA). At the time of preparation of this ESIA, there are no resettlement sites lacking provision of basic services (medical center, school, water, electricity). Implementation of the current **RAP 2 (2017-2026)** and future RAPs will ensure that infrastructure is provided in future to keep pace with ongoing resettlement.

Impact	Description
Interactions with host communities	If host communities are opposed to in-migration into their area, there is potential for hostile interactions which in extreme cases may become violent. However, extensive preparation works were undertaken before the commencement of resettlement into the current sites, including an assessment of the ability of the area to accommodate additional population, and consultations with the jamoats. All of the resettlement sites except Darband are also located at some distance (at least 100m, and in some cases more than 2km) from the nearest host communities. Host communities can also benefit from infrastructure and job opportunities at resettlement sites, increasing community cohesion. Some host community members were observed working at resettlement sites and host communities advising resettlers about adapting agricultural techniques to local climatic conditions. Available information suggests limited but positive relationships between resettlers and host communities.
Host communities	
Infrastructure provision	Host communities benefit from infrastructure improvements in their area. For example, the large hospital (including ambulance services) and maternity unit in Darband are available to the surrounding area, and the catchment area for the school in Toichi includes host communities. Improvements have also been made to water and energy infrastructure in areas where resettlement sites are located.
Interactions with resettlers communities	As stated above, available information suggests limited but positive relationships between resettlers and host communities.
Non-resettled communities in the Project AoI	
Infrastructure provision	If non-resettled communities are reliant on key facilities that are lost to inundation, they may be negatively impacted by their loss. Some such examples of non-resettled villages that may lose access to critical infrastructure have been identified (see **Volume 1, Chapter 17: Socio-economics** of this ESIA). While infrastructure is replaced within the Project AoI, for some villages distances to access this infrastructure will be longer, and there may be gaps in provision of services usually provided at village level or for groups of closely-linked villages (primary schools, medical centers), or when regionally- or nationally-important facilities are lost (e.g., Navobod psychiatric hospital).
Remoteness and isolation	The non-resettled villages in the Project-affected Districts are located on the upper slopes and in tributary villages, often in rather remote locations. The loss of their nearest neighbors could render these villages more isolated and potentially reduce social contacts, particularly if friends and family are resettled. Not all villages will be rendered more isolated, however. New roads will facilitate access to other settlements, especially for villages located near to them, and several villages (Obilurd, Khumdon, Tirgar) are contiguous or near-contiguous with Darband and will become more suburban in character. These changes will have benefits for residents' health and wellbeing, such as easier access to medical care, but will also have impacts on those struggling to adapt to the changed conditions.

18.4.42. The above-identified impacts are either Beneficial or Very small adverse after the implementation of the RAPs (for resettled and host communities) and MoLMEP economic study and its outcomes (for non-resettled communities), as well as other mitigation measures identified in **Volume 1, Chapter 17: Socio-economics** of this ESIA. These communities are considered medium-sensitivity from a CHSS perspective. The effects will therefore be **Positive** or **Minor adverse**.

18.4.43. Community members may also be exposed to asbestos if they salvage certain building materials from demolished houses and if they install asbestos containing materials in their new house. On a precautionary basis, this impact is considered to be **Medium** given the large number of people potentially impacted, though over a short-term period, and the potential for fatalities, and the effect is therefore **Moderate Adverse**.

OPERATION

Drowning risk

18.4.44. The reservoir at full operation will continue to present a hazard once the Project is complete. The non-resettled villages in the Project-affected Districts (medium-sensitivity) will be closer to the water, and some will be on the reservoir shore. Fall risk from the new bridges and roads located on the banks may remain, although this will be reduced if they are constructed with safety features such as suitable barriers and guard rails. It is understood that that the MMRS will retain responsibility for monitoring the reservoir and performing rescue operations during this Project phase. There will be continued placement of signs by the MMRS as the reservoir grows and reaches its full extent.

18.4.45. Resident communities will also have had many years to become accustomed to the presence of the Project during construction and reservoir filling. However, if tourism increases due to interest in the fully operational Project, it is more likely that people from outside the local area (low sensitivity) may be present, and may be more likely to engage in reckless behavior, such as swimming or diving in the reservoir. The discharge patterns from the Project will not change (see **Volume1, Chapter 13: Water**) so there is likely to be no increased risk of drowning for communities that are downstream of Nurek.

18.4.46. This risk is therefore **Medium**, and the effect is **Moderate** adverse.

18.5 MITIGATION AND ENHANCEMENT MEASURES

CONSTRUCTION

18.5.1. A construction **Community Health and Safety Management Plan** (CHSMP) has been developed for implementation during the remaining construction phase of the Project (**Volume 3, A8: Community Health and Safety Management Plan** of this ESIA). This will address risks identified in this assessment, which will also be mitigated through actions set out in other complementary Management Plans which include mitigations as described below. The CHSMP contains special measures for Pasi muhraho, to reflect the unique nature of this settlement and the specific impacts its residence experience due to its location within the site. Affected communities will also be able to access to the Project-specific **Grievance Redress Mechanism (GRM)** to raise any concerns or complaints that they might have related to safety around the construction site.

18.5.2. Specific mitigation related to individual impacts is presented below and summarized in other management plans, such as the ESMP.

Drowning risk

18.5.3. MMRS will conduct a full safety assessment and prepare a Reservoir Discharges Safety Plan (RRDSP), which will be reviewed and updated for each stage of reservoir filling. This will identify the areas of highest risk, and the need for safety signage and rescue equipment installation, as well as communication channels with local communities, training, and community sensitization, and the need for reservoir patrols and monitoring by the MMRS. Safety signage and equipment will need to be regularly monitored and moved as the reservoir fills and shoreline shifts.

18.5.4. Information sessions with local communities which will become (temporarily or permanently) shoreline or near-shoreline settlements, including schools sessions for children, will be organized by Rogun JSC/PMG and with the involvement of the MMRS. These sessions will cover the hazards which are specific to the reservoir and discharge waters and how these differ from the river which was present previously, instructions for the use of any rescue equipment that has been installed, emergency contact numbers, and a reminder not to enter the water in order to help other people or animals.

18.5.5. Appropriate safety measures (barriers, signs, rescue equipment) will be integrated into the design of roads and bridges. The **Traffic Management Plan** (**Volume 3, Annex A9b: Off-Site Traffic Management Plan** of this ESIA) includes requirements to add safety barriers to the new M41 highway which has already been constructed.

18.5.6. The implementation of these measures will reduce the impact of drowning risk to **Small**, leading to a **Minor** residual effect.

Collision Risk with Construction Vehicles

18.5.7. The Contractor(s) will ensure works are planned to enable them to be delivered safely, and in a manner which minimizes congestion, road safety risks and disruption for all road users, in accordance with a **Traffic Management Plans (TMPs)** (**Volume 3, Annex A9a: On-Site Traffic Management Plan,** and **Annex A9b: Off-Site Traffic Management Plan** of this ESIA). This Plan includes the following, with relevance to CHSS:

- On-site TMP:
    - A traffic risk and hazard mitigation strategy;
    - Vehicle and mobile plant standards;
    - Transport infrastructure design and maintenance, including internal roads, permanent and temporary bridges, signage, safety barriers, speed reduction and traffic calming measures, and dust control;
    - Traffic regulation and operational procedures, including speed limits, safety rules for drivers, and transportation of hazardous materials;
    - Pedestrian safety measures;
    - Security and traffic coordination measures;
    - Environmental traffic hazard mitigation;
    - Emergency response; and
    - Driver and traffic safety training.
- Off-site TMP:
    - A traffic risk and hazard mitigation strategy;

- Vehicle and equipment specifications;
- Community engagement and road safety, including requirements to implement a road safety campaign, implementation of a GRM, and continuous engagement;
- Traffic operations and journey management;
- Complex, oversized and hazardous loads;
- Environmental mitigation measures; and
- Contractor and driver management.

18.5.8. All drivers will be provided with comprehensive training and be subject to competence requirements as detailed in the TMPs. Responsibility for implementing driver training and ensuring that drivers adhere to it will sit with their direct employer. The Project is to consider, if possible, the implementation of tracking software in Project vehicles to monitor speed and compliance with rules and regulations.

18.5.9. The On-site TMP will mitigate risks to residents of Pasi muhraho. Information sessions are to be held with this community to share the TMP and the new measures to be brought in, particular those affecting the site entrance and the road leading to the village. This will include road safety sessions in schools for children. These activities will be led by the Engagement and Grievance Manager (EGM) responsible for Rogun town and local areas. Further details of engagement methods are detailed in the Stakeholder Engagement Plan (SEP).

18.5.10. The Off-site TMP will mitigate risks to local communities using the public roads and will lead to improvements in road safety. Local communities will not be at risk from on-site traffic.

18.5.11. The Project-specific GRM will be available to all affected communities and stakeholders to enable them to raise concerns related to the Project. The EGM, appointed to manage engagement with Rogun town and surrounding local areas, will be responsible for managing grievances which can be raised by various channels including a paper form, face to face during meetings, online, or via post. Local communities can use this GRM to raise concerns or complaints about issues, such as traffic and road safety, related to the Project.

18.5.12. The implementation of the TMPs, as well as the construction of new roads, is anticipated to improve road safety relative to the current situation and therefore after mitigation this impact will be **Beneficial**. The residual effect is therefore **Positive**.

Unauthorized Access to Construction Areas

18.5.13. The implementation of the Security Management Plan (**Volume 3, Annex A7: Security Management Plan**) will mitigate risks from unauthorized access to the site. The following measures to prevent unauthorized access are included:

- Community engagement and security risk mitigation, including public safety briefings, GRM implementation, and awareness campaigns (including schools), as well coordination with Project and public authorities
- Site security arrangements, including securing the site perimeter, video surveillance, lighting and the presence of guard posts
- Site access control for people and vehicles
- Emergency response procedures to identify, remove and prevent the return of intruders

18.5.14. Construction areas, inclusive of open excavations, stockpiles, steep slopes and construction equipment will continue to be surrounded by barricades with appropriate warning signs to protect the

public and prevent unauthorized access. This will be in accordance with measures set out in the Community Health and Safety Management Plan (CHSMP).

18.5.15. Affected communities will be able to access the Project-specific GRM to raise any concerns or complaints that they might have related to safety around the construction site.

18.5.16. Implementation of the CHSMP and SMP will reduce the magnitude of impact to **Very small**. The residual effect is therefore **Negligible**. For Pasi muhraho, the impact will be reduced to **Small**. The residual effect will be **Minor adverse**.

Labor influx and Communicable disease

18.5.17. Rogun JSC, DFZ and all contractors conduct induction training for all their employees and the employees of all their sub-contractors, which covers health and safety practices. This induction training will be updated to cover community relationships, including acceptable conduct toward local community members, specifically women and girls, and details of sanctions for non-compliance. Additionally, guidance on the detrimental effects of the abuse of alcohol and drugs and other potentially harmful substances, and the risk and concerns relating to HIV/AIDS, COVID-19 and of other health risk-related activities will be provided to workers.

18.5.18. The induction will also include training on the CoC. A sample CoC, to be finalized and approved by Rogun JSC, is annexed to the Labor Management Procedures (Volume 2, Annex 12) for the Project. A CoC will include Project-specific requirements that follow the World Bank-required template. Copies of the CoC will be retained by the employers and displayed on notice boards within worker accommodation facilities.

18.5.19. Where new worker accommodation is being provided, sufficient medical facilities should also be provided to meet the needs of those being accommodated.

18.5.20. Suitable induction training for all workers, alongside the requirement to sign a Workers' CoC, and the enforcement of the CoC will reduce the magnitude of labor influx impacts and potential communicable transmission risks to **Small** in both cases. The residual effect is therefore **Minor adverse**.

Gender-based Violence (GBV)

18.5.21. The following mitigation measures will be implemented to ensure reduced gender-related risks associated with the Project:

- A Gender Action Plan (GAP) has been prepared alongside this ESIA to mitigate gender risks on the Project, including GBV. Implementation of the GAP, which includes detailed roles and responsibilities for managing gender risks and maximizing opportunities, will reduce the likelihood of GBV occurring to a minimum.
- Gender-related grievances will be managed in a gender-sensitive way, including a Sensitive GRM Office that will be applicable to all workers. This will be implemented and widely communicated as part of induction and refresher training. An adequately experienced third-party Sensitive GRM Officer will establish oversight.
- Contractors will be contractually obligated to include provisions against GBV, which will be stipulated within the CoC to be signed by all Project workers.
- Appropriate and adequately trained staff will be employed to handle reports of misconduct, including sensitive grievances.

18.5.22. Further details of mitigation measures to address impacts arising from the Project associated with Gender can be found in **Annex 17.1: Gender** of this ESIA. A full suite of actions to mitigate risks arising from the Project associated with gender is set out in the **GAP**.

18.5.23. The implementation of actions set out in the **GAP**, alongside the implementation of a Workers' CoC and induction training covering appropriate and acceptable behaviors, will likely reduce the incidence of GBV below the current baseline, and the effect will therefore be **Negligible**.

Violence perpetrated by Security Workers

18.5.24. The SMP (**Volume 03, A7: Security Management Plan** of this ESIA) includes competency requirements for private security personnel, a CoC for private security personnel, and rules regarding the reasonable use of force by private security personnel. The requires all Contractors to carry out background checks on newly hired workers, proportionate to their role. Security-related training needs are also identified. Military and police personnel behaviors are governed by the Code of Ethics for Civil Servant in the Republic of Tajikistan (2015). The Security Management Plan contains requirements for interactions between community members and private and public security personnel, including special precautions for interactions with under-18s. It is recommended that Rogun JSC implement training at schools in Rogun City to ensure that children are aware of their rights and responsibilities regarding complying with security searches.

18.5.25. The local community and Project workers each have their own Project-specific GRMs (detailed in the SEP and Labor Management Procedures respectively) where concerns or complaints related to the Project, including any related to security personnel, can be raised.

18.5.26. The implementation of the SMP will reduce the impact to **Very small**. The residual effect is therefore **Negligible**.

Physical and economic displacement – asbestos exposure during demolition and construction of resettlers' houses

18.5.27. An outline **Demolition Management Plan** (**Volume 3, Annex B14: Outline Demolition Management Plan** of this ESIA) has been prepared, which includes measures for the management of waste from demolition activities, including the management of asbestos-containing waste. This outline plan has been prepared for use by PMG and JSC, to be completed by EPC Contractors, this is also to be adopted by DFZ, and applied to demolition activities associated with resettlement.

18.5.28. Displaced people will be prohibited from salvaging and reusing asbestos from demolished buildings.

18.5.29. Implementation of the Demolition Management Plan should reduce the risk of asbestos exposure to **Small**, resulting in a **Minor** adverse residual effect.

OPERATION

Drowning risk

18.5.30. An operational public safety assessment and RRDSP will be undertaken when the reservoir is at full operation. This will identify key risks and hazards, and provide mitigation measures to be implemented. This will also take account of long-term development plans for the reservoir and surrounding area, and whether any recreational uses of the reservoir have developed either spontaneously or as a result of targeted economic development measures. As during construction, mitigation will include safety signage and rescue equipment installed at key locations, engagement and training with communities, and MMRS patrols.

18.5.31. Drowning risk to be considered in the development of any tourist infrastructure. If any elements are constructed to attract tourists into the vicinity of the reservoir (e.g., viewing platforms, photogenic signs), safety barriers and signage will be implemented.

18.5.32. The implementation of these measures will reduce the impact of drowning risk to **Small**, leading to a **Minor** residual effect.

18.6 RESIDUAL EFFECTS

18.6.1. Residual impacts are impacts that remain after the implementation of mitigation and reflect the effectiveness of the specific mitigation measures. The mitigation measures are implemented by the responsible parties specified in the ESMP to manage the social performance of the Project and monitoring of the mitigation measures provides the data required to report to the regulatory authorities, Lenders and other stakeholders.

18.6.2. The periodic review of the mitigation measures will consider the residual impacts of the impact assessment to benchmark implementation performance.

CONSTRUCTION

18.6.3. During construction, no significant adverse CHSS effects will remain after the implementation of all identified mitigation measures. Positive residual effects will remain for collision risk with Project vehicles, GBV risk, and physical and economic displacement. The assessment of these effects as positive acknowledges that many of these impacts have already occurred as part of the baseline conditions due to the partially-built Project, and the implementation of the mitigation measures outlined in this chapter will lead to improvements relative to the current situation.

OPERATION

18.6.4. No significant adverse CHSS effects will remain after the implementation of all identified mitigation measures when the Project is complete and fully operational. Positive effects arise from improved connectivity due to the new roads and bridges, and enhanced protection against PMF.

18.7 SUMMARY

18.7.1. During the construction phase, positive effects are anticipated to arise from implementation of the RAPs and LRPs, GAP and TMPs, and the improvements in community infrastructure constructed to replace that lost due to impoundment.

18.7.2. Once operational the Project is anticipated to have positive CHSS effects arising from protection against PMF and infrastructure improvements. No significant adverse effects are anticipated in operation.

Table 18-7 – Summary of CHSS Impacts (Construction)

Impact	Drowning	Collision with construction vehicles	Unauthorized access to construction site	Air Quality	Water Pollution	Noise and vibration	Labor influx	Communicable disease	GBV	Violence perpetrated by security workers	Physical and economic displacement	Asbestos exposure during construction and demolition
Receptor sensitivity	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	High	Medium	Medium	Medium
Frequency	Infrequent	Frequent	Infrequent	Frequent	Infrequent	Infrequent	Constant	Infrequent	Infrequent	Infrequent	Constant	Infrequent
Likelihood	Unlikely	Likely	Unlikely	Likely	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely	Certain	Likely
Extent	Local	Local	Local	Local	Local	Local	Local	Local	Local	Local	National	Local
Duration	Permanent	Short-term	Short-term	Short-term	Short-term	Short-term	Short-term	Short-term	Short-term	Short-term	Permanent	Permanent
Magnitude	Medium	Medium Large (Pasi muhraho)	Small Medium (Pasi muhraho)	Very small	Very small	Very small	Medium	Small	Medium	Small	Beneficial or Very Small	Large
Effect	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Positive and Negative	Negative
Direct / Indirect	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct and Indirect	Direct
Significance	Moderate	Moderate Major (Pasi muhraho)	Minor Moderate (Pasi muhraho)	Minor	Negligible	Negligible	Moderate	Minor	Major	Minor Moderate (Pasi muhraho)	Positive and Minor	Major
Mitigation (Y/N)	Y	Y	Y	N	N	N	Y	Y	Y	Y	N	Y
Residual Significance	Minor	Positive	Negligible Minor (Pasi muhraho)	Minor	Negligible	Negligible	Minor	Negligible	Negligible	Negligible	Positive and Minor	Minor

Table 18-8 – Summary of CHSS Impacts (Operation)

Impact	Drowning risk
Receptor sensitivity	Medium
Frequency	Infrequent
Likelihood	Unlikely
Extent	Local
Duration	Permanent
Magnitude	Medium
Effect	Negative
Direct / Indirect	Direct
Significance	Moderate
Mitigation (Y/N)	Y
Residual Significance	Minor

19 REFERENCES

WHO. (2014). *Global report on drowning: preventing a leading killer.* Retrieved from https://www.who.int/publications/i/item/global-report-on-drowning-preventing-a-leading-killer

PUBLIC

JSC “Rogun HPP”

State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT – UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Volume 1, Chapter 19: Labor and Working Conditions



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19 LABOR AND WORKING CONDITIONS

19.1.1. This chapter outlines the assessment of potential impacts of the Project on labor and working conditions, in line with the requirements of the World Bank's Environmental and Social Standard (ESS) 2: Labor and Working Conditions (2016).

19.1.2. A comprehensive description of social baseline conditions is presented in **Volume 2, Annex 7.1: Baseline Conditions Report** and a summary is provided in **Volume 1, Chapter 7: Environmental and Social Baseline** of this ESIA. An assessment of the potential Project impacts on labor and working conditions is presented in **Section 19.4**. and where necessary, recommendations for the avoidance of impact, impact minimization and/or long-term management are included.

19.2 LEGISLATIVE FRAMEWORK, POLICY AND GUIDANCE

19.2.1. The labor and working conditions assessment has considered the relevant legislation, policy and guidance framework.

TAJIKISTAN LEGISLATION AND REGULATIONS

19.2.2. The Labor Code (2016) of the Republic of Tajikistan is a comprehensive legal framework that regulates labor relations and ensures the protection of workers' rights. The labor code aims to create a fair and balanced labor environment focused on social justice and protecting the rights of all parties in the labor market.

19.2.3. In Tajikistan, Occupational Health and Safety (OHS) is primarily governed by the Law of the Republic of Tajikistan on Labor Safety (2009). Additional legislation applicable to the Project is set out in **Table 19-1**.

Table 19-1 – Applicable Tajik Legislation

Tajik Legislation	Requirements
Law on State Social Insurance (No. 517, 1997)	This law outlines the provisions for social insurance, including benefits for sickness, maternity and unemployment.
Law on Fire Safety (No. 363, 2008)	This law outlines the general legal, economic, social and organizational basis for ensuring fire safety in the country.
Law on Labor Protection (No. 517, 2009).	This law establishes the legal framework for labor protection, aiming to create safe working conditions that preserve the life and health of workers.
Law on Employment of the Population (No. 669, 1997)	This law regulates employment policies, including job placement services, vocational training and measures to support employment for vulnerable groups.
Law on Occupational Safety and Health (No. 517, 2009)	This law outlines the responsibilities of employers and employees in ensuring safe and healthy working conditions.

Tajik Legislation	Requirements
Law on Trade Unions (No. 575, 1992)	This law governs the formation, rights and activities of trade unions in Tajikistan.
Law on Collective Agreements and Contracts under the Labor Code (No. 1329, 2016)	This law provides the framework for negotiating and implementing collective agreements and contracts between employers and employees.
Law on Minimum Wage (No. 1009, 2024)	This law sets the minimum wage standards and ensures workers receive fair labor compensation.
The Law on Equality and Elimination of all Forms of Discrimination 2022, Article 6.	All citizens of Tajikistan have the right to equality and effective protection against discrimination in all its forms. National legislation prohibits “sexual harassment and non-physical harassment in the workplace”

19.2.4. **Table 19-2** sets out state laws, policies, and guidance documents relevant to this labor and working conditions impact assessment.

Table 19-2 – Applicable International Standards and Guidance

International Standards and Guidance	Requirements
World Bank ESS2: Labor and Working Conditions	ESS 2 outlines project workers' health and safety requirements, labor management, and fair treatment. The primary objective of ESS2 to promote sound worker management relationships and enhance the development benefits of a project by treating workers fairly, while also providing them with safe and healthy working conditions.
AIIB Environmental and Social Framework ESS1	Outlines the expectations for labor management relationships (including the provision of clear, written terms of employment, timely payment of wages, provision of adequate periods of rest, written notice of termination, and employment based on equal opportunity and non-discrimination). Child labor is prohibited under the age of 18 unless conformity with local laws or regulations and Standards (including the ILO Minimum Age Convention, 1973) can be achieved for children aged 16 and over. Forced or compulsory labor should be prevented by all means possible.
World Bank’s Environmental, Health and Safety (EHS) Guidelines (2007)	These guidelines provide technical reference documents with general and industry-specific examples of good international industry practice (GIIP).
Asian Development Bank (ADB) Core Labor Standards Handbook (2006)	This Handbook provides information about the core labor standards (CLS) that need to be considered in the design and implementation of ADB investment projects.

19.2.5. **Good International Industry Practice (GIIP)** refers to the standards and practices mostly accepted and applied by the international community to ensure safe and efficient operations across various industries.

19.2.6. According to the World Bank, GIIP refers to guidelines that are technical reference documents focused on industry-specific examples of best practices. These include occupational health and safety related to safe facility design and operation, adequate training, personal protective equipment (PPE), and management of physical, chemical, biological, and radiological hazards. Specific guidelines relevant to this chapter include;

- General Environmental, Health, and Safety (EHS) Guidelines 2.0: Occupational Health and Safety (2007), and
- General EHS Guidelines 4.0: Construction and Decommissioning (2007).

19.2.7. There are key International Labour Organization (ILO) conventions which set out basic principles to be implemented, including strict requirements on the minimum age for employment, employee rights, and the elimination of forced and child labor cases. ILO Conventions that have been ratified by the Government of Tajikistan are as follows;

- Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87)
- Right to Organise and Collective Bargaining Convention, 1949 (No. 98)
- Forced Labour Convention, 1930 (No. 29) (and its 2014 Protocol)
- Abolition of Forced Labour Convention, 1957 (No. 105)
- Minimum Age Convention, 1973 (No. 138)
- Worst Forms of Child Labour Convention, 1999 (No. 182).
- Equal Remuneration Convention, 1951 (No. 100)
- Discrimination (Employment and Occupation) Convention, 1958 (No. 111)
- Maternity Protection Convention (Revised), 1953 (no. 103)
- Working Environment (Air Pollution, Noise and Vibration) Convention, 1977 (No. 148)
- Employment Policy Convention, 1964 (No. 122)
- Labor Inspection Convention, 1947 (No. 81)

19.3 ASSESSMENT METHODOLOGY

19.3.1. The approach to the assessment has been to review the proposed Project and baseline conditions, including the workforce characteristics, followed by the identification of risks related to the sector and location of the Project, and the Project activities which may cause an impact.

RECEPTORS

19.3.2. Receptors have been categorized according to ESS2 as follows:

- **Direct Workers** involved in the execution and completion of the project on the Project site; Direct workers will include PMG, Rogun JSC and DFZ employees and staff. These workers will be hired under individual contracts, on a full-time and/or part-time basis, with specific definitions of assigned tasks and responsibilities. There will be approximately 1,200 workers across various disciplines forming this category on the Project during construction, reducing to 800 once fully operational.

- **Contract Workers** and subcontractors involved in construction activities for the Project. All contract workers involved in the construction will be hired based on a written labor agreement aligned with the Tajikistan Labor Code. The number of contract workers will be between 12,000 and 17,000 as needs and activities on the Project evolve.
- **Primary Supply Chain Workers:** These workers regularly supply the goods and materials required for the Project's construction phase.
- **Community Workers:** Community workers will not be employed in relation to this Project as local community members are hired as the contractor's labor force (Labor Management Procedures, 2023).

RECEPTOR SENSITIVITY

19.3.3. The table below describes the relative sensitivity categories of receptors based on the baseline information to identify their sensitivity.

Table 19-3 – Labor and Working Conditions Sensitivity Criteria

Sensitivity	Description
High	The project is in a location or sector for which there are reports of non-compliance of labor and working conditions with international standards. The workforce is predominantly migrant labor, including workers from low-income countries. Work takes place in high-risk conditions, including hazardous activities, extreme temperatures, long hours or at isolated locations. Workers will have to use worker accommodation which is provided by their employer and is at high risk of non-compliance with applicable standards. High risk that the Government will not enforce labor and working conditions to the applicable standards. Workers will likely struggle to adapt to adverse labor and working conditions without extensive support and/or measures implemented by their employer.
Medium	The project is in a location or sector for which some reports or anecdotes demonstrate a potential risk of gaps in labor and working conditions and compliance with international standards, but the prevalence of such risks is uncertain. The workforce includes some migrant labor. Work takes place in conditions that present some risk to workers, but activities are common and risks are well understood, e.g. involving heavy machinery and working at heights. Workers may be able to independently adapt to their labor and working conditions to a limited extent, with limited intervention by their employer. The risks identified can be absorbed and addressed by following any proposed mitigation procedures.
Low	The project location or sector is not known to have poor labor and working condition practices. Workers are not reliant on the accommodation provided by their employers, and the risks of non-compliance with applicable standards for worker accommodation are low. Workers are from the Project country or include only a small expatriate workforce.

Sensitivity	Description
	There is a low risk that the government will not enforce labor and working conditions to the applicable standards. The potential risks faced by workers are low and can easily be mitigated. Workers have minimal vulnerability to their labor and working conditions, and are able to realize opportunities provided by their employment without the assistance of their employer.

ASSESSMENT OF IMPACT SIGNIFICANCE

19.3.4. The assessment will evaluate the potential impacts on labor and working conditions on the Project resulting from non-compliance with applicable standards. The significance of the effect is the outcome of the interaction of the receptor sensitivity and the impact magnitude, and indicates the requirement for additional mitigation. The post-mitigation outcome has also been assessed to determine the significance of the residual effect.

19.3.5. The descriptions in Table 19-4 summarize the categories used to determine the magnitude of the potential impacts on labor and working conditions for the receptors. The magnitude of potential impacts is based on the extent to which measures are in place to ensure that labor practices and working conditions are aligned with the applicable standards. As the receptors are defined as the workforce, and the aim is to align all labor and working conditions with the applicable standards, the standard impact assessment criteria for magnitude (as set out in **Volume 1, Chapter 5: ESIA Methodology**, Table 5-1) of geographical extent, duration, and frequency are not applied in this assessment.

Table 19-4 - Impact Magnitude Categories

Magnitude	Description
Large	Few, or no, measures are in place to help ensure alignment of labor practices and working conditions with the applicable standards. This is likely to include the absence of employment contracts, wages which are not fair or paid on time, sub-standard welfare and accommodation facilities, and an absence of human resource programs preventing discrimination in hiring practices and during employment. Occupational Health and Safety (OHS) systems are not established or followed, equipment is not maintained or serviced on a regular basis, no training is provided for workers, and the provision and use of PPE is limited.
Medium	Some measures are in place to help ensure alignment of labor practices and working conditions with the applicable standards, but there is risk of gaps. This could include incomplete employment contracts, wages which are occasionally not paid on time, inconsistent standards are implemented for welfare and accommodation facilities, and human resource practices ensuring non-discrimination are not applied consistently. OHS systems are not consistently followed or monitored, an inconsistent approach is taken to equipment maintenance, some training is provided but it is not consistent or monitored, and PPE is provided but no checks are in place to ensure it is used or replaced when needed.
Small	A comprehensive system of measures is in place to help ensure alignment with labor practices and working condition standards, non-compliance is likely to be for minor issues only. Human resources practices are well managed, with the majority of employees having suitable contracts in place and their wages paid on time. Welfare

Magnitude	Description
	facilities and accommodation are maintained to a good standard and discrimination during hiring and employment is unlikely. OHS is well managed and monitored, equipment is maintained on a regular service schedule, training is provided regularly on a range of relevant subjects, with attendance records held, and all workers are provided with appropriate PPE which is replaced as needed.
Very Small	Robust and comprehensive system of measures are in place which ensure alignment with labor practices and working condition standards. The risk of non-compliance is only likely to be for isolated issues.

19.3.6. The receptor sensitivity category in Labor and Working Conditions Sensitivity Criteria and the impact magnitude category combine to provide a qualitative assessment of the resulting impact.

19.3.7. The matrix for assessing significance of effects is shown in **Volume 1, Chapter 5: Impact Assessment Methodology** of this ESIA and effects that are classified as moderate or major are considered to be significant effects. Effects classified as minor or negligible are considered to be not significant.

19.4 POTENTIAL IMPACTS

19.4.1. Impacts on labor and working conditions are experienced by those working on the Project including OJSC Rogun HPP, Project Management Group (PMG), Project Management Consultant (PMC), EPC Contractors for Lots 1-4, other non-EPC contractors, State Enterprise, Directorate of the Flood Zone of Rogun HPP (DFZ) and consultants. Potential impacts can occur at various stages of a project or operation. Addressing these potential impacts at each stage is critical to ensure that the well-being of workers is maintained according to the labor standards.

19.4.2. Potential impacts assessed in this Chapter include the topics, and the standards that should be met for each;

- **Labor management:** Workers should have their terms and conditions of employment in writing, which is clear and understandable, and include details of their hours of work, wages and any benefits. Workers shall be paid on a regular basis, and be provided with adequate periods of rest. The recruitment process and employment relationship will be based on the principle of equal opportunity, and without discrimination. Workers have a right to form and join workers organizations, and legally established worker organizations will be respected. A mechanism for raising grievances should be in place for all workers to raise concerns.
- **Occupational Health and Safety:** An OHS programme should be in place which identifies potential hazards to project workers, provides preventive and protective measures for workers, ensures applicable training is provided regularly, sets out a procedure for reporting accidents and incidents, and specifies remedies for adverse impacts. OHS performance should be regularly reviewed, with a system in place to enable continual improvements.
- **Underage and forced labor:** Workers under the minimum legal age will not be employed. No trafficked person will be employed on the Project, and involuntary or compulsory labor is prohibited.
- **Retrenchment:** Significant job losses should be planned for, and a process established to provide support for securing future employment.

- **Worker accommodation and facilities:** Workers should be provided with facilities appropriate to their circumstances, including canteens, sanitary and accommodation facilities. Policies should be in place to ensure accommodation is managed in such a way as to protect the health, safety and well-being of workers.
- **Inclusion, vulnerability and gender:** Vulnerable workers should be provided with appropriate measures of protection and assistance.

19.4.3. Based on the criteria set out in **Table 19-3**, the sensitivity of all Labor and Working Conditions receptors is considered **high**, based on the following:

High Sensitivity Description (Taken from Table 19-3)	**Justification from Baseline (Volume 1, Chapter 7)**
The project is in a location or sector for which there are reports of non-compliance of labor and working conditions with international standards. The workforce is predominantly migrant labor, including workers from low-income countries. Work takes place in high-risk conditions, including hazardous activities, extreme temperatures, long hours or at isolated locations. Workers will have to use worker accommodation which is provided by their employer and is at high risk of non-compliance with applicable standards. High risk that the Government will not enforce labor and working conditions to the applicable standards. Workers will likely struggle to adapt to adverse labor and working conditions without extensive support and/or measures implemented by their employer.	The construction sector is known for labor abuses worldwide. 95% of Project workers are Tajik, and 77% live more than 50km away from the Project; they are “migrants” and are from a low income country. The construction sector is particularly dangerous, and the Project is situated in steep terrain and involves working near water, all of which are considered high-risk. Accommodations are provided for most of the Workforce. Past evidence shows that the Government of Tajikistan does not enforce compliance with national standards.

CONSTRUCTION

Labor Management

19.4.4. Current practices on site for construction shift workers are to work a pattern of 15 consecutive calendar days (not to be exceeded), with working hours not to exceed 12 hours per day or night which includes a one hour meal break and one 15-minute break after every two hours of work. Workers are not allowed, or required, to work overtime. Based on figures collected in 2024, approximately 85% of Project workers are working this type of shift pattern.

19.4.5. Working hours for office/normal workers will not exceed 40 hours per week. For workers working a 5-day week, the duration of work will not exceed 8 hours per day. Office workers must have a meal break and at least two rest breaks during their working hours. These office workers comprise 15% of the workforce based on figures collected in 2024.

19.4.6. A Labor Audit Team conducted a 12-day site visit between the 5-16th of March 2023 to audit all active contractors and subcontractors on site **(Labor Audit Report, 2023).** In addition, the Labor Management Procedures was published in February 2024. The Labor Audit found that several contractors have provided employment contracts with missing information (e.g. wages, working hours, and break and rest periods). There was also evidence of shift workers working longer hours than the standard 12-hour shift, which the Labor Code prohibits. However, these findings were not consistent across all contractors, many of whom were found to be operating in compliance with the Labor Code. PMG and OJSC have been working with contractors to ensure there is compliance across the board.

19.4.7. Workers are allowed to join labor unions, and there is evidence of organized on-site labor. A worker grievance mechanism is also provided for workers to submit complaints in a formal and documented process (Labor Management Procedures, 2024).

19.4.8. Evidence of poor working conditions have been observed, although this is inconsistent across the Project. Observations included limited provision of drinking water, no soap or disinfectant in toilet cubicles for workers to wash their hands, poorly maintained toilet facilities, and inadequate first aid and medical facilities for workers. The November 2024 OHS Progress Audit report identified that there are currently insufficient number of toilets available to workers on site and that other measures are in place to improve sanitary and medical conditions.

19.4.9. The magnitude of this impact is assessed as **medium**; the effect is, therefore, **major adverse**.

Occupational Health and Safety

19.4.10. The Project requires a large construction workforce that, at its peak in the late 2020s is anticipated to require up to 20,000 workers (a full breakdown of Project workers currently on site is provided in the Labor Management Procedures of this ESIA).

19.4.11. Common activities undertaken during construction can introduce risks to the health and safety of the construction workforce, such as the movement of machinery, demolitions and excavations, electrical works, handling of chemicals, and works undertaken at height and within confined spaces. Risks are more likely to be apparent for those unfamiliar with the type of work undertaken and the associated hazards.

19.4.12. The main potential health and safety construction risks associated with the Project relate to:

- Use of explosives for tunnelling;
- Working at height in the tunnels and dam (including steep, potentially unstable slopes);
- Working in confined spaces;
- Hot work, e.g. welding;
- Repetitive working and hard manual labor;
- Exposure to physical hazards from use of heavy equipment and machinery;
- Working with pressurized equipment;
- Trip and fall hazards;
- Exposure to noise and poor air quality (e.g. dusty activities and emissions in tunnels);
- Exposure to electrical hazards from the use of tools and machinery;
- Carrying heavy loads;
- Exposure to chemicals (e.g., paints, fuels, fresh concrete);
- Traffic and transportation (within the Project tunnels as well as risks to pedestrians);
- Working in both hot and cold conditions due to the climate extremes; and

- Risk of road traffic incidents.

19.4.13. All major contractors on site are supposed to have HSE specialists who are tasked with implementing safety programmes, however during a recent audit where seven Contractor HSE Managers were interviewed, none had received formal OHS training. There are generally poor OHS standards on site, with the exception of one contractor's work areas, and there have been a series of accidents resulting in both serious and fatal injuries. An individual international OHS Specialist has been appointed to support PMG to identify risks and provide corrective actions. The first audit of contractors was held in November 2023, the second in November 2024, and a third in April 2025. Over this period there have been some improvements to OHS practices, but there are still significant OHS risks present on site. Key findings from the most recent audit include;

- HSE Manager competence: Managers do not have sufficient training to identify safe/unsafe practices and conditions, provide training, or to supervise/enforce OHS performance.
- Traffic management and vehicles: Speed limits are not adhered to and unsafe practices, including overtaking, are common practice. Safety belts are rarely worn, and the condition of vehicles is often poor and not recorded in pre-start inspections (many with broken lights, cracked windscreens, insufficient tread depth, absent reversing alarms and no first aid or fire extinguishers). Flagmen are not used effectively when works are being conducted in roads, or next to roads. There are also many roads without sturdy barriers to prevent a vehicle from driving over the edge.

19.4.14. A corrective action plan has been prepared to address the identified OHS issues. Some actions are already being implemented, focussing on improving the use of PPE and improving traffic safety. The Employers Representative (PMC) have appointed nine international HSE Managers to improve standards on site.

19.4.15. In the absence of mitigation, due to the large scale of construction activities and the potential for accidents and incidents in the workplace, the magnitude of this impact is assessed as **large**, and the significance of the effect is **major adverse**.

Underage and Forced Labor

19.4.16. The Project has a large workforce with many contractors, and recruitment is ongoing. If controls are not properly implemented, there is a risk of underage and forced labor.

19.4.17. The Labor Code (Article 208) prohibits the employment of workers under the age of 18 for heavy, underground and harmful or hazardous works. Workers' age is verified during the onboarding process by using legally recognized documents to prove their right to work (e.g. passport, birth certificates). WSP undertook a Labor Audit in March 2023 and observed working conditions during subsequent site visits. No evidence of workers under the age of 18 years was found on site during the March 2023 Labor Audit or any subsequent site visit.

19.4.18. Similarly, no evidence of forced labor was found during the March 2023 Labor Audit. Most workers are internal migrants from other parts of Tajikistan or local community members, and when a sample population was spoken to, confirmed that they were working willingly. The minority of workers from abroad are specialists in professional roles whose risk of exposure to forced labor practices is minimal.

19.4.19. Compliance with legislation and the current practices to check legal documents means that the risk of child or forced labor is **small**. Thus, the significance of the effect is **moderate adverse**.

Retrenchment

19.4.20. At its peak later in the 2020s, the construction workforce is expected to include up to 20,000 workers. This workforce will then be downsized to match demand as construction activities are completed in 2032. The operational workforce of approximately 800 personnel will be much smaller than the construction phase workforce.

19.4.21. Due to the length of the construction period for the Project, which first started in the 1980s, it has provided long-term employment opportunities for the local and regional population. It is unlikely that workers will find another local project of a similar size and scale to provide similar long-term job security. Workers may need to re-locate or travel abroad to find employment as a result. The types of jobs available during the operational phase will include a slightly higher proportion of highly skilled technical roles, with a reduced demand for unskilled labor. These job losses are likely to disproportionately impact communities local to Rogun, as approximately 23% of workers come from within a 50km radius of the Project site. Most workers originate from elsewhere in Tajikistan and may need to travel to other locations both within, or outside of, Tajikistan to find new employment.

19.4.22. There are currently no retrenchment plans or policies for the Project, which is currently still in a phase of scaling up the size of the workforce. A Retrenchment Plan should be completed and implemented to mitigate the impacts of the Project reducing its workforce, and the changing skills demand, during the shift to operation.

19.4.23. The magnitude of this impact is assessed as **large** due to the absence of a plan or policy for future retrenchment, and the significance of the effect is **major adverse**.

Worker Accommodation and Facilities

19.4.24. Poor accommodation, sanitary, and catering facilities can occur on construction sites and negatively impact workers' health and the surrounding environment. Overcrowding and poor hygiene can arise in substandard accommodation facilities. Poor ablution facilities can result in contamination of the local environment (e.g., nearby watercourses) or disease outbreaks among workers. Hygienic food preparation and dining facilities, with hand-wash areas, are essential to prevent food poisoning.

19.4.25. Workers also require adequate and suitable food, rest breaks, and rest areas with protection from weather conditions to work effectively. Tajikistan has a continental climate and experiences seasonal temperature extremes. Workers, therefore, need accommodation or rest facilities that are suitably vented, insulated, and heated.

19.4.26. The construction workers' accommodation camps include catering, recreational, and sports facilities. Some on-site facilities are available to all workers, including those whose employers do not have such facilities. Many worker accommodation camps have medical facilities with basic medicines and equipment staffed by nurses and/or doctors. The closest medical center for workers who do not have access to on-site facilities is the Rogun Medical Centre. All serious injuries or operations would likely be treated in a hospital in Dushanbe.

19.4.27. Worker accommodation facilities were inspected as part of the Labor Audit in 2023, where it was found that most international contractors provide exceptional facilities for workers, including clean and well-designed apartments, and hygienic canteens and kitchens. However, there were areas of non-compliance limited to specific contractors, where some toilets and sanitary facilities were unsanitary or out of use. Inequalities were noted between male and female facilities in some worker

accommodation, including examples where shower facilities are shared by men and women, and an example where women's toilet facilities lacked appropriate sanitary provisions.

19.4.28. It should be noted that most of the current accommodation provision is in the process of being demolished and cleared as reservoir levels rise. New accommodation will be provided in Construction Areas 2 and/or 5. From the outset, new worker accommodation will be required to meet international standards (set out in the IFC/EBRD guidance note "Standards and processes for workers' accommodation: processes and standards").

19.4.29. The magnitude of this impact is assessed as **medium** due to the inconsistent standard of facilities available, and the significance of the effect is, therefore, **major adverse**.

Inclusion, Vulnerability and Gender

19.4.30. Female workers can experience particular risks and impacts when there are culturally biased norms and expectations in the workplace. As in many countries, employees in the construction sector in Tajikistan are predominantly male and the current Project workforce is predominantly male, although female workers are present on site. Social attitudes about 'women's work' can affect women's careers. Both overt discrimination and unconscious bias may negatively impact women's opportunities.

19.4.31. Women currently comprise between 5.2% of the workforce, primarily undertaking domestic work such as cleaning, preparing food for workers and washing dishes. A small number also work as nurses, engineers and in administrative roles. Tajik legislation prohibits women from undertaking heavy work, doing hazardous work, or working underground (Article 216), and women who are pregnant or who have children under the age of three are prohibited from working overtime, on weekends, or from taking business trips.

19.4.32. Certain other categories of workers have vulnerabilities that may lead to negative treatment in the workplace, including bullying, harassment, or discrimination in wages or access to opportunities. This may include, *inter alia*:

- Members of national, ethnic and religious minorities,
- Migrant workers,
- Lesbian, Gay, Bisexual, Transgender, other identities (LGBT+) people, or those assumed to be LGBT+,
- People with disabilities, or
- People with union or political affiliations.

19.4.33. Gender-Based Violence, Sexual Exploitation and Abuse and Sexual Harassment (GBV/SEA/SH), as well as other forms of bullying, harassment, or discrimination, may occur within the Project workforce. The table below sets out types of harassment, including GBVH, that may impact the Project workforce.

Table 19-5 - Types of Harassment

Type of Harassment	Relevance to and Impact of the Project
Both target and perpetrator are Project workers	The Project has a duty of care towards its workers. Violence, harassment and bullying (based on gender or any other characteristic) can have severe negative

Type of Harassment	Relevance to and Impact of the Project
	impacts on workers' physical and mental health, and work performance. It can also have wider negative impacts on team dynamics.
A local community member targets a Project worker	Project workers, especially female and LGBT+ workers, may be targets of GBV/SEA/SH. Particular risks will occur in rural areas with a small population, where there is already an excess of men amongst the local community. Alternatively, this could occur where social attitudes are conservative, and people who are not performing traditional gender roles are more likely to attract attention.

19.4.34. While there are particular risks faced by vulnerable groups working on the Project, there have been no formally reported incidents of violence, bullying, or harassment. There is currently no separate grievance procedure to handle sensitive grievances, such as those relating to GBV/SEA/SH. Many contractors rely on 'open door' policies for workers to raise concerns to managers, alternatively workers can raise concerns with their trade union representative however there isn't a mechanism to do this anonymously. Workers can file anonymous complaints to the workers' GRM.

19.4.35. The magnitude of this impact is assessed as **medium**, and the significance of the effect is, therefore, **major adverse**.

OPERATION

Labor Management

19.4.36. Current operational employees work similar shift patterns as construction workers; some employees (including operators or duty officers) operate on a shift pattern (12 hours on / off) to provide continuous operation of the Project, while a smaller number of office workers and managers work a five day week (8 hours a day). Most of the current operational employees live in on-site accommodation.

19.4.37. The existing operational labor management practices (shift patterns and accommodation provision) are anticipated to remain for the duration of the operation of the Project.

19.4.38. The magnitude of this impact is assessed as **small**, and the effect is therefore **moderate adverse**.

Occupational Health and Safety

19.4.39. During the operational phase, OHS risks are anticipated to be reduced for workers due to there being fewer risky activities required to operate the Project. However, risks remain for workers who undertake underground work, those who work with electricity, and those who work near water.

19.4.40. With the implementation of corrective actions, as identified by the OHS Audits, and the appointment of HSE Managers, improvements to the health and safety of working practices are likely to improve thought his will depend on a commitment to continuous improvement by the Project.

19.4.41. The magnitude of this impact is assessed as **medium**, and the significance of the effect is, therefore, **major adverse**.

19.5 MITIGATION AND ENHANCEMENT MEASURES

CONSTRUCTION

Labor Management and Occupational Health and Safety

19.5.1. In summary, the LMP provides mitigation measures for all employers on the Project to minimize the potential impacts experienced. Measures include the following:

- Providing non-discrimination and equal opportunity, including fair employment practices and proper implementation of a Project Code of Conduct (CoC);
- Implementing and operating a worker GRM with multiple communication channels, including allowance for anonymous complaints, will be implemented and well communicated, including as part of staff induction and refresher trainings. A separate central grievance procedure will be established to handle sensitive grievances such as those relating to SEA/SH, which will allow for anonymous and confidential submissions;
- Preventing SEA/SH, including mandatory induction and periodic refresher training on SEA/SH policies and integrate gender-responsive H&S measures across the Project site;
- Managing labor-related challenges related to retrenchment, gender equality, discrimination, fair wages, job security, working conditions, workplace harassment, overtime, unionization, family and medical leave, workplace safety and wrongful termination.
- Enabling organized workers, including allowing trade union membership and advertisement of union member rights;
- Preventing forced labor, including prohibited non-voluntary working arrangements and loan agreements;
- Setting out terms and conditions for employment, including contracting contents and sharing, recruiting from local communities, retrenchment requirements, overtime policy, and all workers' rights;
- Providing up-to-standard worker accommodation facilities, including essential requirements, inspections, drinking water, food nutritional value, training sessions, laundry services, toilet and shower facilities, ventilation, sewage and waste disposal systems and fire protection measures;
- Increasing the number of toilets available to workers (GIIP is one toilet per 20 workers);
- Providing regular and safe transportation, including the provision of transport to and from the site to accommodation and to and from the home district to Rogun;
- Complying with the age of employment, ensuring no one under the age of 18 works on site;
- Adhering to terms and conditions of workers, including working hours, overtime, rest days, payment days, wage deductions and sick leave for shift workers and office workers;
- Complying with the requirements of the worker grievance mechanism, including information on maintaining grievance logs, registering sensitive grievances, and role and responsibilities;
- Maintaining contractor management, ensuring labor standards and H&S are included in the tendering process and contracts require contractors to report on issues such as the number of

accident rates, near misses, severity rates, number of recurring non-compliances, violations of compliance and safety, fatalities and serious injuries and penalties for non-compliance;

- Continuing semi-annual OHS audits by an international OHS specialist, who will focus on each of the contractors, and the Employee Representative (ER), practices. Implement all actions identified in the OHS Corrective Action Plan. Contractors are required to develop their own OHS Plans;
- Ensuring the ER and Contractors' HSE and OHS managers have the authority to suspend works that they deem to be unsafe;
- Providing training on the Workers Code of Conduct.

Retrenchment

19.5.1. Employees will be informed at least two months before their expected release date if their contract will not be renewed or will be terminated early.

19.5.2. A Retrenchment Policy will be prepared for the Project by Rogun JSC, which will inform the development of a Retrenchment Plan for contractors when the final months of their engagement approach. This approach will meet the requirements of the Policy, and Rogun JSC will implement the Plan following approval by the Project Management Consultant.

Worker Accommodation and Facilities

19.5.3. New accommodation and facilities will be provided as construction camps are re-located. These will be provided in accordance with GIIP and the following measures undertaken:

- Conducting frequent inspections of accommodation facilities to identify and rectify any hazards.
- Developing and regularly updating emergency response plans.
- Ensuring that living quarters, bathrooms and kitchens are cleaned.
- Implementing proper waste disposal systems.
- Implementing measures to control access to accommodation facilities to enhance security.
- Ensuring adequate lighting in and around accommodation facilities to enhance security.
- Offering recreational facilities and activities to promote mental wellbeing and reduce stress.
- Providing separate facilities for men and women.

Inclusion, Vulnerabilities and Gender

19.5.4. All Plans developed for the Project, for example, the Code of Conduct, will be gender-sensitive and sensitive to the needs of vulnerable groups. Specific actions will include, but not be limited to:

- Provision of a sensitive worker GRM with appropriate procedures to protect complainants;
- Delivery of training and regular refreshers on the Code of Conduct for all operational workers;
- Exploring opportunities to maximize opportunities for women and vulnerable groups, for example, through training opportunities to fill operational jobs or by making reasonable adjustments to the working environment to accommodate worker needs; and
- Implementing the recruitment plan with an unbiased, non-discriminatory onboarding process for operation-phase jobs;

- Implementing policies that promote diversity and inclusion in hiring practices;
- Creating equal opportunities for training and leadership roles for all genders and vulnerable groups;
- Providing separate and safe sanitation facilities for men and women;
- Ensuring facilities are accessible to all workers, including those with disabilities;
- Establishing a zero-tolerance policy for harassment and discrimination;
- Regularly monitoring and evaluating the effectiveness of inclusion and gender-focused policies; and
- Providing workers with access to support services such as counselling and childcare.

OPERATION

Labor Management and Occupational Health and Safety

19.5.5. To mitigate effects regarding labor management and occupational health and safety, the following measures will be set out in the Operational Environmental and Social Management Plan (OESMP) and associated action plans:

- Development and implementation of a Human Resources Manual and Operational Workers' Code of Conduct;
- Training on the Operational Workers Code of Conduct;
- Worker contracts shall be compliant with the Labor Code and meet the standards set out in the Labor Management Procedures document;
- An Operational Health and Safety Plan shall be in place to address potential occupational health and safety risks presented by the project's operation;
- Ensure all workers can access and use appropriate Personal Protective Equipment (PPE) such as helmets, gloves and safety glasses;
- The worker GRM will continue to be implemented, as will the sensitive GRM;
- Office staff should modify workstations and tools to reduce physical strain;
- Maintain a comfortable working environment by controlling the temperature and ventilation;
- Conduct regular safety inspections to identify and mitigate potential risks; and
- Schedule regular health check-ups to monitor the workers' health and identify any problems early.

19.6 RESIDUAL IMPACTS

19.6.1. Residual impacts are impacts that remain after the implementation of mitigation and reflect the efficacy of the specific mitigation measure. The mitigation measures are implemented by the relevant party, specifically the EPC contractor and the subcontractors for the construction phase and the operator and subcontractors for the operational phase, to manage the project's social performance. Quarterly monitoring of the mitigation measures provides the data required to report to the regulatory authorities, Lenders, and other stakeholders.

19.6.2. The periodic review of the mitigation measures must consider the residual impacts of the impact assessment to benchmark implementation performance.

CONSTRUCTION

19.6.3. For the construction phase, the additional mitigation measures are safeguards to ensure that the magnitude of potential impacts that the workforce is exposed to on-site is minimized to the greatest extent possible, especially so for the proportion of the workforce that is considered vulnerable, such as minority ethnicities and women.

19.6.4. For all receptors, the significance of the residual impact is **minor**.

OPERATION

19.6.5. In the operational phase, the additional mitigation measures minimize the magnitude of potential impacts on the workforce, especially for vulnerable groups.

19.6.6. For all receptors, the magnitude of the residual impact is **minor**.

19.7 SUMMARY

19.7.1. For the construction phase, the magnitude of the impact on four of the receptors, namely labor management, occupational health and safety, retrenchments and inclusion, vulnerabilities and gender is **medium** and the magnitude of the impact is **small** for two of the receptors, namely underage and forced labor and worker accommodation and facilities.

19.7.2. Given that the sensitivity of all receptors is **high**, the significance of the pre-mitigation effect is **major** for four receptors (labor management, occupational health and safety, retrenchments and inclusion, vulnerabilities and gender) and **moderate** for two receptors (underage and forced labor and worker accommodation and facilities).

19.7.3. The successful implementation of the additional mitigation measures outlined will reduce the significance of all residual effects in the construction phase to **minor adverse** effects for all potential Project labor and working conditions impacts.

19.7.4. For the operational phase, the magnitude of the impact on the receptors, namely inclusion, vulnerabilities and gender, is small and, given that the receptor sensitivity is **high**, the significance of the effect is **moderate**. With the effective implementation of the mitigation measures, the residual significance is **minor** for all potential operational phase labor and working conditions impacts.

Table 19-6 – Summary of Labor and Working Conditions Potential Impacts (Construction)

Impact	Labor management	Occupational Health & Safety	Underage and forced labor	Retrenchment	Worker accommodation and facilities	Inclusion, vulnerabilities and gender
Receptor sensitivity	High	High	High	High	High	High
Likelihood	Certain	Certain	Unlikely	Certain	Likely	Likely
Magnitude	Medium	Large	Small	Large	Small	Medium
Effect	Negative	Negative	Negative	Negative	Negative	Negative
Direct / Indirect	Direct	Direct	Direct	Direct	Direct	Direct
Significance	Major	Major	Moderate	Major	Moderate	Major
Additional Mitigation (Y/N)	Y	Y	Y	Y	Y	Y
Residual Significance	Minor	Minor	Minor	Minor	Minor	Minor

Table 19-7 – Summary of Labor and Working Conditions Potential Impacts (Operation)

Impact	Labor Management	Occupational Health and Safety
Receptor sensitivity	High	High
Likelihood	Certain	Likely
Magnitude	Small	Medium
Effect	Negative	Negative
Direct / Indirect	Direct	Direct
Significance	Moderate	Major
Additional Mitigation (Y/N)	Y	Y
Residual Significance	Minor	Minor

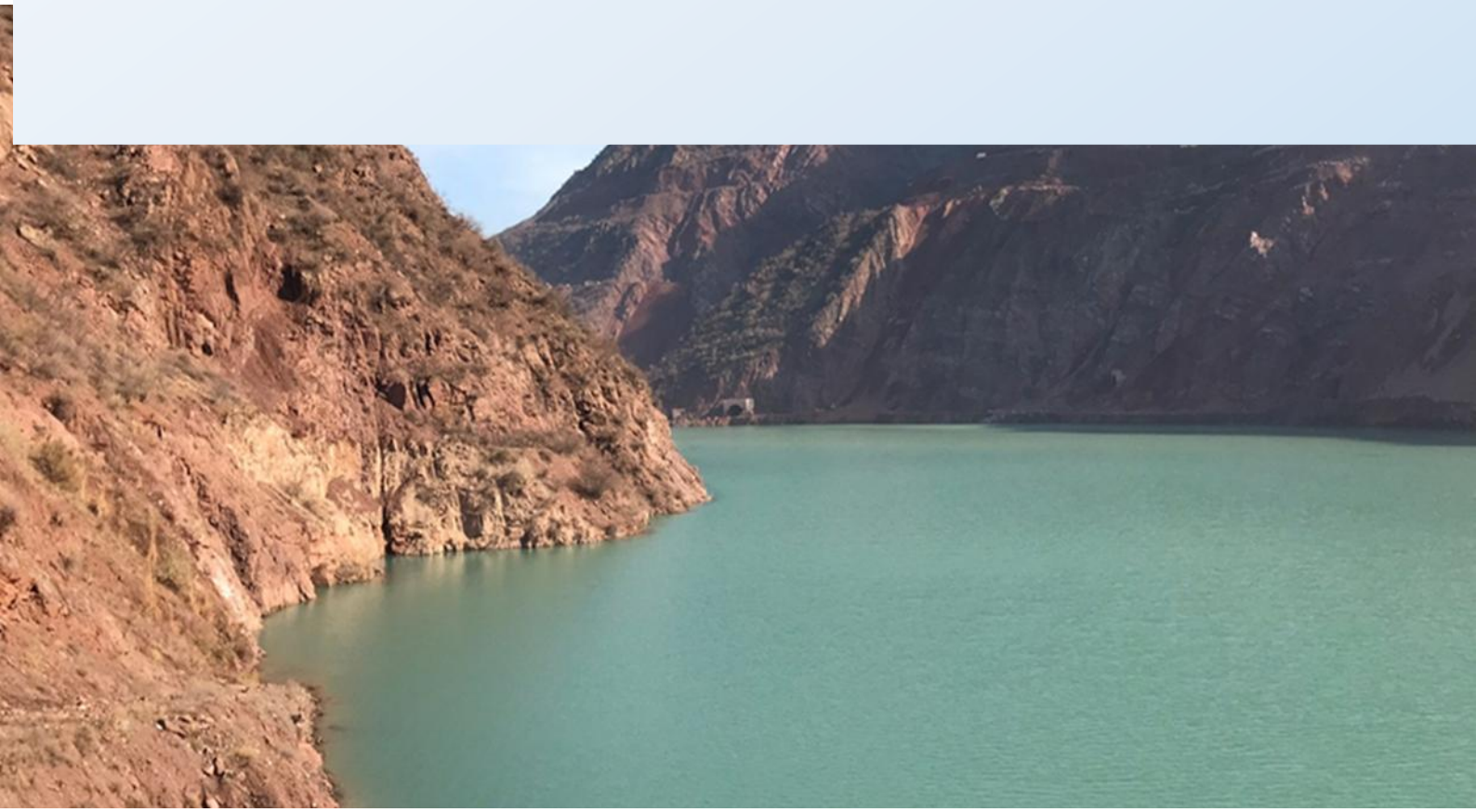
JSC “Rogun HPP”

State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT – UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Volume 1, Chapter 20: Cultural Heritage



MAY 2025

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PUBLIC

PROJECT NUMBER

PROJECT REF

DATE: MAY 2025

QUALITY CONTROL

LIST OF ACRONYMS AND ABBREVIATIONS

Term	Definition
ADB	Asian Development Bank
AIIB	Asian Infrastructure Investment Bank
AoI	Area of Influence
BCE	Before Common Era
CFP	Chance Find Procedure
CIA	Cumulative Impact Assessment
DFZ	Directorate of Flooding Zone of Rogun HPP
EBRD	European Bank for Reconstruction and Development (EBRD VOL 2)
EHS	Environmental, Health and Safety Guidelines
EIB	European Investment Bank
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESP	Environmental and Social Policy
ESS	Environmental and Social Standards
FSL	Full Supply Level
GIIP	Good International Industry Practice
GRM	Grievance Redress Mechanism
HPP	Hydropower Project
JSC	Joint Stock Company
LRP	Livelihood Restoration Plan
M asl	Meters above sea level
NGO	Non-Governmental Organization
NTS	Non-Technical Summary

Term	Definition
OHL	Overhead Lines
PAPs	Project Affected Persons
PIC	Rotterdam Convention on Prior Informed Consent
PMF	Probable Maximum Flood
PMG	Project Management Group
RAP	Resettlement Action Plan
RPF	Resettlement Policy Framework
SEP	Stakeholder Engagement Plan
UAV	Unmanned Aerial Vehicle
UNESCO	United Nations Educational Scientific and Cultural Organization
VC	Valued Components
WB	World Bank
WBG	World Bank Group

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20 CULTURAL HERITAGE

20.1.1. This chapter presents the assessment of potential impacts of the Project on cultural heritage resources, in line with the requirements of the World Bank's Environmental and Social Standard (ESS) 8: Cultural Heritage (2016).

20.1.2. The full cultural heritage baseline is presented in **Volume 2**, **Annex 7-1 – Baseline Conditions Report** and a summary is provided in **Volume 1**, **Chapter 7** of this ESIA. This chapter should also be read in conjunction with the Cultural Heritage Management Plan (CHMP).

20.1.3. For the purposes of this assessment, cultural heritage' is defined in accordance with ESS8 to include the full suite of cultural resources, both moveable and immoveable. This encompasses physical, archaeological resources, including archaeological sites (which may be sub-surface), cultural artefacts, historical monuments and buildings. It also incorporates cultural resources (e.g., sacred and religious places) including natural features of local cultural value, related intangible practice, ethnographic heritage and cultural landscape.

20.1.4. In this context the following ESS8 definitions apply:

- "*…movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Tangible cultural heritage may be located in urban or rural settings, and may be above or below land or under the water*"; and
- "*…practices, representations, expressions, knowledge, skills – as well as the instruments, objects, artifacts and cultural spaces associated therewith, that communities and groups recognize as part of their cultural heritage, as transmitted from generation to generation and constantly recreated by them in response to their environment, their interaction with nature and their history*".

(World Bank, 2018).

SUPPORTING INFORMATION

20.1.5. This chapter is supported by the following associated documents:

- **Volume 2, Annex 20.1** – Gazetteer of Archaeological, Historical, Paleontological, Cultural and Sacred Sites
- **Volume 2, Annex 20.2** – Gazetteer of Villages
- **Volume 2, Annex 20.3** – Village Ethnography Data
- **Volume 2, Annex 20.4** – M-Vector Household Data
- **Volume 2, Annex 20.5** – Cultural Heritage Drawings
- **Volume 2, Annex 20.6** – Cultural Heritage Field Reports (June & August-September 2023)
- **Volume 3, A6** – Cultural Heritage Management Plan

20.2 LEGISLATIVE FRAMEWORK, POLICY AND GUIDANCE

20.2.1. The following legislation, policy and guidance have been considered as part of the assessment:

- The UNESCO World Heritage Convention (1972; ratified by Tajikistan in 1992);
- Asian Development Bank Environmental Assessment Guidelines (2003);

- The Law of the Republic of Tajikistan on the Protection and Use of Objects of Historical and Cultural Heritage (2017);
- The Law of the Republic of Tajikistan About Culture (1997);
- World Bank ESS8: Cultural Heritage (2016) and associated Guidance Note (2018); and
- European Investment Bank Environmental and Social Standards (2022).

20.2.2. National Law in Tajikistan (the Law on the Protection and Use of Historical Cultural Heritage, 2017) governs the protection, use and promotion of cultural heritage. Intangible cultural heritage is also protected in the Law About Culture (1997), which covers non-material aspects. Cultural heritage is identified as the exclusive property of the State.

20.2.3. The 2017 law states (Chapter 3, article 23) that all related research (excavations and the survey of archaeological monuments) must be carried out only with the permission of the authorized state body, the Academy of Sciences of the Republic of Tajikistan (the A. Donish Institute).

INTERNATIONAL LENDER REQUIREMENTS

20.2.4. Cultural heritage is defined in accordance with ESS8 and the other policy and guidance, to include both immoveable and moveable and ethnographic elements. ESS8 requires the proponent to identify and reduce or avoid adverse impacts upon cultural heritage resources. The ESS provides guidance which specifies the participation of Project Affected Persons (PAPs) and other interested parties in the identification of, and potential mitigation of, cultural heritage resources, recommending appropriate strategies for impact reduction and long-term cultural heritage management (e.g., through development and implementation of a Cultural Heritage Management Plan (CHMP) and a Chance Find Procedure (CFP)).

20.2.5. Standard 10 of the European Investment Bank's (EIB) Environmental and Social Standards (2022) concerns cultural heritage. This Standard aligns with ESS8 and requires a "*precautionary approach to the management and sustainable use of cultural heritage*". With regard to mitigation measures, EIB Standard 10 states that, when minimization of adverse impacts is not possible, the restoration *in situ* of the cultural heritage receptor(s) after the adverse impacts have occurred should take place to "*ensure full restoration of the functionality and significance of the cultural heritage for the affected communities*". Where minimization and restoration are not feasible, remediation / compensation for the loss of cultural heritage must be agreed with the PAPs before any potentially impactful works begin. Standard 10 also states that the views of PAPs on cultural heritage of importance should be incorporated into the Project design.

20.2.6. The 1972 United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Convention was ratified by Tajikistan in 1992. Each State Party to the Convention recognizes that it has the primary obligation to ensure the identification, protection, conservation, presentation and transmission to future generations of the cultural and natural heritage … situated within its territory (Article 4). For the purposes of this Convention, "cultural heritage" means:

- Monuments: monumental architectural, sculptural or painting works, elements or structures of an archaeological character, inscriptions, caves and groups of elements, which are of outstanding universal value from the point of view of history, art or science;
- Ensembles: groups of isolated or united buildings which, because of their architecture, their unity, or their integration into the landscape, have outstanding universal value from the point of view of history, art or science; and

- Sites: works of man or combined works of man and nature, as well as areas including archaeological sites that have outstanding universal value from the historical, aesthetic, ethnological or anthropological point of view.

20.3 ASSESSMENT METHODOLOGY

AREA OF INFLUENCE

20.3.1. The Area of Influence (AoI) for cultural heritage includes the footprint of the Project and associated components, incorporating:

- The Rogun HPP dam and associated construction areas;
- The reservoir area at full supply level (FSL);
- Access roads, ancillary facilities and other core infrastructure;
- Left bank roads and bridges; and
- All villages and settlements undergoing resettlement (under RAP 2 and future RAPs).

20.3.2. A 1 km buffer incorporating the key Project components listed above has been used to draw an AoI for cultural heritage to adequately consider both direct and indirect impacts during impact assessment (as described in **Table 20-5**). The AoI is shown on **Drawing 20-3** (**Annex 20.5**). Areas of direct and indirect influence are described further in **Section 20.4**.

20.3.3. This 1 km buffer is refined from the 20 km baseline study area (**Drawings 20-1** and **20-2**), described in **Volume 2, Annex 7-1**, which has allowed for a detailed appreciation of cultural heritage resources found within the Project area, to understand their rarity, historical association and context.

20.3.4. The Project consists of three main components:

- The existing hydropower plant, consisting of 2 x 400MW turbines in operation, the associated dam, whose crest is 1,110 meters above sea level (m asl), and the current reservoir, with a surface area of approximately 12 km^2, plus associated roads and other facilities;
- The completed dam with a crest at 1,300m asl, hydropower plant with 6 x 630MW turbines, and reservoir that will cover approximately 170 km^2, and progressively raised to 1,290 m asl by approximately 2038; and
- The ongoing Resettlement Program affecting 69 villages and phased according to the reservoir levels and villages' relative temporal risk of inundation. Resettlement began in 2014 and is expected to be completed by 2032.

20.3.5. The current, partially completed, dam is considered to represent the existing baseline, therefore the assessment of impacts that have already occurred (prior to 2023) are not considered within this chapter. This chapter considers Project impacts up until approximately 2038 when the full supply level (1,290 m asl) of the reservoir is due to be reached.

CULTURAL HERITAGE RECEPTORS

20.3.6. To enable an analysis of potential Project-related impacts on cultural heritage, the full suite of resources, comprising archaeological, historical and paleontological resources, natural features that embody cultural values and intangible forms of culture, as defined by ESS8, were considered as receptors for the assessment.

20.3.7. The archaeological, historical and paleontological baseline resource is selected as a receptor type representing the ancient history of the region. Archaeological, historical and paleontological sites and artefacts, one of which is of potential national importance, have been identified within the AoI during the baseline study.

20.3.8. There is evidence that the area has been utilized since at least the Stone Age period (c. 1,000,000 Before Common Era (BCE) to c. 2,000 BCE). Additionally, a number of settlements within the wider baseline 20 km study area (described in **Volume 2, Annex 7-1**) are over 300 – 500 years old.

20.3.9. Sacred and cultural resources identified during the baseline ethnographic study include natural features embodying spiritual values, including springs and trees, as well as mosques, cemeteries and memorial sites / shrines (*mazars*). Sacred and cultural resources are selected as a receptor type, representing the tangible manifestation of local cultural values and identity.

20.3.10. In accordance with ESS8, cultural landscape is also a recognized component of this receptor type, representing important watercourses / springs, viewpoints, viewsheds and / or routeways through the landscape. In this sense cultural landscape is integral to a holistic understanding of the local 'sense of place' associated with the current visual setting of this part of the Vakhsh River valley and the historical and cultural receptors within.

20.3.11. Intangible cultural heritage practice represents local cultural activities and behaviors, with a number of unique practices recognized in the more isolated and historically remote village communities. Intangible activities recorded include wool carpet weaving, carpentry painted with regional motifs, needlework and embroidery, musicians making their own traditional instruments and playing music and well as specific local customs, taboo and ritual, as described in **Volume 2, Annex 7-1**.

20.3.12. These three receptor types, applicable to the cultural heritage impact assessment, are summarized in **Table 20-1**.

Table 20-1 – Types of Cultural Heritage

Receptor Type	Definition	Receptor Examples
Archaeological, Historical and Paleontological Resources	Tangible, material remains of past human occupation of a landscape and all associated activities and paleontological resources. Encapsulates all periods from prehistory through to the historical era. Resources include archaeological, historical and paleontological sites or individual artefacts and groups of artefacts. These can be found at surface (above ground) or sub-surface (buried).	• Prehistoric burial mounds • Pottery or sherds (fragments of broken vessels, isolates and scatter) • Stone artefacts (individual lithic 'isolates' and collections of debitage or 'scatter') • Iron artefacts (e.g., arrowheads) • Evidence of past human activity (e.g., abandoned settlement areas) • Fortified sites and outposts (fortresses and watchtowers) • Historic buildings • Paleontological remains and fossils

Receptor Type	Definition	Receptor Examples
Cultural and Sacred Resources	Tangible, physical features or natural objects embodying spiritual and cultural values. Historical and active landscapes, places and objects used by a community for long-standing cultural and religious purposes. Landscapes that are valued locally, representing the combined works of humans and their natural environment.	• Sites of spiritual significance or festivity • Mosques • Shrines • Community museums • Cemeteries and burial grounds • Sacred trees and other natural features (spring sites) • Medicinal plants or trees • Central 'magical greeting' pillars found within many traditional houses. • Key views and important routeways, such as those associated with the seasonal movement of livestock. Aspects integral to the current 'sense of place'
Intangible Cultural Heritage Practice	Unique cultural activities and belief systems, including indigenous cultural knowledge and traditional lifestyles.	• Storytelling and legends (unique cultural knowledge / oral history) • Practice of traditional medicine / healing (unique cultural knowledge) • Pilgrimage • Traditional craft activities (wool carpet weaving, carpentry painted with regional motifs, needlework and embroidery, iron-mongering, musicians making their own instruments and playing traditional music) • Traditional construction techniques, including use of traditional clay hearths • Traditional farming practices, agricultural tools and local crop/tree varieties

RECEPTOR SENSITIVITY

20.3.13. To identify the sensitivity of potential cultural heritage receptors, a scale of relative sensitivity presented in **Table 20-2** has been used, with reference to the information collated in the baseline and as further described in **Annex 7-1**.

Table 20-2 – Criteria for determining Sensitivity of Receptors – Cultural Heritage

Receptor Sensitivity	Example Receptors
Very high	• Archaeological, historical and paleontological sites considered to be of international importance with the greatest potential for further, significant associated discoveries to be made. This also includes exceptionally rare and previously unstudied features with a high potential for further research. • Cultural sites which have been frequented by the local community for longstanding cultural purposes and those which attract visitors from further afield. UNESCO World Heritage assets. • Intangible cultural heritage practice considered to be of international importance, including those examples included on the UNESCO Lists of Intangible Cultural Heritage which are particularly vulnerable to societal change, including induced demographic change and economic development. Certain behaviors and knowledge may be entirely lost from one generation to another.
High	• Archaeological, historical and paleontological resources considered to be of national importance with the greatest potential for further, significant discoveries to be made; or cultural / sacred resources considered to be of the highest value to the community. • Cultural sites which have been frequented by the local community for longstanding cultural purposes. Sites associated with oral history, and which may be representative of a number which no longer exist. Sites which are non-moveable (e.g., associated with natural landscape features). • Intangible cultural heritage practice considered of national or regional importance, which maybe be closely linked to both individual and regional identity and which is particularly vulnerable to societal change, including induced demographic change and economic development. Certain behaviors and knowledge may be entirely lost from one generation to another.
Medium	• Archaeological, historical and paleontological sites considered to be of regional importance with limited potential for further discoveries. • Cultural sites which may be no longer in use but are known to the community and associated with settlement history/oral history. Cultural sites which are common and potentially moveable.
Low	• Archaeological, historical and paleontological features considered to be of local importance including features which are very common and well understood, or those which are very poorly preserved and / or badly disturbed, offering limited potential for further research. • Cultural resources which are very common and potentially moveable - in the sense that new buildings (e.g., churches or mosques), without historical value, can be established or cultural sites which are not in current use, with no enduring local importance or historical value.

20.3.14. Only those resources located within the 1 km AoI (extracted from the wider baseline study area) have been carried through for impact assessment in **Section 20.4**. This includes only baseline resources that are potentially affected by the proposed Project activities. It does not, for example, include the lithic scatters as these resources were found redeposited and already removed from their archaeological context. The assessment of impacts on previously undiscovered resources (including surface 'Chance Finds') is incorporated. These receptors carried through to impact assessment are listed in **Table 20-3**. The Gazetteer of Archaeological, Historical, Paleontological, Cultural and Sacred Sites (**Volume 2, Annex 20.1**) includes a complete list of identified tangible cultural heritage resources and their sensitivity (as defined in **Table 20-2**). The distribution of sites and their related sensitivity value is presented in **Drawing 20-4** and **Drawing 20-5** (**Volume 2, Annex 20.5**). The GPS locations of these resources are confidential and will be shared with the Project team on a 'need to know' basis.

Table 20-3 – Receptors within the AoI and their Sensitivity

Receptor Type	Receptor	Component / Location	Sensitivity
Archaeological, Historical and Paleontological Resources	Fortresses		
	RHPP-AR-01	Pandovchii Agba	Low
	RHPP-AR-02	Magzori Sir	Medium
	RHPP-AR-03	Dakhana	Low
	RHPP-AR-05	Navdonak	Medium
	RHPP-AR-06	Navdonak	Medium
	RHPP-AR-07	Navdonak	Medium
	RHPP-AR-10	Shohindara	Medium
	RHPP-AR-38	Mehrobod	Medium
	RHPP-AR-39	Sari Ju	Medium
	RHPP-AR-40	Roghuni poyon	Medium
	RHPP-AR-41	Dakhani gumush	Medium
	RHPP-AR-42	Yapoloki	High
	RHPP-AR-46	Zarda	Medium
	Mound RHPP-AR-04	Dakhana	Medium
	Tower RHPP-AR-11	Dakhana	Medium
	Building (Mill) RHPP-AR-12	Lughuri poyon	Medium
	Abandoned / historical settlements RHPP-AR-14	Mehrobod / Furudgoh	Medium

Receptor Type	Receptor	Component / Location	Sensitivity
	RHPP-AR-24	Kavlokho	
	Abandoned structures RHPP-AR-28 RHPP-AR-31 RHPP-AR-32 RHPP-AR-37	 Dehai Amirbek Roghuni poyon Darband City Khakimii poyon	Low
	Earthwork remains of field systems RHPP-AR-33 RHPP-AR-34 RHPP-AR-35	Multiple locations	Low
	Fossilized dinosaur footprints RHPP-AR-36	 Rogun	High
	As yet unknown receptors / chance finds	Unknown	Unknown (High on a worst-case basis)
Cultural and Sacred Resources	Mosques RHPP-CR-05 RHPP-CR-07 RHPP-CR-08 RHPP-CR-14 RHPP-CR-15 RHPP-CR-16 RHPP-CR-23	RAP 2 Villages	Low
	Cemeteries, Tombs, Graves RHPP-CR-01 RHPP-CR-02 RHPP-CR-03 RHPP-CR-04 RHPP-CR-06 RHPP-CR-09 RHPP-CR-10 RHPP-CR-11 RHPP-CR-12	RAP 2 Villages	High

Receptor Type	Receptor	Component / Location	Sensitivity
	RHPP-CR-17 RHPP-CR-18 RHPP-CR-20 RHPP-CR-21 RHPP-CR-22 RHPP-CR-24 RHPP-CR-25 RHPP-CR-26 RHPP-CR-27 RHPP-CR-28 RHPP-CR-29 RHPP-CR-30 RHPP-CR-31 RHPP-CR-32 RHPP-CR-34 RHPP-CR-35 RHPP-CR-36		
	Springs RHPP-CR-13 RHPP-CR-19	RAP 2 Villages	High
	Tree RHPP-CR-33	Mehrobod	High
	Museum RHPP-CR-37	Sangi Maliki	Low
	As yet unknown receptors	Unknown	Unknown
Intangible Cultural Heritage	Intangible Practice	RAP Village Communities	High

ASSESSMENT OF IMPACT SIGNIFICANCE

20.3.15. The assessment considers the impact of the Project with the application of embedded mitigation (i.e. that which is an inherent component of the Project design). This gives an indication of the need for additional mitigation to be implemented. The likely effectiveness of that additional mitigation has then been considered, and a residual effect stated.

20.3.16. An evaluation of impacts on cultural heritage receptors takes into account the following characteristics:

- The sensitivity of the impacted receptor;
- The type of impact (positive or negative);
- The duration, and extent of the impact;
- The timing and frequency of the impacts;
- The ability of the affected receptor to recover from temporary impacts (reversibility); and
- The likelihood of the identified impact.

20.3.17. The definitions in **Table 20-4** summarize the criteria used for assessing impact magnitude, or intensity, in relation to cultural heritage.

Table 20-4 – Criteria for assessing Magnitude of Impact – Cultural Heritage

Magnitude of Impact	Description of Criteria
Large	• Archaeological, historical and paleontological receptors or their settings are altered, and key elements are changed such that the resource value is entirely and permanently altered or lost. • Intangible cultural heritage receptors, or component parts thereof, are altered; removed; damaged and/or their functionality/setting/accessibility are entirely and permanently changed or lost; their value or traditional beliefs, practices and/or behaviors cannot continue and are lost, or severely inhibited.
Medium	• Archaeological, historical and paleontological receptors or their settings are partly altered, and key elements are changed such that the resource value is modified and/or information is permanently lost. • Intangible cultural heritage receptors, or component parts thereof, are altered such that their value and/or functionality/setting/accessibility are permanently changed. Such actions result in modification of receptor use and/or modification of traditional beliefs, practices or behaviors.
Small	• Archaeological, historical and paleontological receptors or their settings are slightly altered but their integrity is maintained, or archaeological receptors are altered but no information is lost (through archaeological excavation and recording). • Intangible cultural heritage receptors, or component parts thereof, are altered such that their value and/or functionality/setting/accessibility are slightly changed. Such actions do not result in modification of receptor use or traditional beliefs, practices or behaviors.
Very Small	• Archaeological, historical and paleontological receptors or their settings are not altered, or changes are so minor that their integrity is maintained, and no information is lost. • Intangible cultural heritage receptors, or component parts thereof, are not altered or changes are so minor that that their value and/or functionality/setting/accessibility remain unchanged, and no modification of receptor use is required. Traditional beliefs, practices or behaviors are not modified.

20.3.18. The potential impacts on cultural heritage receptors as a result of the Project have been estimated qualitatively, according to a methodology that considers the sensitivity of the receptor, the frequency of occurrence and the magnitude of the impacts being considered, with reference to **Table 20-2** and **Table 20-4**, respectively. Where potential impacts have been identified, these are considered in turn and mitigation is set out where necessary to ensure that any potential impacts are reduced as far as practicable.

20.3.19. The matrix for assessing significance of effects is shown in **Volume 1, Chapter 5** of this ESIA, and impacts that are classified as moderate or major are considered to be significant effects. Impacts classified as minor or below are considered to be not significant.

20.4 POTENTIAL IMPACTS AND EFFECTS

20.4.1. Cultural heritage sites have the potential to be impacted by Project-related interactions that cause alteration, such as physical disturbance or excavations affecting resource fabric, context or integrity. Project activities and ground-related works with the potential to directly and physical interact with cultural heritage resources would occur during the construction (including pre-construction/preparation) phase. This includes the submergence of resources within the inundation zone.

20.4.2. Direct impacts will therefore occur within, or directly adjacent to, the proposed Project footprint, including all supporting infrastructure (new-build settlements in support of the RAP, left bank roads and bridges and transmission lines).

20.4.3. Secondary, or indirect impacts may also affect cultural heritage resources. For example, Project activities may give rise to variations in the local environmental setting (e.g., due to noise, dust, vibration or visual impacts). These impacts may occur at both construction and operation phases of the Project. The resettlement of PAPs during construction may restrict local access to cultural resources and indirectly limit the continuation of normal cultural activities and intangible cultural heritage, particularly where these activities are tied to natural landscape features. Indirect impacts are therefore likely to occur to tangible receptors in close proximity to the development (depending on the nature of the receptor or the combined Project activities in the vicinity), while indirect impacts on intangible cultural heritage may occur throughout the AoI.

20.4.4. Any secondary land slippage which may occur, resulting from the progressive flooding / seasonal variations in the reservoir water level, may damage resources in the near vicinity. This impact is likely to affect resources on the upper terraces (above the inundation zone, over 1,290 m asl) near to the reservoir perimeter. These impacts, if they were to occur, could damage resources located close to the reservoir edge. **Annex 13-2 – Reservoir Slope Stability** indicates that these impacts will be restricted to a zone about 1 km from the full reservoir edge, with closer areas generally more at risk. The risk of landslides occurring is discussed in detail in **Annex 13-2**. In the context of the Project, potential physical impacts to cultural heritage resources on the upper terraces of the reservoir as a result of landslip, are considered to be indirect, as they will occur secondary to the (direct) impacts upon any resources within the confines of the inundation zone.

20.4.5. Direct impacts are permanent and irreversible. Indirect impacts can be both temporary (e.g., where dust during construction is predicted), or permanent. Permanent indirect impacts include landslip induced damage and loss of access to traditional local cultural resources through the resettlement of PAPs.

20.4.6. These types of potential Project impacts considered for the cultural heritage assessment are summarized in **Table 20-5**.

Table 20-5 – Types of Cultural Heritage Impact

Type	Description
Direct Impact	Impacts that result from a direct interaction between a planned Project activity and the receiving environment/resource (i.e., destruction or damage of an archaeological feature or locally cultural site through ground disturbance). Direct impacts may also occur cumulatively, because of gradual degradation from overlapping Project activities These 'direct impacts' are likely to occur to resources within or adjacent to the proposed Project footprint. They include the progressive inundation of the reservoir (submergence), the development of all ground intrusive supporting infrastructure and the establishment of new-build settlements in support of the RAP.
Indirect Impact	Indirect impacts will not affect the land surface directly but may alter the environmental setting in which a cultural heritage resource is experienced or accessed (e.g., by related dust and vibration disturbance, or through the resettlement of PAPs). These impacts may occur in combination, and cumulatively, from overlapping Project activities in proximity to resources. Indirect impacts also include possible secondary land slippage, resulting from the progressive flooding and seasonal variations in the reservoir water level, which may damage resources in the reservoir perimeter. Intangible cultural heritage may be impacted indirectly, resulting from Project induced demographic changes and population influx, for example. Impacts to intangible heritage can also occur in combination, due to both induced change and a loss of access to cultural resources through resettlement.

20.4.7. The impact activities assessed in relation to the cultural heritage component include:

Construction Impacts:

- The introduction of new buildings and infrastructure has the potential to result in direct interactions with cultural heritage resources. Sub-surface archaeological resources may be physically damaged or destroyed during vegetation clearance or invasive groundworks. Discrete cultural sites may also be partially or wholly destroyed during the development of new infrastructure. This includes the construction of new-built settlements in support of the RAP, the left bank roads and bridges and transmission lines. Burial sites may also experience direct physical damage through ground invasive activity, or compaction through the presence of heavy construction traffic required to support the development of Project facilities.
- Increases in dust and/or noise levels and the emission of vibration may indirectly change the environmental setting in which a cultural resource (e.g., memorial site or cemetery) is experienced. The normal sense of place (i.e., tranquil nature) will be interrupted. Similarly, the normal cultural activities of PAPs may also be interrupted if exceedances in safe levels prevent routine access to cultural sites, preventing the continuation of usual cultural behaviors. Vibration emissions may also result in structural damage to archaeological, historical and paleontological resources and cultural resources, such as cemetery sites.

Resettlement Impacts:

- Resettlement activities are related to the relocation of PAPs. This may result in the indirect prevention of routine access to cultural resources, including burial grounds, sacred places (e.g., shrines) or other places of local cultural and ethnographic value, preventing the continuation of usual cultural behaviors and intangible cultural heritage practice. This does not include direct ground disturbance activities associated with (physical) resettlement (which are assessed as impacts derived from construction activities).

Inundation Impacts

- Inundation of the reservoir will occur gradually, in phases. Flooding will result in a direct loss of access to (and possible degradation of) archaeological, historical, paleontological and cultural and sacred resources (including ancient and modern cemeteries) within the reservoir area as they are submerged. If it were to occur, landslide movement triggered by the filling of the reservoir could indirectly affect archaeological, historical and paleontological resources. The presence of the reservoir at FSL will also result in an indirect change to the local sense of place and associated viewshed for those who remain in the area.

20.4.8. The impact assessment has been carried out in accordance with the methodology described in **Volume 1, Chapter 5** of this ESIA, to assess the potential consequence of proposed activities upon the baseline cultural heritage environment. A matrix of anticipated interactions between the cultural heritage receptor types (**Section 20.3**) and the relevant impact arising as a result of the proposed Project has been developed (**Table 20-6**). The objective of this matrix is to demonstrate where potential consequences may occur, and hence where potential interactions must be explicitly considered as part of the impact assessment process.

Table 20-6 – Receptor Type versus Impact Matrix

Impact / Receptor Type	Construction Activities	Resettlement	Inundation (progressive and at FSL)
Archaeological, Historical and Paleontological Resources	√		√
Cultural and Sacred Resources	√	√	√
Intangible Cultural Heritage Practice	√	√	√

CONSTRUCTION PHASE IMPACTS

20.4.9. The construction phase of the Project is ongoing (the dam will be completed in approximately 2032). During this phase it is anticipated that all groundworks have the potential to disturb both known and unknown resources throughout the Project footprint.

Archaeological, Historical and Paleontological Resources

20.4.10. The introduction of heavy machinery (e.g., bulldozers, excavators, dump trucks, vibrating roller, crane and other equipment and machines) could result in the direct destruction of archaeological, historical and paleontological sites through a change in the existing land surface and the direct destruction of the site's environmental context, and therefore, its material value. Construction activity may also result in secondary ground compaction or vibration (e.g., as heavy equipment is transported). As a result of these ground disturbance activities, archaeological, historical and paleontological resources in the near vicinity may also experience indirect impacts through vibration impacts associated with construction activity (e.g., road haulage of construction material).

20.4.11. The reservoir will progressively rise during the construction phase and archaeological, historical and paleontological resources within the maximum inundation level will be submerged (and degraded). If it were to occur, landslide movement triggered by the filling of the reservoir could affect archaeological and paleontological resources on the upper terraces during the construction phase.

20.4.12. Direct interactions with the archaeological, historical and paleontological resources baseline component are therefore anticipated to result from the following construction phase activities:

- Land preparation and construction of project infrastructure (including left bank roads and bridges and transmission lines);
- Development of new-build resettlement locations; and
- Progressive reservoir inundation (i.e., flooding).

20.4.13. Indirect interactions with the archaeological, historical and paleontological resources component are anticipated to result from the following construction phase activities:

- Any groundworks (land preparation and construction) that may result in a change in local environmental setting, including secondary (e.g., vibration) impacts; and
- Progressive reservoir inundation (resulting in erosion and landslip).

Direct Impacts

20.4.14. A total of 46 archaeological, historical and paleontological resources were recorded during the baseline cultural heritage surveys. Direct construction phase impacts may occur to 15 known receptors within the AoI. Of these, 13 are located within the inundation zone. These are listed in **Table 20-7** and illustrated on **Drawing 20-4** (**Volume 2, Annex 20.5**). These include the locations of fortresses, abandoned and historical settlements and structures which are considered low to medium in terms of cultural heritage value and sensitivity. A set of dinosaur footprints (**RHPP-AR-36**) of high sensitivity is also located within the AoI and included in this table due to their proximity to the dam and existing construction infrastructure (they are immediately adjacent to an existing construction access road). The Stone Age lithic scatters recorded within the AoI (**RHPP-AR-43** – **RHPP-AR-45**) have not been included in the impact assessment, as these were removed from the site and retained by the A. Donish Institute when they were identified.

Table 20-7 – Archaeological, Historical and Paleontological Resources within the AoI: Potential Direct Construction Phase Impacts

Receptor	Description	Sensitivity	Location
RHPP-AR-01	Fortress – Kalai Kofir	Low	Within inundation zone (Pandovchii Agba)
RHPP-AR-02	Fortress – Kalai Shokhon	Medium	Within inundation zone (Magzori Sir)
RHPP-AR-03	Fortress – Kalai Dakhana	Low	Within inundation zone (Dakhana)
RHPP-AR-04	Mound – mound at Dakhana	Medium	Within inundation zone (Dakhana)
RHPP-AR-11	Tower – possible site of Dalhana Watchtower	Medium	Within inundation zone (Navobod)
RHPP-AR-12	Building – Lughuri poyon Mill	Medium	Within inundation zone (Lughuri poyon)
RHPP-AR-14	Settlement – location of historical site	Medium	Within inundation zone (Mehrobod / Furudgoh)
RHPP-AR-24	Settlement – remains of an abandoned settlement located on a platform above the Vakhsh River	Medium	Within inundation zone (Kavlokho)
RHPP-AR-28	Structure – potential remains of structures located on low ground	Low	Within inundation zone (Dehai Amirbek)
RHPP-AR-31	Structure – potential remains of structures on a plain	Low	1.7 km from maximum inundation zone, but potentially close to the proposed left bank access road, the design for which has not yet been finalized (Roghuni poyon)
RHPP-AR-36	Fossil – dinosaur footprints	High	Close to existing construction infrastructure (Rogun)
RHPP-AR-37	Structure – poorly preserved ruins/settlement, pottery	Low	Within inundation zone (Khakimii poyon)
RHPP-AR-38	Fortress – poorly preserved ruins of the fortress, ceramics	Medium	Within inundation zone (Mehrobod)

Receptor	Description	Sensitivity	Location
RHPP-AR-39	Fortress – Kalankok Fortress, poorly preserved ruins, ceramics	Medium	Within inundation zone (Sari Ju)
RHPP-AR-40	Fortress – ruins, ceramics	Medium	Within inundation zone (Roghuni poyon)
N/A	Unknown 'Chance Finds'	High (worst case)	Project footprint / supporting infrastructure

20.4.15. Archaeological, historical and paleontological resources are non-renewable, and on a worst-case basis, without the implementation of archaeological mitigation measures, there is potential for sensitive materials, as listed in **Table 20-7**, to be re-deposited, damaged or destroyed as a result of the direct (ground disturbance-related) construction phase activities.

20.4.16. Throughout the AoI there is also a potential for archaeological and paleontological resources, including monumental assets, surface artefacts or sub-surface sites, to occur that have not yet been located during previous survey phases. These 'chance finds' may be accidentally disturbed during preparatory ground works and construction-related activities. Chance finds are of unknown sensitivity and are therefore classified on a conservative basis. The left bank roads and bridges, transmission lines, and any other proposed supporting infrastructure sites not yet subject to targeted archaeological reconnaissance and receptor mapping, are highlighted in this regard.

20.4.17. The direct disturbance and loss of these resources would result in an impact, prior to the implementation of appropriate mitigation, that is permanent, irreversible and with the potential to occur locally within multiple discrete locations throughout the proposed Project footprint. These impacts would be large in magnitude, upon individual resources that are (on a worst-case basis) highly sensitive, resulting in a major impact significance.

20.4.18. Due to their proximity to the dam and existing construction infrastructure, the set of dinosaur footprints (**RHPP-AR-36**) are at risk of being further directly (and indirectly) impacted through during the construction phase without the implementation of urgent mitigation measures. Although their typology is yet to be determined, the footprints likely date to the Cretaceous period and are considered to be of potential national importance (high sensitivity).

Indirect Impacts

20.4.19. Indirect construction phase impacts may occur to 12 known receptors within the AoI. These are listed in **Table 20-8** and illustrated on **Drawing 20-4** (**Volume 2, Annex 20.5**). These include the locations of fortresses, an abandoned structure and agricultural earthwork remains which are considered low to high in terms of cultural heritage value and sensitivity and one paleontological resource of high sensitivity.

Table 20-8 – Archaeological, Historical and Paleontological Resources within the AoI: Potential Indirect Construction Phase Impacts

Receptor	Description	Sensitivity	Location
RHPP-AR-05	Fortress – Kalai Bacha	Medium	140m from maximum inundation zone / RAP village
RHPP-AR-06	Fortress – Kalai Dukhtarak A	Medium	30m from maximum inundation zone / RAP village
RHPP-AR-07	Fortress – Kalai Dukhtarak B	Medium	30m from maximum inundation zone / RAP village
RHPP-AR-10	Fortress – Kalai Shohindar	Medium	150m from maximum inundation zone / RAP village
RHPP-AR-32	Structure – potential remains of multi-rooms structure	Low	730m from maximum inundation zone
RHPP-AR-33	Agricultural – possible remains of field systems	Low	Multiple locations throughout AoI
RHPP-AR-34	Agricultural – possible remains of lynchets	Low	Multiple locations throughout AoI
RHPP-AR-35	Agricultural – possible remains of terraces	Low	Multiple locations throughout AoI
RHPP-AR-36	Fossil – dinosaur footprints	High	Close to existing construction infrastructure (Rogun)
RHPP-AR-41	Fortress – Gumushkala Fortress ruins, ceramics	Medium	520m from maximum inundation zone
RHPP-AR-42	Fortress – Yapoloki Fortress ruins, ceramics	High	600m from maximum inundation zone
RHPP-AR-46	Fortress – Kalai Chungi Zubaid	Medium	c. 170m from maximum inundation zone
N/A	Unknown ‘Chance Finds’	High (worst case)	Within 100m of maximum inundation zone

20.4.20. On a worst-case basis, without the implementation of specific mitigation measures, there is potential for archaeologically sensitive materials, of potential national importance, to be re-deposited, damaged or destroyed following secondary landslips that may occur in the vicinity of the reservoir perimeter, as its water level changes throughout the construction phase. Eleven resources within the vicinity of the FSL (shown on **Drawing 20-4**, **Volume 2, Annex 20.5**) are highlighted in this regard (situated between 30 m and 730 m from the perimeter), and their historically advantageous position on the uppermost terraces of the valley is particularly vulnerable to under-cutting and eventual slippage (as described in **Annex 13-2 – Reservoir Slope Stability**).

20.4.21. The extent of this impact is difficult to quantify without sub-surface analysis. If necessary, the sensitivity levels applied to these resources will be refined following their archaeological evaluation (as described in paragraph **20.4.27**). On a conservative basis, this impact is permanent, irreversible and with the potential to occur locally within multiple discrete locations throughout the proposed Project footprint. These impacts would be large in magnitude, upon individual resources that are (accounting for the highest sensitivity receptor and the likelihood for 'chance finds') highly sensitive. This would result in a major impact significance.

20.4.22. Potential indirect impacts resulting from changes to the environmental setting (noise, dust etc.) of the 11 archaeological and historical resources (**Table 20-8**) are considered to be negligible, with the closest receptor over 10 km from the dam construction zone. However, due to their proximity to the dam and associated construction infrastructure, the set of dinosaur footprints (**RHPP-AR-36**) are at risk of being indirectly impacted through vibration induced damage from HGV during the construction phase, without the implementation of urgent mitigation measures (and presuming the avoidance of direct impacts).

20.4.23. This indirect impact would result in irreversible damage to the fabric of the paleontological resource, resulting in an impact, prior to the implementation of appropriate mitigation, that is permanent and site-specific. This impact would be large in magnitude, upon an individual resource that is highly sensitive, resulting in a major impact significance.

Mitigation: Archaeological, Historical and Paleontological Resources (Construction Phase)

Impact Avoidance and Minimization – Cultural Heritage Management Plan (CHMP) (AM-20-01)

20.4.24. To reduce potential significant effects, and to ensure good practice construction methods relating to protection of cultural heritage, in line with the Mitigation Hierarchy, the following measures (AM-20-01 to AM-20-08) shall be implemented, through adherence to the overarching Project CHMP (**Volume 3, A6**).

20.4.25. The CHMP is a "live" document and PMG are responsible for its annual review and any subsequent update, during the lifetime of the Project (as outlined in Section 15 of the CHMP and the Environmental and Social Management Plan (ESMP; **Volume 3**, **A1**).

20.4.26. The preparation and implementation of an on-site cultural heritage awareness training program will be made available (during site induction) for all 'on site' employees and sub-contractors, to provide awareness of the mitigation and management measures applicable to cultural heritage (as outlined in Section 6 of the CHMP).

Impact Avoidance - Avoidance Plans (AM-20-02)

20.4.27. Archaeological, historical and paleontological resources are non-renewable, and the primary goal of cultural resource management should be their physical preservation in-situ, in accordance with World Bank guidance (ESS8, 2018) (i.e., to avoid direct impacts regardless of the protected status of the potential receptor). The preferred mitigation for all sites potentially directly impacted by Project activities is, therefore, avoidance, particularly in advance of site-specific mitigation measures (see AM-20-02). It is recognized that the archaeologically sensitive locations identified within the proposed flooding zone cannot be avoided. Impacts on these resources will therefore be effectively minimized as discussed below (see AM-20-02).

20.4.28. To facilitate the avoidance of sensitive, potentially non-replicable resources within the remainder of the proposed footprint and supporting infrastructure (construction access roads etc.), all known resources located outside the inundation zone will be mapped and presented to the Employer's Representative / future PMC and DFZ as areas for avoidance and physical demarcation (with barriers) during all ground preparation and construction works (Avoidance Plans).

20.4.29. The thirteen identified archaeological, historical and paleontological resources which can be avoided (i.e., those situated outside the inundation zone) will be buffered by an appropriate and practical "exclusion zone" (to account for the potential extent of sub-surface resources). The avoidance of construction activities in proximity will also help to manage indirect impacts, particularly related to vibration, noise and dust. Further detail is provided in Section 8 of the CHMP. The Avoidance Plans will be developed through the CHMP implementation process and include the receptors listed below:

- Kalai Bacha fortress site (**RHPP-AR-05**);
- Kalai Dukhtarak A fortress site (**RHPP-AR-06**);
- Kalai Dukhtarak B fortress site (**RHPP-AR-07**);
- Kalai Shohindar fortress site (**RHPP-AR-10**);
- Potential remains of structures on a plain near Roghuni poyon / left bank roads and bridges (**RHPP-AR-31**);
- Potential remains of multi-room structure near Darband City (**RHPP-AR-32**);
- Potential earthwork remains of field systems (**RHPP-AR-33**, **RHPP-AR-34**, **RHPP-AR-35**);
- Fossilized dinosaur footprints near Rogun (**RHPP-AR-36**);
- Gumushkala fortress site (**RHPP-AR-41**);
- Yapoloki fortress site (**RHPP-AR-42**);
- Kalai Chungi Zubaid fortress site (**RHPP-AR-46**); and
- all resources (yet to be identified) within supporting infrastructure locations (e.g., left bank roads and bridges).

Impact Avoidance and Minimization: Ongoing baseline data capture (AM-20-03)

20.4.30. Baseline data collection for archaeological, historical and paleontological resources and cultural and sacred resources throughout the AoI is ongoing, as described in Section 7 of the CHMP.

20.4.31. Additionally, preconstruction surveys will be required for elements of the Project whose locations have not yet been finalized, such as the left bank roads and bridges and transmission lines. Any mitigation measures subsequently deemed necessary must be undertaken prior to the construction of these elements of the Project and will form part of the Pre-construction Survey Process (**Volume 3, Chapter 1**) and the Management of Change Procedure (**Volume 3, Chapter 2**), as per the ESMP and in conformance with the CHMP.

Impact Minimization – Evaluation (AM-20-04)

20.4.32. In the event that the avoidance of archaeological, historical and paleontological resources is not possible, as in the case of those identified within the proposed flooding zone and near perimeter landslip 'risk zone', then a phase of archaeological evaluation is required to fully investigate the subsurface potential of the locations of heightened archaeological potential and sensitivity. This approach is in conformance with World Bank guidance (ESS8, 2018), to minimize and reduce impacts on resources where avoidance is not possible.

20.4.33. This evaluation stage must occur urgently, before any ongoing preparatory works or construction activities commencing and before the inundation of the receptors. This program will be phased in response to the inundation schedule and will determine the sub-surface extent and research value of those receptors thus far identified by purely visual means. If necessary, the sensitivity levels applied to these resources will be refined following their archaeological evaluation.

20.4.34. Archaeological evaluation typically comprises a scheme of preliminary, shallow and targeted hand-dug test pits (e.g., 1m x 1m in size) at sites previously identified through desktop study or non-intrusive walkover only. This scheme of sub-surface analysis will seek to eliminate the risk of archaeologically induced delays during the construction phase and the loss of sensitive, non-renewable resources as they are characterized in better detail. The schedule of archaeological surveys and evaluation must be included in the Overall Implementation Program (OIP) prepared by the Employers Representative, in consultation with DFZ.

20.4.35. Once the evaluation stage is complete, further measures to minimize impacts to archaeological resources will be determined. For example, if the targeted sites yield archaeological material, it may be necessary to implement a program of "preservation by record" through systematic recording (e.g., archaeological excavation). Such work, where required, will be described in appropriate detailed work programs and specifications (known as Written Schemes of Investigation) to be prepared by a Cultural Heritage Management Team (CHMT), retained by PMG, comprised of the A Donish Institute and external experts familiar with Lender standards and GIIP, as described in Section A6.10 of the CHMP.

20.4.36. The scope and suitability of additional work that will be required to further investigate identified sites and/or additional areas will be developed as information from any preconstruction evaluation is assessed and disseminated. The effectiveness of this next stage will be supported by the continued engagement of competent cultural heritage experts including those at the A. Donish Institute currently engaged on the Project, supported by experts familiar with international good practice and Lender requirements, and adherence to best practice techniques.

20.4.37. A methodology for the archaeological evaluation phase is incorporated into the CHMP and includes the receptors listed below:

- **RHPP-AR-01** (fortress site);
- **RHPP-AR-02** (fortress site);
- **RHPP-AR-03** (fortress site);
- **RHPP-AR-04** (mound);
- **RHPP-AR-11** (watchtower site);
- **RHPP-AR-12** (building);
- **RHPP-AR-14** (historical settlement);
- **RHPP-AR-24** (abandoned settlement);

- **RHPP-AR-28** (structural remains);
- **RHPP-AR-37** (structural remains);
- **RHPP-AR-38** (fortress site);
- **RHPP-AR-39** (fortress site);
- **RHPP-AR-40** (fortress site);
- **RHPP-AR-05** (fortress site);
- **RHPP-AR-06** (fortress site);
- **RHPP-AR-07** (fortress site);
- **RHPP-AR-10** (fortress site);
- **RHPP-AR-46** (fortress site); and
- all resources (yet to be identified) within supporting infrastructure locations (e.g., left bank roads and bridges).

20.4.38. The location of paleontological receptors recorded within the AoI, including those recorded on the Mindat.org online database (see **Volume 2, Annex 7-1**), will need to be verified and interpreted during the evaluation stage. This will require engagement with a paleontological specialist (e.g., at the A Donish Institute of Geology) and, potentially, consultation with appropriate regional stakeholders depending on the assessment of the local paleontological specialist. Further detail is provided in Section 8 of the CHMP.

Impact Minimization: Environmental Monitoring: Upper Terraces Cultural Heritage Monitoring Program (AM-20-05)

20.4.39. The phased implementation of cultural heritage monitoring in the upper terraces (over 1,290 m asl) of the valley during progressive inundation is required in collaboration with the CHMT. The aim of the program is to minimize the impact on archaeological, historical and paleontological resources and cultural and sacred resources in areas at risk of landslip. It is proposed that the cultural heritage monitoring (and recording) of the upper terraces (from the water or via Unmanned Aerial Vehicles (UAV) is informed by the reservoir inundation schedule (phased programme) and as agreed with the CHMT. This program will be confirmed and prepared by the CHMT, in continued consultation with the Dam Safety Panel of Experts (DSPoE), the Engineering Geology team and PMG.

20.4.40. Further detail is provided in Section A0.16.14 of the CHMP.

Impact Minimization: Implementation of Project Chance Find Procedure (AM-20-06)

As described, there is a high potential for further, as yet unknown, archaeological, historical and paleontological resources to exist within the Project footprint and surrounding AoI, particularly in the locations not previously subject to systematic archaeological investigation where preconstruction surveys will be necessary (e.g., supporting infrastructure locations, left bank roads and bridges etc.). The cultural heritage baseline is therefore, considered representative of the Project AoI and it is possible that other sites of interest exist that are not currently identifiable by purely visual means. Other (potentially important) remains may survive in below-ground deposits, or in areas which were inaccessible to baseline survey.

20.4.41. In line with World Bank ESS8, the implementation of a Chance Find Procedure (CFP) is required, to mitigate any accidental damage of both surface and sub-surface archaeological, historical and paleontological resources, i.e., to provide a mechanism to address discoveries during Project activities when a Cultural Heritage Expert is not present. The CFP will be a core component of the Cultural Heritage Awareness Training program (AM-20-01).

20.4.42. The CFP will apply for the lifetime of the Project, throughout the entirety of the footprint and associated infrastructure, and during any / all ground works, including vegetation clearance. The CFP will clarify the exact steps to be taken in the event of any potential resource discovery. Further detail is provided in Section 11 of the CHMP. Strict adherence to the Project's Chance Find Procedure by all on site construction workers, where groundwork activities are ongoing or planned, will help to manage any accidental and unforeseen risks to archaeological resources.

20.4.43. Ongoing external engagement with non-governmental organizations (NGOs) will be facilitated by the Project CHMT, in collaboration with PMG and DFZ.UNESCO's ongoing Silk Roads research program, already supported by the A Donish Institute, is of particular relevance, given the proximity of the flood zone to the Karategin sub-section of the ancient Silk Road route. If deemed appropriate, the CHMT will engage with UNESCO and share relevant data acquired during ongoing baseline data capture and/or identified through the CFP process. Further detail is provided in Section 15 of the CHMP.

Cultural and Sacred Resources

20.4.44. There are 37 currently identified cultural and sacred resources located within the AoI. This number may be updated as the ongoing baseline data collection and mapping phase continues, particularly related to supporting infrastructure locations (e.g., left-bank roads and bridges). The introduction of heavy machinery (e.g., bulldozers, excavators, dump trucks, vibrating roller, crane and other equipment and machines) could result in the direct destruction of cultural and sacred resources (burial grounds, ritual objects, sacred places etc.) through a change in the existing land surface and the direct destruction of the site's material value.

20.4.45. Construction activity may also result in ground compaction or vibration (e.g., as heavy equipment is transported), affecting cemeteries and burial sites in particular. As the reservoir will progressively rise during and after the construction phase, 33 known cultural resources within the inundation zone will be submerged. Furthermore, this will lead to the loss of usual local access to cultural and sacred resources (see **Table 20-9** below) as communities are moved as part of the resettlement program.

20.4.46. Direct interactions with the cultural and sacred resources component are therefore anticipated to result from the following construction phase activities:

- Construction of supporting infrastructure (e.g. left bank roads and bridges and transmission lines);
- Demolition and relocation of cultural and sacred resources (e.g. mosques and graves) to resettlement villages; and
- Progressive reservoir inundation.

20.4.47. Indirect interactions with the cultural and sacred resources component are anticipated to result from the following construction phase activities:

- Any groundworks that may result in a change in baseline environmental setting;
- The RAP resettlement program and related land acquisition; and
- Progressive reservoir inundation.

Direct Impacts

20.4.48. A total of 37 cultural and sacred resources were recorded during the baseline cultural heritage surveys. Direct construction phase impacts are predicted to occur to 33 known receptors within the AoI, which incorporates the proposed Project footprint. These are listed in **Table 20-9** and illustrated on **Drawing 20-5** (**Annex 20.5**). These include the locations of cemeteries, tombs, mosques and springs which are considered low to high in terms of cultural heritage value and sensitivity.

Table 20-9 – Cultural and Sacred Resources within the AoI: Potential Direct Construction Phase Impacts

Receptor	Description	Sensitivity	Location
RHPP-CR-01	Cemetery	High	Within inundation zone (Khakimii bolo)
RHPP-CR-02	Burial – Oftobkhuja Tomb	High	Within inundation zone (Khakimii bolo)
RHPP-CR-03	Burial – Mohtobkhuja Tomb	High	Within inundation zone (Khakimii bolo)
RHPP-CR-04	Burial – Bobokhuja Tomb	High	Within inundation zone (Khakimii bolo)
RHPP-CR-05	Mosque	Low	Within inundation zone (Khakimii bolo)
RHPP-CR-06	Cemetery	High	Within inundation zone (Khakimii poyon)
RHPP-CR-07	Mosque	Low	Within inundation zone (Khakimii poyon)
RHPP-CR-08	Mosque	Low	Within inundation zone (Khumrogh)
RHPP-CR-12	Cemetery	High	Within inundation zone (Obiboriki bolo)
RHPP-CR-13	Spring	High	Within inundation zone (Obiboriki bolo)
RHPP-CR-14	Mosque	Low	Within inundation zone (Obiboriki bolo)
RHPP-CR-15	Mosque	Low	Within inundation zone (Obiboriki poyon)
RHPP-CR-16	Mosque	Low	Within inundation zone (Lughuri poyon)
RHPP-CR-17	Cemetery	High	Within inundation zone (Lughuri poyon)

Receptor	Description	Sensitivity	Location
RHPP-CR-18	Burial – Tomb	High	Within inundation zone (Lughuri poyon)
RHPP-CR-19	Spring	High	Within inundation zone (Obiboriki poyon)
RHPP-CR-20	Burial	High	Within inundation zone (Khakimii bolo)
RHPP-CR-21	Cemetery	High	Within inundation zone (Pandovchii Agba)
RHPP-CR-22	Mausoleum – Xazrati Khujai Paron	High	Within inundation zone (Pandovchii Agba)
RHPP-CR-23	Mosque – no longer in use	Low	Within inundation zone (Bulbuldara)
RHPP-CR-25	Cemetery	High	Within inundation zone (Margzori Sir)
RHPP-CR-26	Cemetery – Oromgoh	High	Within inundation zone (Sari Kosh)
RHPP-CR-27	Burial – Mazori Domullobacha	High	Within inundation zone (Bedikho)
RHPP-CR-28	Burial – Mazori Sangi Dushokha	High	Within inundation zone (Bedikho)
RHPP-CR-29	Burial – Mazori sha χ id	High	Within inundation zone (Bedikho)
RHPP-CR-30	Burial – Mazori sha χ id	High	Within inundation zone (Bedikho)
RHPP-CR-31	Burial – Mazori Chorma-zak chashma	High	Within inundation zone (Bedikho)
RHPP-CR-32	Burial – Mazori Bibi-Otun	High	Within inundation zone (Mehrobod)
RHPP-CR-33	Tree – Chanor	High	Within inundation zone (Mehrobod)
RHPP-CR-34	Burial – Mazori Ashoni Asrori	High	Within inundation zone (Aligalaboni bolo)
RHPP-CR-35	Burial – unknown tomb	High	Within inundation zone (Aligalaboni bolo)
RHPP-CR-36	Burial – unknown tomb	High	Within inundation zone (Aligalaboni bolo)

Receptor	Description	Sensitivity	Location
RHPP-CR-37	Museum – Boqi Rahimzoda	Low	Within inundation zone (Sangi Maliki)

20.4.49. Prior to the implementation of cultural heritage mitigation, direct impacts on known cultural and sacred resources could result in the loss of, or damage to, 33 receptors within the inundation zone due to submergence. On a worst-case basis, and without the implementation of mitigation measures, this would include 25 highly sensitive community receptors. Without mitigation, these impacts would be permanent and irreversible. The significance of the impacts would be major (on highly sensitive receptors i.e., cemeteries, burials, tombs and springs) and with the potential to disrupt normal cultural activities, such as site visitation and / or related festivities.

20.4.50. Throughout the AoI there is also a potential for as yet unidentified cultural resources, including cemeteries, shrines, springs etc., to occur. These locations may be accidentally disturbed during and preparatory or construction-related activities. The supporting infrastructure locations (e.g., left bank roads and bridges) are highlighted in this regard. These resources are of unknown sensitivity and are therefore classified according to the criteria in **Table 20-2** on a conservative basis.

20.4.51. The direct disturbance and loss of cultural and sacred resources would result in an impact, prior to the implementation of appropriate mitigation, that is permanent, irreversible and with the potential to occur locally within multiple discrete locations throughout the proposed Project footprint. These impacts would be large in magnitude, upon individual resources that are (on a worst-case basis) highly sensitive, resulting in a major impact significance.

Indirect Impacts

20.4.52. Indirect construction phase impacts may occur to four known cultural and sacred receptors within the AoI. These are listed in **Table 20-10** and illustrated on **Drawing 20-5** (**Volume 2, Annex 20.5**). These include the locations of burials, a cemetery and a *mazar* which are considered high in terms of cultural heritage value and sensitivity. Their exact locations are subject to ongoing verification, as detailed in Sections 7, 9 and 12 of the CHMP. This is considered appropriate for a Project of this scale, where baseline data capture and characterization will inevitably continue beyond the ESIA stage. The baseline dataset incorporated within this Chapter is appropriate for the assessment of Project impacts and the design of effective mitigation strategies – within the limitations described in **Volume 1, Chapter 7 (Cultural Heritage Baseline)**.

Table 20-10 – Cultural and Sacred Resources within the AoI: Potential Indirect Construction Phase Impacts

Receptor	Description	Sensitivity	Location
RHPP-CR-09	Cemetery	High	Khumrogh (exact location unknown)
RHPP-CR-10	Burial – Hazrat Shamsiddinkhoja Tomb	High	Khumrogh (exact location unknown)
RHPP-CR-11	Burial – Tomb of Sayedawazi Kozi	High	Khumrogh (exact location unknown)

Receptor	Description	Sensitivity	Location
RHPP-CR-24	Mazar – Vakhobiddin	High	Zarda (exact location unknown)

20.4.53. The resources listed in **Table 20-10** are over 10 km from the dam construction area (hence indirect changes to noise, dust etc., are not assessed), and are located in settlements close to (but outside) the maximum inundation zone. Any indirect disturbances related to resettlement (demolition) are also not assessed, due to the presumed distance of limited impacts generated during the removal of household debris. Unforeseen indirect impacts, such as exceedances in noise and dust, will be captured through the implementation of the CHMP. The CHMP sets out a programme for continued local engagement for all villages, in alignment with the SEP and the Project Greivance Redress Mechanism (GRM).

20.4.54. The planned resettlement program will likely prevent continued, safe, usual local access to these resources. On a worst-case basis, and without mitigation, indirect changes to local access will be permanent and irreversible and have the potential to result in a major impact significance, with the potential to disrupt normal cultural activities, such as site visitation.

20.4.55. Without the implementation of specific mitigation measures, there is also potential for culturally sensitive materials (including graves) to be re-deposited, damaged or destroyed if secondary landslips were to occur in the vicinity of the reservoir perimeter, as it is gradually filled throughout the construction phase. The four resources within the immediate vicinity of the FSL are highlighted in this regard (**Table 20-10**). On a conservative basis this impact is permanent, irreversible and with the potential to occur locally within multiple discrete locations throughout the proposed Project footprint. These impacts would be large in magnitude, upon individual resources that are (on a worst-case basis) highly sensitive. This would result in a major impact significance.

Mitigation: Cultural and Sacred Resources (Construction Phase)

20.4.56. Tangible cultural and sacred resources are non-renewable, and the primary goal of cultural resource management should be their physical preservation in-situ, in accordance with World Bank guidance (ESS8, 2016) (i.e., to avoid direct impacts regardless of the protected status of the receptor). As described previously (AM-20-01), to reduce potential significant effects, and to ensure good practice construction methods relating to protection of cultural heritage, the following measures shall be implemented through adherence to the Project CHMP and related staff training. The CHMP is presented in **Volume 3**.

Avoidance Plans (AM-20-02)

20.4.57. To facilitate the avoidance of sensitive cultural and sacred resources across the Project area, avoidance plans will be incorporated into the Project's CHMP. The avoidance areas will include the sensitive receptor and an appropriate buffer and the associated community access route, as agreed with the site guardian / representative. The construction phase avoidance plan will include all cultural and sacred resources currently identified within the AoI, but outside the maximum inundation zone, and it will be updated by PMG (in collaboration with the Project CHMT) as further resources are identified in participation with communities (see AM-20-05 below). The avoidance plans will be developed through the CHMP implementation process and include:

- Cemetery in Khumrogh (**RHPP-CR-09**);

- Tomb of Hazrat Shamsiddinkhoja in Khumrogh (**RHPP-CR-10**);
- Tomb of Sayedawazi Kozi in Khumrogh (**RHPP-CR-11**); and
- Vakhobiddin mazar in Zarda (**RHPP-CR-24**).

20.4.58. Where the exact location of a cultural and sacred resource is currently not known, this will be determined as a matter of urgency through ongoing community consultation and related mapping (Section 7 and .9 of the CHMP). If ongoing consultation determines resources **RHPP-CR-09, RHPP-CR-10, RHPP-CR-11** and **RHPP-CR-24** are within 1 km of the FSL and vulnerable to landslip impacts, the program of cultural sites and/or grave relocation (as described below, AM-20-05), may apply.

Minimization: Ongoing Engagement (AM-20-07)

20.4.59. Where indirect environmental effects are identified at cultural and sacred site receptors, additional cultural heritage mitigations during construction are recommended, in consultation with site users. This may include:

- Plans for environmental screening (e.g., planting or additional noise barriers);
- Plans for continued safe access to specific locations as necessary;
- Plans for ongoing consultation with village representatives yet to be engaged by the A. Donish Institute Ethnography Team in relation to cultural and sacred sites (see Section 7 of the CHMP); and
- Plans for continued, ongoing consultation with cultural leaders to monitor ongoing residual impacts and the effectiveness of proposed mitigations, in alignment with the SEP and GRM.

20.4.60. Where ongoing consultation identifies a need for it, a strategy for maintaining community access to sacred resources and facilitating respect for local intangible cultural heritage, tradition and taboo will be incorporated in the CHMP to ensure that the negative socio-cultural effects are effectively mitigated. For example, it may be necessary to demarcate areas to be avoided by noisy, dust inducing construction vehicles at certain times of the week/year so as to avoid disturbance of traditional ceremonial activities in close proximity of construction routes; with regular platforms for community liaison recommended in this regard. In addition, this is will help to prevent any accidental loss of (unknown) sensitive cultural assets throughout the construction phase (and beyond).

Minimization: Relocation (AM-20-08)

20.4.61. In the event that the avoidance of cultural and sacred resources is not possible, as in the case of those identified within the proposed flooding zone (**Table 20-9**), then relocation of the receptors may be the most appropriate form of mitigation, if at all possible. This relocation program will be phased in response to the inundation schedule and developed in consultation with the CHMT.

20.4.62. Through close cooperation with the local communities and DFZ, the most appropriate destination for receptors to be relocated will be determined. The nature, scale and ‘movability’ of the receptors will also need to be taken into account when making this decision. It may be possible for such receptors to be relocated to the new villages where local communities have been resettled. This process will be led by DFZ in conjunction with the CHMT and the site guardian prior to the commencement of Project operations in the area of concern. Further detail of this relocation and ongoing management program is outlined in Section 12 of the CHMP.

20.4.63. Alternatively, it may be considered more appropriate to move the receptor to a local museum where it can be easily accessed by local communities. The WSP Cultural Heritage Team visited a small museum situated in Tursunzoda School in March 2023. Through careful management, and in consultation with local communities, 'heritage hubs' or community museums will be created in the new built settlements under the guidance and management of professional museum experts. Museums like this would provide opportunities to help manage equitable sharing of benefits of the Project while maintaining access to local cultural knowledge / associated artefacts.

20.4.64. As a strategy for 'heritage hubs' or community museums is defined through CHMP implementation (CHMP Section 12), a fair and equitable strategy regarding the acquisition or purchase of artefactual ethnographic resources (e.g., traditional musical instruments or representations of local craft) to be removed / relocated during resettlement will be prepared, in association with local museums and cultural centers. If local grievances are raised, regarding local compensation for artefactual materials relocated to museums, the GRD will apply. Further detail is provided in Section 12 of the CHMP.

20.4.65. The current cemetery relocation practices are described and evaluated in Annex 7-1. An Ongoing Cemetery Relocation Best Practice Guide will be developed and implemented through the CHMP, in close consultation with local communities and other stakeholders. It will outline the necessary steps that must be taken for burial and cemetery sites which cannot be avoided, through the ongoing relocation program overseen by DFZ. The Ongoing Cemetery Relocation guidelines will be compliant with Good International Industry Practices (GIIP). Further detail is provided in Section 13 of the CHMP.

Intangible Cultural Heritage Practice

20.4.66. Throughout the ethnographic studies completed in support of baseline data collection, a variety of unique local practices were recorded in consultation with PAPs. These include intangible cultural heritage that is distinct and integral to the isolated, rural mountain communities within the Project AoI, incorporating traditional music, dance, food, crafts and ceremonial activities (as described in **Volume 2, Annex 7-1**). In the context of the Project, intangible heritage is a receptor, defined as the normal cultural behavior and knowledge transmitted from one generation to the next, which communities or individuals recognize as part of their cultural heritage and local identity.

20.4.67. Intangible cultural heritage has been assigned a value of 'high sensitivity'. This valuation recognizes that intangible cultural heritage is closely linked to both individual and group identity in the study area and may be particularly vulnerable to societal change, including induced demographic change and economic development as communities are transferred to more urban settings.

20.4.68. Certain behaviors and knowledge, particularly those that are unique to the AoI, may be entirely lost from one generation to another. Although it is recognized that some adjustments in cultural behaviors are inevitable over time, endurance of traditional activities is likely to be a considerable factor in the ability of the community (particularly older generations) to deal with and adapt to, changing external circumstances, resolve conflict and maintain resilience.

20.4.69. The construction phase will therefore include a series of activities that have a potential to indirectly influence intangible cultural heritage practice across the AoI.

20.4.70. These activities include:

- Progressive reservoir inundation; and
- The resettlement program.

20.4.71. In combination, these activities will likely prevent continued, usual local access to cultural and sacred resources and disrupt normal cultural activities and festivities, both for those communities who are resettled and those who remain in the valley. During the construction phase, the combination of these impacts upon intangible cultural heritage practice is considered both cumulatively and individually. Selecting the magnitude of impacts from these activities is subjective, with change from the local cultural norm perceived as either potentially positive or negative. This is also likely to vary by age group. For example, anecdotal evidence gathered during informal consultations suggested that older generations feel more 'attachment' to their villages within the AoI, with younger generations excited to engage with the opportunities afforded by a more urbanized setting. In the context of the Project and prior to the implementation of specific mitigation, potential loss, deviation, or dilution of normal cultural behavior is considered a negative impact.

20.4.72. If indirect impacts are to occur, they could be of unknown and, therefore, high intensity (on a worst-case basis) and throughout the duration of construction. Societal changes are considered irreversible in the context of intangible cultural heritage and major in terms of impact magnitude (without mitigation). This is impact is also induced, with a high likelihood of demographic change (and employment opportunities) throughout construction, which may be compounded by the presence of workers and predicted influx (see **Volume 1, Chapter 17**).

Mitigation: Intangible Cultural Heritage Practice (Construction Phase)

20.4.73. As described previously (AM-20-01), to reduce potential significant effects, and to ensure good practice construction methods relating to protection of cultural heritage, the following measures shall be implemented through adherence to the Project CHMP and related staff training. The CHMP is presented in **Volume 3**.

Avoidance and Minimization: Cultural Heritage Awareness Program (AM-20-01)

20.4.74. A cultural heritage awareness program will be prepared and implemented for specialist on-site staff (interacting with PAPs), facilitating respect for local intangible cultural heritage, tradition and taboos, as applicable for the construction phase (and throughout Operation). It will include as a minimum:

- Information on 'no go' areas demarcated by avoidance plans;
- Relevant information on local cultural activities (e.g., rules governing certain places, or a schedule of seasonal ceremonies / festivities);
- Information on local cultural sensitivities and acceptable behaviors; and
- Any other pertinent issues to be discussed / prepared in participation with PAPs.

20.4.75. Further detail is provided in Section 6 of the CHMP (in **Volume 3**).

Minimization: Ethnographic Management (AM-20-07 and AM-20-08)

20.4.76. A strategy for maintaining community access to tangible sacred resources and thereby facilitating respect for, and continuation of, local intangible cultural heritage (traditions and taboos) will developed through CHMP implementation (and as described in AM-20-04 and AM-20-05). For example, it may be necessary to demarcate areas to be avoided by noisy, dust inducing construction vehicles at certain times of the week/year to avoid disturbance of traditional ceremonial activities in proximity to construction routes, with regular platforms for community liaison recommended in this regard. In addition, this is will help to prevent any accidental loss of sensitive cultural assets throughout the construction phase (and beyond).

20.4.77. If the avoidance of such tangible sacred resources is not possible, as in the case of those identified within the proposed flooding zone, then relocation of the receptors may be the most appropriate form of mitigation, if at all possible. This would ensure continued access to such sites and effectively mitigate negative socio-cultural effects.

20.4.78. The CHMP includes provisions for continued local engagement for all villages in alignment with the SEP (including those not yet consulted with) to address any unforeseen issues regarding the preservation of intangible heritage throughout the lifetime of the Project, should they arise. This will also be aligned with the implementation of the Project GRM.

20.4.79. The CHMP sets out a strategy for linking to the Project Livelihood and Restoration Program (LRP) in the resettlement villages. This program will be specific to traditional crafts and skills, with the aim of ensuring that such intangible cultural heritage practice is not completely lost as a result of the Project. The program will be developed in close consultation with local communities and will be run from a central 'heritage hub' or community museum in each resettlement area. Community cultural heritage 'champions' will be identified to organize courses and events.

20.4.80. Through careful management, and in consultation with local communities, 'heritage hubs' or community museums will be created in the new built settlements under the guidance and management of professional museum experts. Museums like this would provide opportunities to help manage equitable sharing of benefits of the Project while maintaining access to local cultural knowledge / associated artefacts. Further detail is provided in Section 12 of the CHMP (**Volume 3**).

OPERATIONAL PHASE IMPACTS

Archaeological, Historical and Paleontological Resources, Cultural and Sacred Resources and Intangible Cultural Heritage Practice

20.4.81. This phase of the cultural heritage impact assessment is completed for the fully operational Project. This considers the reservoir to be flooded to the maximum extent (1,290 m asl). As discussed above, there is a risk, prior to the implementation of effective mitigation measures, that cultural heritage resources within the perimeter of the reservoir will be impacted by landslip during Project operation.

20.4.82. Although this potential impact is hypothesized to occur throughout the construction phase (as the reservoir is progressively filled), the FSL will vary seasonally, potentially triggering landslide movement which could affect physical cultural heritage resources. Any such landslide movement would likely occur close to the reservoir perimeter and be triggered by new erosion processes during operations, as described in **Volume 2, Annex 13-2**. The potential for archaeological, paleontological or cultural features to be damaged as a result of landslide movement would depend on their proximity to the reservoir and the nature of the surrounding geology.

20.4.83. The loss of access to specific (tangible) cultural and sacred resources is not assessed at operations phase, as these are permanent indirect impacts which are derived in the construction phase (associated with each RAP) and assessed (and mitigated) in the preceding section (paragraphs 20.4.56 – 20.4.65). Any ongoing physical degradation, triggered by potential landslip at FSL, is assessed for this operations phase.

Impact Classification: Archaeological, Historical and Paleontological Resources and Cultural and Sacred Resources

20.4.84. The Rogun dam will be constructed by about 2032, and the FSL reached by approximately 2038. Archaeological, paleontological and cultural remains in the upper terraces (above the inundation zone) may survive but are likely to be at a greater risk of damage / loss as a result of landslip caused by erosion / undermining from the reservoir during operation.

20.4.85. On a worst-case basis, without the implementation of specific mitigation measures, there is potential for sensitive materials, of potential national importance, to be re-deposited, damaged or destroyed following any secondary landslips that may occur in the vicinity of the reservoir perimeter once it reaches FSL. Assuming their endurance throughout the construction phase, 11 archaeological resources and four cultural and sacred resources within the immediate vicinity of the FSL are highlighted in this regard. These are situated within 1 km of the FSL and are particularly vulnerable to under-cutting and eventual slippage (as described in **Volume 2, Annex 13-2 – Reservoir Slope Stability**). **Volume 2, Annex 13-2** also describes the mitigation and monitoring measures applicable to the management of shoreline erosion and landslip, the impact significance is evaluated as minor.

20.4.86. The extent of this indirect impact on cultural heritage is difficult to quantify without further analysis of the archaeological resources in particular (beyond visual / surface inspection). On a conservative basis this impact is permanent, irreversible and with the potential to occur locally within multiple discrete locations throughout the proposed Project footprint. If they were to occur, these impacts would be large in magnitude, upon individual resources that are (on a worst-case basis) highly sensitive. This would result in a major impact significance, pre-mitigation.

Mitigation: Archaeological, Historical and Paleontological Resources & Cultural and Sacred resources (Operational Phase)

20.4.87. To reduce potential significant effects, and to ensure good practice construction methods relating to protection of cultural heritage in accordance with ESS8, the following measure shall be implemented through adherence to the Project CHMP and related staff training during operations.

CHMP: Upper Terrace Cultural Heritage Monitoring Program (AM-20-05)

20.4.88. A cultural heritage monitoring program will be put in place during construction (as described in AM-20-05), comprising visual reconnaissance from the water or UAV survey, in continued consultation with the DSPoE, and the Engineering Geology team, to monitor ongoing slippage in the upper terraces of the valley and to assess the effectiveness of existing measures for ensuring slope stability (Annex 13-2 – Reservoir Slope Stability). Further detail is provided in Section 14 of the CHMP.

Impact Classification: Intangible Cultural Heritage

20.4.89. During the operations phase, the indirect impact of the presence of the reservoir upon intangible cultural heritage practice is considered cumulatively for PAPs. This is impact is also induced, with a high likelihood of demographic change (and employment opportunities) because of the fully operational Project, which may be compounded by the presence of project workers and predicted influx (see **Chapter 17**). Any deviations from the local cultural norm resulting from induced demographic changes may be perceived as either positive or negative, and are also likely to vary by age group, with older generations likely to feel more 'attachment' to their villages or original and/or rural identity within the AoI. In the context of the Project and prior to the implementation of specific, long-term, operations-specific mitigation, potential loss, deviation, or dilution of normal cultural behavior and experience is considered a negative impact.

20.4.90. Selecting the magnitude of impacts from changes in cultural landscape character is currently poorly understood. It is recognized however, that although fundamentally the presence of the project during operation / at FSL, will represent a major change – from an isolated, mountainous, braided river valley, the pace of change is very gradual. As a consequence, it is predicted that the 'shock' from impact is reduced (gradual) and the opportunity for adaption and resilience in the face of change in the landscape character is high.

20.4.91. If these indirect (and induced) impacts are to occur, they could be of unknown and, therefore, high intensity (on a worst-case basis) and throughout the duration of construction. Societal changes are considered irreversible in the context of intangible cultural heritage and major in terms of impact magnitude (without mitigation).

Mitigation: Intangible Cultural Heritage Practice (Operational Phase)

20.4.92. To reduce potential significant effects, and to ensure good practice relating to protection of intangible cultural heritage, the mitigation measures outlined for the construction phase must continue throughout the operations phase of the Project: These include:

CHMP: Cultural Heritage Awareness Program (AM-20-01)

20.4.93. Further detail is provided in Section 6 of the CHMP and above under construction phase Mitigation (20.4.73 – 20.4.80).

CHMP: Ethnographic Management (AM-20-07 and AM-20-08)

20.4.94. Further detail is provided in Section 12 of the CHMP and above under construction phase Mitigation (20.4.73– 20.4.80).

TRANSBOUNDARY EFFECTS

20.4.95. Based on the information gathered to date, there are no known cultural heritage resources that could be affected that are of international value or significance that may trigger the need for a transboundary heritage assessment.

20.5 SUMMARY OF MITIGATION AND ENHANCEMENT MEASURES

20.5.1. A number of enhancement measures will be implemented to address the potential changes that will take place during the construction and operational phases, potentially adversely affecting cultural heritage resources if no intervention measures are put into place. These measures are summarized below (**Table 20-11**) and described in detail in the CHMP.

20.5.2. The CHMP is implemented in accordance with the relevant legislation, policy and guidance, namely the UNESCO World Heritage Convention (1972; ratified by Tajikistan in 1992); Asian Development Bank Environmental Assessment Guidelines (2003); the Law of the Republic of Tajikistan on the Protection and Use of Objects of Historical and Cultural Heritage (2017); the Law of the Republic of Tajikistan About Culture (1997); World Bank ESS8: Cultural Heritage (2016) and associated Guidance Note (2018); and European Investment Bank Environmental and Social Standards (2022).

Table 20-11 – Cultural Heritage Mitigation Summary

Receptor Type	Overview of Mitigation Measure
Construction Phase	
Archaeological, Historical and Paleontological Resources **Cultural and Sacred Resources** **Intangible Cultural Heritage**	**Implement Cultural Heritage Management Plan to include:** ■ Cultural heritage awareness training (AM-20-01); ■ Preparation of / adherence to Avoidance Plans (constraints mapping, demarcation) (AM-20-02); ■ Ongoing Baseline Data Capture (AM-20-03); ■ Archaeological and Paleontological evaluation stage (AM-20-04); ■ Implementation of Chance Find Procedure (AM-20-06); ■ Environmental monitoring, including Upper Terrace Cultural Heritage Monitoring Program (AM-20-05). ■ Continued consultation and ethnographic management (AM-20-07 and AM-20-08); and ■ Ongoing grave relocation program (AM-20-08).
Operation Phase	
Archaeological, Historical and Paleontological Resources **Cultural and Sacred Resources**	**Continuation of Cultural Heritage Management Plan to include:** ■ Cultural heritage awareness training (AM-20-01); ■ Avoidance Plans (constraints mapping, demarcation) (AM-20-02); ■ Environmental monitoring, including continuation of Upper Terrace Cultural Heritage Monitoring Program at FSL (AM-20-05); ■ Continuation of Chance Find Procedure (AM-20-06); and

Receptor Type	Overview of Mitigation Measure
Intangible Cultural Heritage	■ Continued consultation and ethnographic management (AM-20-07 and AM-20-08).

20.6 SUMMARY OF RESIDUAL EFFECTS

20.6.1. Impacts are predicted or hypothesized to 26 archaeological, historical and paleontological resources and 37 cultural and sacred resources within the AoI. Through the application of the mitigation hierarchy, to avoid and reduce impacts on cultural heritage resources, the residual impact magnitude will be reduced from ‘major’ to ‘moderate to minor’. This recognises the high sensitivity of impacted receptors and the degree of induced change driven by the Project. Successful mitigation and management will also require sustained efforts throughout construction and throughout operation.

PUBLIC

JSC “Rogun HPP”

State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT – UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Volume 1, Chapter 21 – Major Accidents and Disasters



PROJECT REF
SEPTEMBER 2025

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QUALITY CONTROL

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21. MAJOR ACCIDENTS AND DISASTERS

21.1. INTRODUCTION

21.1.1. This Chapter provides a high-level assessment of likely significant effects of the Project on environmental and social receptors, arising from the vulnerability of the Project to risks of relevant major accidents and/or disasters due to natural or manmade hazards (hereafter referred to as Major Events). In addition, this Chapter considers the selection process for resettlement sites. Resettlement sites are handed over to the local authority control after one year. Similarly, as the construction of resettlers' houses is carried out by the resettlers themselves and is not under direct Project control, any risks related to house re-construction or normal habitation will not be considered.

21.1.2. The Chapter takes into consideration both external and internal factors during the operation and construction phases, namely:

- The vulnerability of the Project and resettlement sites to Major Events; and/or
- The Project and resettlement activities' potential to cause Major Events

21.1.3. Based on professional judgement, Major Events are occurrences or scenarios that have the potential to affect the Project or associated receptors, causing immediate or delayed major damage to one or more of the following:

- Human health;
- Property; and
- Environment.

21.1.4. This assessment is based on the information available within other chapters of this ESIA, such as receptors, likely significant effects, and appropriate mitigation measures. This Chapter is intended to be read as part of the wider ESIA, with reference to the following chapters in particular:

- Volume 1, Chapter 03: Project Description;
- Volume 1, Chapter 07: Baseline;
- Volume 1, Chapter 08: Air Quality;
- Volume 1, Chapter 09: Greenhouse Gases;
- Volume 1, Chapter 10: Climate Resilience;
- Volume 1, Chapter 11: Noise and Vibration
- Volume 1, Chapter 12: Geology and Soils;
- Volume 1, Chapter 13: Water;
- Volume 1, Chapter 15: Biodiversity;
- Volume 1, Chapter 17: Socioeconomics;
- Volume 1, Chapter 18: Community Health, Safety and Security;

21.1.5. The potential Major Events to which the Project may be at risk of vulnerability during construction and operation phases considered in this Chapter are listed in **Table 21-1**.

Table 21-1 - Major Event Categories and Types

Event Category	Event Type	Event
Natural	Geophysical	Earthquakes Volcanic Activity Landslides and mudslides Sinkholes Tsunamis
	Hydrological	Coastal Flooding Fluvial Flooding Glacial Lake Outburst Flooding (GLOF) Pluvial Flooding Groundwater Flooding Avalanches
	Climatological and Meteorological	Cyclones, hurricanes, typhoons, storms and gales Thunderstorms Wave surges Extreme temperatures: Heatwaves, Low (sub-zero) temperatures and heavy snow Droughts Fog Wildfires: Forest fire, Bush/brush pasture Poor Air Quality
	Biological	Disease epidemics: Viral Bacterial Parasitic Fungal Prion Animal diseases: Zoonotic: – Avian influenza – West Nile virus – Rabies Non-zoonotic: – Foot and mouth

Event Category	Event Type	Event
		Swine fever Plants
Technological or Manmade Hazards	Societal	Extensive public demonstrations which could lead to violence and loss of life Widespread damage to economies and societies The need for large-scale multi-faceted humanitarian assistance The hinderance or prevention of humanitarian assistance by political and military constraints Significant security risks for humanitarian relief workers in some areas Famine Displaced population
	Industrial and Urban Accidents	Major accident hazard chemical sites Major accident hazard pipelines Nuclear Fuel storage Dam breaches Mines and storage caverns Fires
	Transport Accidents	Road Rail Waterways Aviation
	Pollution Accidents	Land Water
	Utility Failures	Electricity Gas Water supply Sewerage system
	Malicious Attacks	Unexploded ordnance (UXO) Attacks: Chemical Biological Radiological Nuclear

Event Category	Event Type	Event
		Transport systems Crowded places Cyber Infrastructure
	Engineering Accidents and Failures	Bridge failure Flood defense failure Mast and tower collapse Property or bridge demolition accidents Tunnel failure / fire

21.1.6. This Chapter describes the assessment methodology and the baseline conditions relevant to the assessment, and a summary of the likely significant effects resulting from the vulnerability of the Project to Major Events. The study area comprises:

- The Project site (construction area, HPP and reservoir); and
- Active resettlement sites, including:
  - Saidoni Nav (Rogun District);
  - Yoli Garmoba (Rogun District);
  - Darband (Nurobod District);
  - Chorsada-2 (Danghara District);
  - Sebiston (Faizobod District);
  - Toichi (Tursunzoda District); and
  - Namuna (Tursunzoda District).

21.1.7. The definition of key terms used in this Chapter are provided in **Table 21-2**. These definitions have been developed by reference to the definitions used in EU and Tajik legislation and guidance relevant to major accidents or disasters, as well as professional judgement based on knowledge and experience of similar projects, in the context of the Project.

Table 21-2 - Key Terms

Term	Definition
Disaster	A naturally occurring phenomenon such as an extreme weather event (for example storm, flood, temperature) or ground-related hazard events (for example subsidence, landslide, earthquake), which may or may not be exacerbated by human-caused factors, which has the potential to cause an event or situation that meets the definition of a Major Event as defined below.
External Influencing Factor	A factor which occurs beyond the Project may present a risk to the Project, e.g. If an external disaster occurred (e.g. earthquake, major accident at another facility) it would increase the risk of serious harm or damage to a receptor associated with the Project.

Term	Definition
Hazard	Anything with the potential to cause harm, including ill-health and injury to people, damage to property or the environment; or a combination of these.
Internal Influencing Factor	A factor which occurs within the Project may present a risk to the Project itself.
Major Accident	In the context of the Project, an event that threatens immediate or delayed serious damage to human health, safety, welfare, property or the environment, and requires the use of resources beyond those of the Project implementing agencies or its contractors to respond to the event. Serious damage includes the loss of life or permanent injury to at least one person, and/or permanent or long-lasting damage to a receptor that cannot be restored through minor clean-up and restoration efforts. The significance of this effect considers the extent, severity and duration of harm and the sensitivity of the receptor.
Major Event	A Major Event is a low-likelihood, high-consequence event, encompassing both the term Major Accident and the term Disaster.
Risk	The likelihood of an impact occurring, combined with effect or consequence(s) of the impact on a receptor if it does occur.
Risk Event	An identified, unplanned event, which is considered relevant to the Project and has the potential to be a Major Accident or Disaster subject to assessment of its potential to result in a significant adverse effect on a receptor.
Significant effect	Significant in the context of Major Events could include the loss of life, permanent injury and temporary or permanent destruction of an environmental receptor which cannot be restored through minor clean-up and restoration.
Vulnerability	In the context of the EU Directive 2014/52/EU, the term refers to the 'exposure and resilience' of the Project to the risk of a Major Accident or Disaster. Vulnerability is influenced by sensitivity and adaptive capacity of the receptor and magnitude of impact.

21.2. LEGISLATIVE FRAMEWORK, POLICY AND GUIDANCE

21.2.1. This assessment has been completed in accordance with paragraph 15 of EU Directive 2014/52/EU and the Law of the Republic of Tajikistan on Ecological Expertise (news of Majlisi Oli of the Republic of Tajikistan 2003 № 4, art. 150, 2005, № 12, art. 638, 2007, № 7 art. 690). For further information on legal requirements, see **Volume 1, Chapter 2: Legislation and Standards** of this ESIA.

NATIONAL LEGISLATION

21.2.2. The applicable legislative framework covering the design, construction and operation of the Project includes:

- Code No. 1329 of 23 July 2016 Labor Code of the Republic of Tajikistan;
- Code No. 1688 of 2 April 2020 Water Code of the Republic of Tajikistan;
- Law No. 721 of 28 June 2011 on Security;

- Law No. 518 of 1 October 2007 on the Peculiarities of Licensing Certain Types of Activities;
- Law No. 14 of 28 February 2004 on Industrial Safety of Hazardous Production Facilities (as amended 02/01/2020); and
- Law No. 666 of 29 December 2010 on Safety of the Hydraulic Structures (as amended 17/05/2018).

21.2.3. The State Committee on Land Management and Geodesy is responsible for identifying suitable land for resettlement sites under Resolution No. 47 of 20 January 2009, "On Resettlement of the Population of Rogun Town and Nurobod District from the flooding zone of Rogun HPP", with amendments to Resolution No. 47 of 20 January 2009 including:

- Resolution No. 395 of August 27, 2011, "On modifications and additions to Resolution of the Government of the Republic of Tajikistan No. 47 of January 20, 2009"
- Resolution No. 162 of 28 March 2015, "On modification and additions in the order of the Government of the Republic of Tajikistan of No. 47 of January 20, 2009.

INTERNATIONAL LEGISLATION AND GUIDANCE

21.2.4. The applicable legislative framework covering the design, construction and operation of the Project is summarized as:

Paragraph 15 of EU Directive 2014/52/EU states:

> *"In order to ensure a high level of protection of the environment, precautionary actions need to be taken for certain projects which, because of their vulnerability to major accidents, and/or natural disasters (such as flooding, sea level rise, or earthquakes) are likely to have significant adverse effects on the environment. For such projects, it is important to consider their vulnerability (exposure and resilience) to major accidents and/or disasters, the risk of those accidents and/or disasters occurring and the implications for the likelihood of significant adverse effects on the environment."*

21.2.5. There is no published guidance for the application of the legal requirements to the assessment of Major Events. However, selected relevant guidance for risk assessment methodologies includes:

- The International Standards Organization's ISO 31000: 2018 Risk Management;
- IEMA (2020) Major Accidents and Disasters in EIA: A Primer;
- IEMA (2016). EIA Quality Mark Article: Assessing Risks of Major Accidents / Disasters in EIA;
- International Commission on Large Dams (ICOLD) (2016) ICOLD Bulletin 148: Selecting Seismic Parameters for Large Dams; and
- ICOLD (2011) Bulletin 137: Reservoirs and Seismicity – State of Knowledge.

21.2.6. Additionally, the following international sources have been consulted to support the identification of potential Major Events:

- The International Federation of Red Cross & Red Crescent Societies (2008), Early Warning, Early Action (International Federation of Red Cross and Red Crescent Societies, 2008). This guidance looks to other countries including those in warmer climates, thereby identifying risks that Tajikistan may encounter in the future considering climate change and global warming.
- The International Disaster Database. This online source contains data covering over 22,000 mass disasters in the world since 1900 to the present day and aims to "rationalize decision making for disaster preparedness, as well as provide an objective base for vulnerability assessment and priority setting".

21.3. ASSESSMENT METHODOLOGY

21.3.1. The assessment of Major Events has been undertaken through a review of available documentation, including other topic chapters of this ESIA, other risk assessments and studies carried out for the Project, and third-party data and documentation. No primary data gathering has been undertaken for the purposes of this chapter, as other sources are considered sufficient for risk identification and assessment.

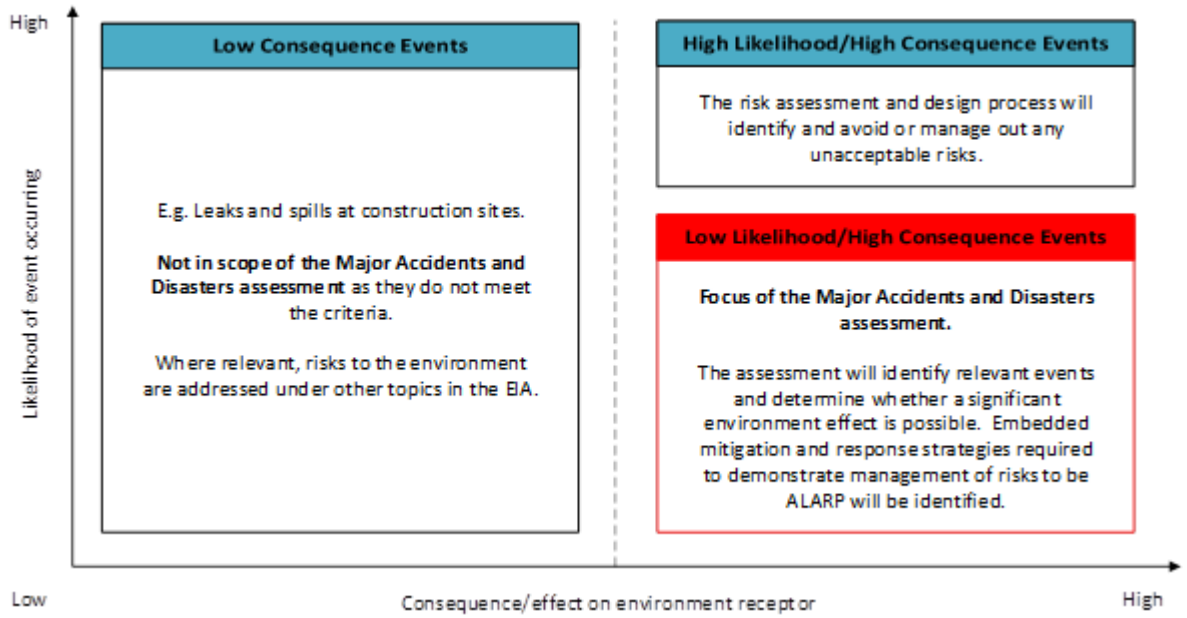
21.3.2. The assessment presents any identified risks along with whether these are managed to be 'As Low As Reasonably Practicable' (ALARP) or require precautionary mitigation actions in addition to the management measures already integrated into the design and execution of the Project.

21.3.3. The following process has been applied to each of the Major Event categories studied:

- Identifying risks;
- Screening these risks;
- Defining the impact;
- Assessing the likelihood; and
- Assessing the risk.

21.3.4. Identify risks - this assessment focuses on low-likelihood, but potentially high-consequence, events, as illustrated in **Figure 21-1**. All low-consequence events, whatever their likelihood, do not meet the definition of Major Events. For example, minor spills which may occur during construction, but would be limited in area and volume and temporary in nature, do not meet the definition of a major accident. Such minor events would be dealt with under the Project Environmental and Social Management Plan (ESMP) and do not fall within the scope of this assessment.

Figure 21-1 - Graphical Representation of Major Accidents and Disasters Consequence Significance



21.3.5. Low-likelihood is defined for the purposes of this assessment as: May occur during the lifetime of the Project, so no more than once in 10 years for the construction phase, and no more than once in 100 years for the operational phase. This is an upper boundary for low likelihood.

21.3.6. Very low likelihood events will also be included in the assessment, which may only occur at most once every 1,000 years. Mitigation measures will reflect what is reasonable for such rare events, considering their potential consequence, within the guiding principle of risks being ALARP.

21.3.7. External and internal influencing factors are considered within the study area presented in **Table 21-3.**

Table 21-3 - Study area for internal and external influencing factors

Feature type	Feature	Study area	Justification
Human-made features	Airports and airfields	13km	the legal distance of the safeguarding zone for licensed airports in the UK
	Major Industrial Accident Risk facilities (i.e. hazardous facilities / Seveso establishments)	3km	Furthest distance of COMAH site Consultation Zone (CZ) in the UK
	Major Accident Hazard (MAH) pipelines, such as dangerous gases, fuel and chemical pipeline systems	1km	Furthest distance of MAH pipeline CZ in the UK
	Nuclear installations	3km	Distance to the Land Use Planning Outer CZ
	Fuel retail sites (including Liquified Natural Gas, Liquified Petroleum Gas)	1km	Professional judgement
	Rail infrastructure	500m	Professional judgement
	Transmission infrastructure (gas, electrical, oil/fuels)	crossing the Project	Professional judgement
	Other features	Case-by-case	The study area for many features depends on factors other than distance from receptors, e.g. large dams pose downstream risks over long distances but more limited upstream risk
Natural features	Natural features, e.g., seismic faults, unstable ground conditions	Up to 3km	Professional judgement, based on their potential to cause risks

SCREENING OF RISKS

21.3.8. To identify whether a Risk Event has the potential to be a Major Event, and thus potentially have a significant adverse effect, a source, a pathway (between source and receptor) and a receptor need to be present. As such the assessment uses the following conceptual model:

- The source is the original cause of the hazard, which has the potential to cause harm;
- The pathway is the route by which the source can reach the receptor; and
- The receptor is the specific component of the human or biophysical environment that could be adversely affected if the source reaches it.

21.3.9. The following screening process is then used to identify those Major Events which would require further consideration within the assessment:

- Is there a potential source, and/or pathway and/or receptor as defined above? If not, no further assessment required;
- Is there a relevant receptor present in the locations where the Risk Event could occur, and a pathway whereby the source of harm can reach the receptor? If not, no further assessment required;
- Does the potential impact on the receptor meet the definition of a significant adverse effect? If not, no further assessment required.

21.3.10. EPPs for Rogun HPP are being developed successively for each impoundment level. Per ESS4 requirements, an EPP will be developed at least 12 months prior to impoundment, and then activated. Following this approach, a construction stage EPP for dam elevation of 1100 masl, which is expected to be reached in 2025, shows that a dam break at Rogun with a dam crest at 1110 masl, there will be no risk downstream of Nurek, including the Nurek dam. As higher dam stages are reached until it reaches 1290 masl in about 2038, there will be successive EPPs in place before the reservoir is raised to the elevation for that stage (according to the latest OIP: 1100 masl in 2025, 1165 masl in 2027, 1230 in 2032, and then annual increased up to 1290 masl in 2038) until a full-fledged EPP is prepared. Where potential risks are identified downstream of Nurek, appropriate mitigations will be required including activation of warning systems. Local communities will receive suitable communication materials, such as posters and brochures, so that they are familiar with required actions in emergencies well before occasions warranting such actions might arise. In addition, a full-fledged EPP for the Vakhsh HPP cascade is being prepared as part of the Nurek rehabilitation project, and is in draft stage for Tajikistan, and the Government is engaging with riparian countries on the approach to develop EPPs in riparian countries.

21.3.11. Risk Events which are not screened out during this process are compiled into a short list for further assessment.

RISK ASSESSMENT

21.3.12. Once the short list of potential Major Events is compiled, the reasonable worst consequence and receptor(s) is identified for each scoped-in Major Event. Potential impacts have been identified in consultation with relevant disciplines for each Major Event type assessed within this ESIA. The impacts are identified through a qualitative process which seeks to answer the question ‘could this event constitute a major accident or disaster in terms of the definitions provided’ (refer to **Table 21-2)**.

21.3.13. The likelihood of the reasonable worst-case effect(s) occurring has been evaluated considering:

- The likelihood of the event occurring considering the measures already embedded into the design and execution of the Project; and
- The likelihood that a receptor is affected by the event.

21.3.14. Likelihood assessments evaluate whether the effect (for example, loss of life) is a possible outcome of the event.

21.3.15. The assessment of the risk has been carried out using a Major Events assessment tool. Where likely significant adverse effects are identified, mitigation measures must be in place, commensurate with the likelihood of the event occurring. The assessment considers, in consultation with relevant disciplines, whether the risk to the receptor is managed to be ALARP with the existing measures.

21.3.16. If gaps are identified, where the existing measures do not represent management of risks to a receptor to be ALARP, then mitigation is required. The Risk Record presented in Section 23.7 records the outcome of the assessment.

APPRAISE RISK MANAGEMENT OPTIONS

21.3.17. Risk management options fall into the following categories:

- Eliminate (or 'avoid') the risk, by adopting alternative processes in order to eliminate the source of the hazard, or remove the receptor from harm;
- Reduce the risk by adapting proposed processes such that either the likelihood or the impact of the Risk Event can be reduced;
- Isolate the risk, by using physical measures to ensure that should the Risk Event occur, it can be effectively isolated such that there is no pathway;
- Control the risk, by ensuring that appropriate control measures are in place (for example emergency response) so that should a Risk Event occur, it can be controlled and managed appropriately. The mitigation hierarchy to repair and compensate any significant damage to receptors may then apply following a control measure; and
- Exploit the risk if it presents potential benefits or new opportunities.

21.3.18. As safety risks will be required to be adequately addressed within the regulatory framework for the Project, it is not anticipated that significant residual effects, in terms of safety risks, will be identified as an output of the assessment.

SIGNIFICANCE CRITERIA

21.3.19. By definition, a Major Event would have a major adverse effect on human health, property or the environment. Accordingly, any risks that could result in a Major Event after the application of existing management or regulatory controls in place, or mitigation identified in other topic chapters, will be assessed as significant.

21.4. BASELINE CONDITIONS

21.4.1. Baseline conditions are summarized in **Volume 1, Chapter 7: Environmental and Social Baseline**, and detailed in **Volume 2, Annex 7-1: Environmental and Social Baseline Conditions Report** of this ESIA. Those aspects of most relevance to this assessment are summarized in **Table 21-5**.

21.4.2. In line with Paragraph 15 of EU Directive 2014/52/EU, the following receptors were considered in relation to Major Events:

- Members of the public and local communities (including communities undergoing resettlement, throughout the resettlement period until the settlement is handed over to local authority control);
- Infrastructure and the built environment;

- The natural environment, including ecosystems, land and soil quality, air quality, surface and groundwater resources and landscape;
- The historic environment, including archaeology and built heritage; and
- The interaction between the factors above.

21.4.3. Receptors that have been excluded from the scope of the assessment, and the justification for excluding them, are set out in **Table 21-4**.

Table 21-4 - Excluded Receptors

Receptor	Applicable Legislative Driver and Justification for Exclusion
Employees of the Project and/or its suppliers, whether during construction, operation, or maintenance of the Project.	Employer's commitment and obligations to manage risks to employees are addressed in Code No. 1329 of 23 July 2016 Labor Code of the Republic of Tajikistan. Risks to employees are therefore covered by Project Occupational Health and Safety (OHS) and Emergency Preparedness and Response Plan (EPRP) and are outside the scope of the Major Events assessment.
Trespassers.	Outside the occupier's legal requirements under Law No. 721 of 28 June 2011 on Security.
Resettlers living at resettlement sites after the sites are handed over to local authority control.	The management of risks to resettled communities after resettlement is complete is the responsibility of the local authorities. Risks for resettlers are no higher than for the pre-existing population.

21.4.4. The baseline features important to the Project are shown in **Table 21-5**.

Table 21-5 - Major Event Baseline Features

Feature	Type	Location	Approximate Distance and Direction from Project Aspect
Existing HPP and reservoir	Receptor / Source	Project site	The Project
Vakhsh River Valley	Receptor / Source	Project site Rogun District and Nurobod District resettlement sites	Adjacent
Vakhsh River	Receptor / Source	Project site Rogun District and Nurobod District resettlement sites	Adjacent
Vakhsh Fault	Source	Project site Rogun District and Nurobod District resettlement sites	Adjacent
Ionakhsh Fault	Source	Project site Rogun District and Nurobod District resettlement sites	Adjacent
Gulizindan Fault	Source	Project site Rogun District and Nurobod District resettlement sites	Adjacent
Reservoir	Source	Project site Rogun District and Nurobod District resettlement sites	Adjacent

Feature	Type	Location	Approximate Distance and Direction from Project Aspect
Pamir mountain ranges	Source	Project site Rogun District and Nurobod District resettlement sites	Adjacent
Fedchenko Glacier	Source	Project site Rogun District and Nurobod District resettlement sites	218km upstream
Nurek dam	Receptor	Project site Rogun District and Nurobod District resettlement sites	70km South-West
		Faizobod District resettlement site	23km South-East
		Danghara District resettlement site	40km North
TALCO aluminum plant (see Figure 23-4)	Source	Toichi District resettlement site	5km North
Dushanbe-Denov Railway line (see Figure 23-2)	Source	Toichi District resettlement site	Adjacent
Tajikistan-Uzbekistan border (see Figure 23-3)	Source	Namuna District resettlement site	Adjacent to planned Presidential land (personal agricultural plots of 0.03ha) 1km East of settlement

Figure 21-2 - Current extent of Toichi and Dushanbe-Denov railway



Figure 21-3 - Current extent of Namuna (green) and approximate location of planned Presidential land (in red)



Figure 21-4 - TALCO aluminum plant (tailing ponds bottom left)



21.4.5. The specific potential receptors of effects resulting from a Major Event are all reported in the relevant topic chapter.

21.5. MAJOR EVENT TYPES SCOPED IN OR OUT OF FURTHER ASSESSMENT

21.5.1. An initial review of the Major Event categories identified in the study area has been undertaken to inform the scoping process. This is summarized in **Table 21-6** to show the potential vulnerability of the Project to the risk of each Major Event type. The phases are indicated in the table as “C” for Construction phase and “O” for Operational phase. For the purposes of this assessment, Operational phase’ is considered to commence when construction of the dam is complete and the reservoir is at Full Supply Level (FSL) (1290masl), although it is acknowledged that the Project is already partially operational and will be generating at full capacity before this point.

21.5.2. For potential Major Events that have been screened out, justification has been provided to support this decision.

21.5.3. Where appropriate, this Chapter includes the further mitigation measures required to prevent, reduce or offset any significant adverse effects, the preparedness for and proposed response to emergencies, and the expected residual effects after these mitigation measures have been employed (if any).

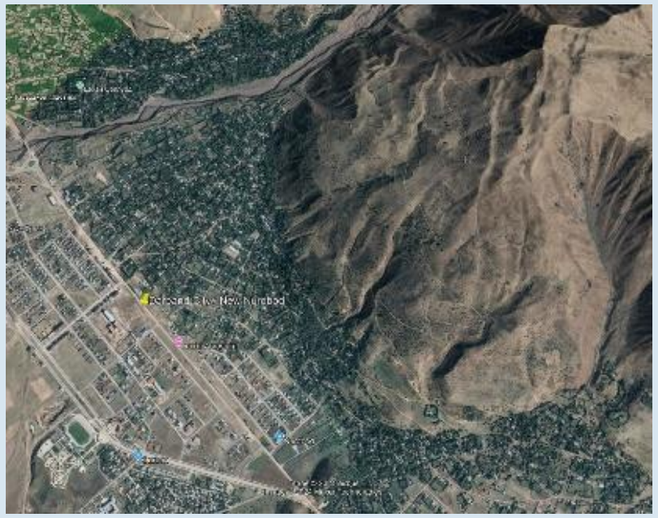
Table 21-6 - Elements Scoped In or Out of Further Assessment

Major Event Group	Major Event Category	Major Event Type	Basis of Decision to Scope In / Out	Scope In? Phase
Natural Hazards	Geophysical	Earthquakes	The Project is located within a seismically active zone. Earthquakes regularly occur in Tajikistan, mostly with magnitudes below 5.5 on the Richter scale. The strongest earthquakes recorded in the wider region were the Karatag earthquake of 1907 with a magnitude of 7.3 and the Khait earthquake in 1949 with a magnitude of 7.6. Damage was caused to the Project itself by an earthquake during construction in 1995. Two earthquakes occurred in May and September 2002, measuring 4.9 and 5.3 respectively. The latter resulted in 3 deaths. A number of tectonic faults are present in the region and close to the Project site. These faults are listed in Table 23-4. At least one active fault (Vakhsh) crosses the dam itself. However, the current Project is being designed to withstand the Maximum Credible Earthquake (MCE). Additionally, a comprehensive Seismic Hazard Update Study for the Project was completed in November 2024 (Seister Seismic Engineering Solutions, 2024), which includes up-to-date probabilistic and deterministic assessments of seismic risk as well as assessment of fault displacement, reservoir induced seismicity (RIS) and provides microzonation and topographic amplification factors. Some seismic monitoring is in place both nationally and at the dam site. The Seismic Hazard Study includes recommendations to improve the Project's existing seismic monitoring network. Detailed reviews of the design and construction work have also been undertaken by the Dam Safety Panel of Experts (DSPoE). Since 2022, six DSPoE missions have been undertaken to review risks and the degree of hazard posed. During these visits, progress on resolving previously identified issues is reviewed and any new issues are identified. The dam is being designed in accordance with the recommendations of the ICOLD bulletin 120: “Design features of dams to resist seismic ground motion” (2001). The 2014 Techno-Economic Assessment Study, identifies design features to reduce the impact of seismic events on the dam these include, for example, foundations being excavated to very dense material or rock, the transverse foundation slope across the core zone should be either horizontal or slope gently upstream along the upper 30m of the abutments of high dams, to assure watertight contacts after shaking; and/or preclude excessive settlement of the embankment materials. and the provision of a larger freeboard than normal to increase lateral dimensions at the maximum water surface. **Reservoir-Induced Seismicity (RIS)** Large dams can trigger earthquakes in two ways: (1) by the added weight of a reservoir; and (2) by the water that seeps into cracks underground or along a fault. There are thought to be over 100 instances of dam reservoirs inducing earthquakes. The most recent case of this was the magnitude 7.9 Sichuan earthquake in China in May 2008, which some experts believe may have been induced by filling the Zipingpu Dam. To reduce the risk of reservoir-triggered seismic events, which is in general higher when filling is done quickly and stresses change more quickly, the Rogun reservoir will be filled slowly, over a period of 16 years. Annex 13.2 Reservoir slope stability provides further detail on this risk. The risk of RIS is addressed in the 2024 Seismic Hazard Study (Seister Seismic Engineering Solutions, 2024). **Resettlement Sites** The Directorate of the Flooding Zone of Rogun Hydro power plant (DFZ) has reported that sites are selected in conjunction with relevant ministries and that seismic hazard is a key consideration. However, earthquake risk is high throughout Tajikistan. Regarding earthquakes, the most relevant risks are collapsing buildings (residential and public buildings), and the triggering of additional Major Events (e.g. landslides and impulse waves, ground collapse). Public buildings remain under Project control where physical resettlement is ongoing – Toichi and Namuna (Tursunzoda District), Darband (Nurobod District), and Sebiston (Faizobod District). Partially constructed buildings which are in use are a particular risk as they may be less stable than completed buildings. The most significant secondary Major Event which could be triggered by an earthquake, in the context of the Project, is a landslide. This is considered separately under ‘Landslides and Mudslides.’	Y C, O *Project site* *Nurobod District (Darband)* *Faizobod District (Sebiston)* *Tursunzoda District (Toichi, Namuna)*
Natural Hazards	Geophysical	Volcanic Activity	The Project is not in a volcanically active area, and it is highly unlikely that an ash cloud could significantly impact on any aspect of the Project. The nearest volcano is the Tianshan volcano in China, over 1,000km to the west which has not erupted since the 7th century CE. The Dacht-i-Navar and Vakak volcanoes in Afghanistan have no confirmed eruptions in the last 10,000 years and are considered dormant. Therefore, this Major Event Type has been scoped out from further assessment.	N
Natural Hazards	Geophysical	Landslides & mudslides	Landslide risk is classified as high in Tajikistan, with the highest risk being present in the center and north west of the country, including the area around the dam site. The highest number of recorded landslides are around the Vakhsh valley (World Bank Group, 2022). Some interviewed Project-Affected People (PAPs) mentioned that landslides were a significant risk in their former village, including one resettled PAP whose former home had been destroyed. Intense periods of rainfall can increase the risk of landslides and mudslides, in conjunction with terrain slope, geology, soil, land cover and (potentially) earthquakes that make localized landslides a frequent phenomenon. The area is prone to erosion which has been made worse by local deforestation caused by logging, agriculture and grazing.	Y C, O Project site *Nurobod District (Darband)* *Rogun City District (Yoli Garmoba, Saidoni Nav)* *Faizobod District (Sebiston)*

Major Event Group	Major Event Category	Major Event Type	Basis of Decision to Scope In / Out	Scope In? Phase
			Reservoir impoundment and oscillations in water levels can increase landslide risk. The most devastating such event was the Vajont dam disaster in Italy in 1963, in which reservoir filling triggered a giant rockfall over 2km in length, which caused an 100m high impulse wave that overwhelmed shoreline settlements and overtopped the dam, resulting in over 2,000 deaths (Association of Dam Safety Officials, n.d.). A smaller incident occurred in Hoseynabad-e Kalpush, Iran, in 2019, in which an impoundment-induced landslide damaged 300 houses (Magdalena Vassileva, 2023). The risk of reservoir-induced landslides and impulse waves are relevant to settlements on the reservoir banks and/or close to the water line. The DSPoE 6th Report identified landslides impacting the Project in Yakhak and Obishur. The Yakhak mudflow occurred in a tributary valley, in which a creek was blocked by a natural dam which then eroded and caused a wave within the reservoir. The Obishur mudflow occurred downstream of Rogun and blocked outflows from the tunnels. The Report provided recommendations to prevent recurring risks to the dam from similar events. Landslide risk is considered in the resettlement program, with some villages outside the flooding zone being resettled based on land stability considerations. The following settlements are undergoing geological studies to determine whether resettlement is required (all of which will be included in future RAPs): Dushokha zamin; Devlokhak; Shule; Dehqonobod (formerly Qizrok); Labi Jar; Shohindara; Zarda; Qal'ai surkh; Dehai Amirbek; Khumdon (formerly Navdonak); Yusti poyon; and Dehai Shokh. At full supply level the reservoir will be at a height of 1290 masl and the height of the dam wall is 335 m. A dam break assessment has been undertaken for FSL at 1100 masl but no dam break assessment has been undertaken to date for the FSL at 1290 masl. The dam break assessment for FSL will consider the risk of a landslide of sufficient scale to generate a wave which could cause overtopping during construction. Once the dam break assessment report is available this risk will be reviewed. Table 3-15: Reservoir Inundation Levels of **Volume 1, Chapter 3: Project Description** outlines the proposed incremental filling of Rogun reservoir. The suitability of resettlement sites is considered in accordance with regulatory requirements. Before land acquisition for the development of resettlement sites can commence, the site must be approved as safe and suitable by the site selection committee and subject to required approvals from appropriate governmental agencies (e.g. the Ministry of Environmental Protection should confirm that the site is not vulnerable to, and will not cause, significant environmental risks). Site selection is also aligned with central government planning for social and economic development. Sites are selected in areas where additional population will not cause strain on local resources, where earthquake, landslide and climate-related risks are low. Mitigation for this risk will be provided via the water level monitoring system, which is already in place, as well as the EPRP. Landslide risk is considered in **Volume 1, Chapter 10: Climate Change** and **Volume 2, Annex 13.2: Reservoir Slope Stability** (which includes an impact assessment), as well as EPRP which are in the process of being updated for the construction site and Vakhsh cascade. Slope stability of the reservoir is also covered within geotechnical design. This risk is therefore scoped out of the Major Events assessment for the Project site. **Resettlement sites** Landslides are not a significant risk at the Danghara and Tursunzoda sites, which are located on flat ground with no mountains, slopes or riverbanks adjacent. This risk is scoped out at these sites. The sites in Nurobod District, Rogun City District and Faizobod District are located on or adjacent to steep slopes and therefore are in higher risk areas. There are three sources of risk: 1. Landslides from uphill (Darband, Saidoni Nav); 2. Ground collapse from below (Darband, Saidoni Nav, Yoli Garmoba, Sebiston); and 3. Upstream landslides causing impact waves which flood or overwhelm settlements on the shore (Darband, Saidoni Nav). This third risk is	

Major Event Group	Major Event Category	Major Event Type	Basis of Decision to Scope In / Out	Scope In? Phase
			no greater at the resettlement sites than at pre-existing settlements at similar elevation and proximity to the reservoir and therefore will be considered alongside them.	
Natural Hazards	Geophysical	Sinkholes	There is no evidence of karst dissolution on the reservoir banks as limestone geology is not present. A risk may be caused by dissolution of salt deposits. The impact of reservoir filling on the stability of the slopes is assessed in **Volume 2, Annex 13.2: Reservoir Slope Stability** of this ESIA, as well as other studies undertaken for the Project such as the DSPoE reports. There is no evidence to suggest sinkhole risk at other sites. This risk is therefore scoped out of further assessment from a Major Events perspective.	N
Natural Hazards	Geophysical	Tsunamis	The Project is located inland, outside a tsunami risk zone. Therefore, this Major Event type has been scoped out from further assessment from a Major Events perspective.	N
Natural Hazards	Hydrological	Coastal Flooding	The Project is located inland, outside a coastal area. Therefore, this Major Event type has been scoped out from further assessment from a Major Events perspective.	N
Natural Hazards	Hydrological	Fluvial Flooding	In the Rogun area, river flood hazard is classified as very low. This means that there is a chance of less than 1% that potentially damaging and life-threatening river floods occur in the coming 10 years (return period of c. 1 in 1,000 years). The Vakhsh river is a snow- and glacier-melt river. The high flows are related to the thaw season with main peaks in July and August. Discharge is not correlated to precipitation. Three major observed flood events of Vakhsh river at Tutkaul gauging station occurred in July 1953, July 1958 and July 1969. The Nurek Hydro Power Plant (HPP) is not designed to handle the Probable Maximum Flood (PMF), and this places both the facility and downstream areas at risk. Rogun HPP is designed to withstand the PMF and its storage capacity and water regulation capability would allow flow control to protect Nurek and the downstream cascade. The Project provides the opportunity to mitigate adverse effects of climate change on downstream areas. The mean annual flow in glacier-fed rivers is predicted to increase in the short to medium-term due to climate change, which is causing glaciers to melt rapidly, but decrease in the long-term as glaciers melt and disappear. Some glaciers in Tajikistan, including the Fedchenko glacier in Pamir, have been observed to be resilient in recent years, however the causes of this phenomenon are unknown and it is therefore unclear how long it will continue. Fluvial flooding has been scoped out during Operation as the Project is designed handle the PMF and will reduce potential flooding along the downstream cascade. Overtopping in the unlikely event of exceedance of PMF is also addressed in the cascade EPRP. Fluvial flood risk in Rogun, Darband and Gharm is very low. One PAP interviewed in a riverside settlement in Rasht confirmed that he had never observed a fluvial flood in his lifetime. **Resettlement sites** As identified above, fluvial flood hazard is classified as very low in Rogun, Darband and Gharm. In all other resettlement sites, including Tursunzoda and Danghara, river flood risk is very low (less than 1% probability that potentially damaging and life-threatening river floods occur in the coming 10 years). A lake (Khavzi Karakul) is present uphill of Darband (Nurobod District); however, this is a small tarn located in a natural depression and is unlikely to present significant flood risk. Therefore, this Major Event Type has been scoped out from further assessment from a Major Events perspective.	N
Natural Hazards	Hydrological	Glacial Lake Outburst Flooding (GLOF)	GLOF occurs where there is a release of meltwater from a naturally formed moraine (ice dam) within a glacial lake. Causes of release can be through natural dam breach, especially in moraine dams which are typically weak in structure, or caused by landslides, earthquakes or avalanches. In addition, increased global warming is leading to rapid loss of ice resulting in the formation and/or expansion of glacial lakes, which when breached present a high risk to communities downstream. According to the Glacier Lake Outburst Flood Database V3.0 (uni-potsdam.de) 17 incidents between 1910 and 2015 have been recorded in Tajikistan, all of which occur in the Pamir mountain range. Several incidents of GLOF have occurred which affected the Project, including one in which the cofferdam was overtopped early in construction, and two more recent incidents in which the powerhouse was flooded. An early warning system is in place to monitor upstream water levels and raise the alarm in case of elevated flow. GLOF has been considered within the Climate Risk and Vulnerability Assessment (CRVA) in **Volume 1, Chapter 10: Climate Change** of this ESIA. A standalone GLOF study has also been commissioned for the Project. This risk is therefore scoped out of further assessment from a Major Events perspective.	N

Major Event Group	Major Event Category	Major Event Type	Basis of Decision to Scope In / Out	Scope In? Phase
Natural Hazards	Hydrological	Pluvial Flooding	Tajikistan's topography is mountainous; much of the country sits 3,000m above sea level and it has peaks over 7,000m in the Pamir and Alay ranges. The Fergana Valley to the north and the Kofarnihon and Vakhsh river valleys to the south are the lower elevation areas. This topography influences the country's hazardscape. Intense rainfall on steep terrain contributes to damaging floods and mudslides on a regular basis. In the Rogun area, urban flood hazard is classified as high. This means that potentially damaging and life-threatening urban floods are expected to occur at least once in the next 10 years. **Resettlement sites** As identified above, urban flood hazard is classified as high in the Rogun area. Urban flood risk in Danghara and Tursunzoda is classified as medium (more than 20% probability that potentially damaging and life-threatening urban floods will occur in the next 10 years). The rural nature of most of the resettlement sites, however, as well as the steep topography in some, make pluvial / urban flooding unlikely. The only site at potential risk, due to being larger, more urbanized, and low-lying, is Toichi in Tursunzoda District. The Project site and most of the resettlement sites are located in rural areas where the risk of surface water flooding is low and therefore the risk of pluvial flooding does not need to be considered further from a Major Events perspective. Furthermore, the risk of pluvial flooding is considered within **Volume 1, Chapter 10: Climate Change** of this ESIA. However, the location of the resettlement site, Toichi, in Tursunzoda District is scoped in for further assessment from a Major Events perspective due to its location in a more urbanized and low-lying area.	Y C *Tursunzoda District (Toichi)*
Natural Hazards	Hydrological	Groundwater Flooding	There are no records of groundwater flooding in the Project area. The risk of the reservoir causing groundwater flooding in neighboring areas by changing groundwater volumes and flows is considered in **Volume 2, Annex 13-2 Reservoir Slope Stability**. Therefore, this Major Event type has been scoped out from further assessment from a Major Events perspective.	N
Natural Hazards	Hydrological	Avalanches	Avalanches occur regularly in Tajikistan due to its mountainous terrain and cold winter climate. The major reason for avalanches in Tajikistan is fresh snow formation. Large amounts of fresh snow not yet consolidated are likely to be set in motion. In addition, the interface between fresh and old snow is unstable and tends to create sliding planes. Most avalanches in Tajikistan are observed in February and March. Avalanche risk is considered in Chapter 10: Climate and is therefore scoped out of this Major Events assessment for the Project site. **Resettlement sites** Danghara and Tursunzoda are located outside the area of avalanche risk. Saidoni Nav (Rogun City District) and Sebiston (Faizobod District) are also at negligible risk due to the topography of the sites; Sebiston is located on flat ground, and Yoli Garmoba has deep valleys on both sides which would protect it from avalanches on nearby mountains. Darband (Nurobod District) and Saidoni Nav (Rogun City District) are at higher risk, due to their location at the base of steep slopes where snow accumulates in winter. Darband extends to the base of the mountain and has a relatively large and growing population. Therefore, this risk is scoped in for further assessment for Nurobod District (Darband) and Rogun City District (Saidoni Nav). **Figure 21-5 - Darband and adjacent mountains (Nurobod District)**	Y C *Nurobod District (Darband)* *Rogun City District (Saidoni Nav)*

Major Event Group	Major Event Category	Major Event Type	Basis of Decision to Scope In / Out	Scope In? Phase
				
Natural Hazards	Climatological and Meteorological	Cyclones, hurricanes, typhoons, storms and gales	In the Rogun area (as well as Danghara and Tursunzoda), cyclone (also known as hurricane or typhoon) hazard is classified as very low. This means that there is less than a 1% chance of potentially damaging cyclone-strength winds in the Project area in the next 10 years. The threat of hurricanes and other storms is considered in **Volume 1, Chapter 10: Climate Change** of this ESIA. Therefore, this Major Event type has been scoped out from further assessment from a Major Events perspective.	N
Natural Hazards	Climatological and Meteorological	Thunderstorms	This type of event could result in lightning strikes to temporary elevated structures during construction (e.g. tower cranes); however, the risk is no different to other construction projects. No elevated structures will form part of operational Project or resettlement sites. Specific measures are therefore not considered to be required as part of the Project. Therefore, this Major Event type has been scoped out from further assessment from a Major Events perspective.	N
Natural Hazards	Climatological and Meteorological	Wave Surges	The Project includes a large reservoir, which will generate waves. The most significant cause of large and potentially dangerous waves is upstream landslides, which is discussed under the 'Landslides and Mudslides' Major Event type above. This Major Event type has been scoped out from further assessment from a Major Events perspective.	N
Natural Hazards	Climatological and Meteorological	Extreme temperatures : Heatwaves, Low (sub-zero) temperatures and heavy snow	In the Rogun area (including neighboring Nurobod and Faizobod), extreme heat hazard is classified as low. This means that there is between 5% and 25% chance that at least one period of prolonged exposure to extreme heat, resulting in heat stress, will occur in the next five years. This risk will increase due to climate change, which will lead to higher average annual temperatures and longer, more intense heatwaves. The Climate Risk and Vulnerability Assessment (CRVA) in **Volume 1, Chapter 10: Climate Change** of this ESIA considers both heatwaves and cold waves. Both are considered very low risk during construction and low during operation. This risk is therefore scoped out of further assessment from a Major Events perspective at the Project site. The Project area experiences heavy snowfall in the winter. The potential risks associated with this have been considered under the Avalanches Major Event type above and therefore heavy snowfall is not considered further here. **Resettlement sites** Danghara and Tursunzoda have a hotter climate and extreme heat risk is medium, which means that there is more than a 25% chance that at least one period of prolonged exposure to extreme heat, resulting in heat stress, will occur in the next five years. This may reasonably occur while the resettlement sites remain under Project control, especially Tursunzoda which continues to receive new resettlers. Resettlement houses are constructed by households themselves, and frequently PAPs move in before the house is fully complete. Metal roofs are also common. This means that temperature control and ventilation cannot be guaranteed. Metal roofs have been identified as a factor increasing the risk of heat-related death; for example, in a 2003 heatwave in Paris was exacerbated by the common use of zinc roofs in the city, which was reported in the media to be	N

Major Event Group	Major Event Category	Major Event Type	Basis of Decision to Scope In / Out	Scope In? Phase
			a contributing factor to heat deaths in the city (e.g., https://www.euronews.com/green/2023/05/04/overheating-parisians-have-the-highest-risk-of-heat-related-deaths-in-europe). In the event of extreme temperatures, the Tajik government will issue guidance to members of the public outlining actions to be taken to minimize the impacts associated with extreme heat and extreme cold. Therefore, this Major Event type has been scoped out from further assessment.	
Natural Hazards	Climatological and Meteorological	Droughts	Tajikistan has historically experienced drought conditions. Tajikistan's worst drought was in 2000 and affected about 3 million people (approximately half the country's population at that time). In the Rogun area, water scarcity is classified as very low or non-existent, where droughts occur much less than once every 1,000 years. The CRVA in **Volume 1, Chapter 10: Climate Change** of this ESIA considers water stress and drought. Both are considered low risk during construction and very low during operation. This risk is therefore scoped out of further assessment for the Project site. **Resettlement sites** Drought is considered very low risk in the area around the Project site, including the Rogun District, Nurobod District and Faizobod District sites, as well as Danghara District. However, Tursunzoda is a medium risk for drought, which means that there is more than a 25% chance that at least one period of drought will occur in the next 10 years. This may reasonably occur while the resettlement sites remain under Project control, especially Tursunzoda which continues to receive new resettlers. The Tajik government will provide guidance on the actions to be taken in the event of drought. Therefore, this Major Event type has been scoped out from further assessment.	N
Natural Hazards	Climatological and Meteorological	Fog	Fog, lasting for more than 24 hours, with a visibility of 50 meters and less, are considered especially dangerous. However, it is a rare phenomenon in Tajikistan. Foggy conditions start in November, reach their peak in December-January, and end in March. The exception is some highland areas in the zones of cloud formation, where fog is near-permanent. In most areas, the total duration of fog does not exceed 50-70 hours a year. On the mountain passes, the duration of fog increases to 1,200 hours a year. Normally, fog continues for 3-5 hours. In the period of 1961-1990, the number of days with fog increased by 20-50%. In the area of Khujand city, the number of days with fog increased by 80%, however Khujand is located in the north of Tajikistan, 180km from the Project area. In the event of reduced visibility construction and maintenance works would be temporarily suspended until visibility improved. The risks incurred would be to Project workers who are covered by occupational health and safety (OHS) legislation and policy and therefore scoped out of this assessment. Risks to resettled communities would be the same or lower than pre-resettlement, depending on whether they remain close to the Project area or move to a lower-lying site. Therefore, this Major Event type has been scoped out from further assessment from a Major Events perspective.	N
Natural Hazards	Climatological and Meteorological	Wildfires: Forest fire, Bush/brush pasture	Wildfire hazard is classified as high in Tajikistan, which means that there is greater than a 50% chance of encountering weather that could support a significant wildfire that is likely to result in both life and property loss in any given year. However, in the Project AoI, forests are rare as most trees have been cut for firewood. The remaining forests are located at higher elevations, far above the reservoir FSL. Shrubs and bushes are found on the slopes of the reservoir, but these are also decreasing since most are cleared to make way for cultivation. Therefore, wildfire is unlikely to be a risk in this location and has therefore been scoped out from further assessment from a Major Events perspective. **Resettlement sites** Wildfire hazard is classified as high in Rogun, Faizobod, Tursunzoda and Danghara, which means that there is greater than a 50% chance of encountering weather that could support a significant wildfire that is likely to result in both life and property loss in any given year. However, no forests that might be the source of wildfires are present around any of the resettlement sites. Therefore, this Major Event type has been scoped out from further assessment from a Major Events perspective.	N
Natural Hazards	Climatological and Meteorological	Poor Air Quality	Air quality in Tajikistan is generally poor and is at its worst during the late autumn and winter months, due to the use of the coal-fired power stations for energy generation and wood fires for domestic heating and cooking. In 2022 the average PM2.5 concentration in Tajikistan was 9.2 times the World Health Organization (WHO) annual air quality guideline value. **Construction:** During the construction phase there will be an increase in dust emissions associated with the use of heavy construction traffic; compacted earth access roads; the operation of the crusher facilities and the associated open conveyors; unloading and loading of materials; the operation of the concrete batching plants, the operation of the borrow pits and the associated transport of the materials in open trucks.	N

Major Event Group	Major Event Category	Major Event Type	Basis of Decision to Scope In / Out	Scope In? Phase
			Road sprinkling is carried out in the construction site to suppress dust emissions. **Operation:** There will be diesel engine emissions originating from all mobile vehicles, and from back-up generators. During the operational phase there will also be emissions of coarse particulate matter from exposed, dried sediments during periodic drawdown of the reservoir for routine inspection and maintenance. The Project will also lead to wider improvements in air quality, however, if fossil-fueled energy generation is displaced, and households are able to switch to electric power for heating and cooking. Air quality impacts during construction and operation are assessed in **Volume 1, Chapter 08: Air Quality** of this ESIA. The air quality assessment found that construction activities have an adverse effect on air quality and mitigation measures are required. For the operational phase, impacts are minor to negligible. This risk can therefore be scoped out of this Major Events assessment. **Resettlement sites** The presence of additional people (including their heating systems and vehicles) is likely to exacerbate poor air quality in the airsheds around the resettlement sites. However, the risks and impacts will be no greater than any other settlement. Therefore, this Major Event type has been scoped out from further assessment from a Major Events perspective.	
Natural Hazards	Biological	Disease epidemics: Viral Bacterial Parasitic Fungal Prion	Tajikistan is a lower-middle income country; however, the population is in generally good health and at least basic medical care is available to most of the population. The most recent major disease epidemic in Tajikistan was COVID-19, the first cases of which were identified in April 2020. Although no longer considered a global health emergency by the WHO, the vulnerability of the Project to a Major Event caused by COVID-19 during construction and operation would be mitigated by the occupational health and safety (OHS) processes that are implemented by both the contractor and government rules and guidelines. An outbreak of polio was also detected in 2021; however, this was responded to rapidly by a vaccination campaign. The outbreak was declared closed in 2022. Labor influx is a potential source of infectious disease outbreak. The workforce is very large, the majority of whom work in two shifts of 15 days and reside in worker accommodation, sharing rooms and facilities with other workers. Risks to workers are managed by OHS and labor management measures. Many workers also commute daily from nearby villages, or reside within Rogun City District alongside the community, which exposes the community to some risk. Risks to the community are discussed in **Volume 1, Chapter 18: Community Health, Safety and Security**. No evidence of significant disease outbreaks associated with the Project has been identified to date. It would be unlikely for any workers to contract Weil's Disease (or leptospirosis) as appropriate PPE will be worn and any risks managed in the Environmental and Social Management Plan (ESMP). Risks from Weil's Disease is a low likelihood, but not of high consequence. The last outbreak of leptospirosis in Tajikistan was recorded in April 2006 approximately 50km east of Dushanbe in the Mehrobod area of the Faizobod District. The construction and operation of the Project will not give rise to any disease epidemics. **Resettlement sites** The Project may contribute to the spread of infectious disease into the resettlement areas because of population movements, however the shift is slow and gradual, and is mostly within sparsely populated rural areas. The risk of significant contributions to the spread of infectious disease, beyond baseline conditions, is therefore considered to be negligible, and as such this Major Event type has been scoped out from further assessment from a Major Events perspective.	N
Natural Hazards	Biological	Animal diseases: Zoonotic: Avian influenza West Nile virus Rabies Non-zoonotic:	Animal diseases present in Tajikistan include: 1. Brucellosis: a zoonotic infection transmitted to humans from infected animals (cattle, sheep, goats, camels, pigs, or other animals) by ingestion of food products (such as unpasteurized dairy products) or by contact with tissue or fluids. Brucellosis is endemic to Central Asia. 2. Rabies: rabid dogs are commonly found in Tajikistan. 3. Crimean-Congo hemorrhagic fever (CCHF): caused by infection with a tick-borne virus and is found in Eastern Europe, particularly in the former Soviet Union, throughout the Mediterranean, in northwestern China, central Asia, southern Europe, Africa, the Middle East, and the Indian subcontinent. 4. Hantaviruses: viruses that can spread from animals to people, that can cause serious disease in people. You can be infected with a hantavirus if you: breathe air or eat food contaminated with the urine, droppings, or saliva of infected rodents; or are bitten by an infected rodent, typically a mouse or a rat. Scoped out as the use of the Project does not involve livestock or other animals, or the disturbance of pristine natural areas. **Resettlement sites**	N

Major Event Group	Major Event Category	Major Event Type	Basis of Decision to Scope In / Out	Scope In? Phase
		Foot and mouth Swine fever	Livestock will be transported from the Project area to resettlement sites, which has the potential to spread animal disease. However, there are no known outbreaks of infectious animal disease in the resettled communities. If a disease were identified, spread would be controlled through containment of infected animals including prohibition of transportation. The resettlement area has been inhabited and in agricultural use for many years, and animals are grazed on open pasture, reducing potential disease exposure (which is a risk mainly when livestock encounter wildlife, or are kept in unhygienic indoor conditions). Therefore, this Major Event type has been scoped out from further assessment from a Major Events perspective.	
Natural Hazards	Biological	Plants	Project construction activities have the potential to introduce/facilitate the spread of non-native invasive plant species to sensitive habitats around the Project site, resulting in the deterioration of these habitats. Standard control measures would be implemented by the appointed contractor during construction to handle and dispose of any diseased plants and/or injurious weeds and prevent their spread. Invasive species are considered in **Volume 1, Chapter 15: Biodiversity** of this ESIA and therefore are scoped out of the Major Events assessment. **Resettlement sites** Invasive species, e.g. Xanthium spinosum, have been identified in the Project area. Resettlement will involve the transportation of plants, as some resettled households have reported transplanting trees. This process is managed by the households themselves, who may accidentally transport seeds or spores. However, it is considered unlikely that this risk will lead to a Major Event. The potential for Major Events caused by the introduction of harmful invasive species is therefore considered to be negligible and scoped out of further assessment.	N
Technological or Manmade Hazards	Societal	Extensive public demonstrations which could lead to violence and loss of life	The Project is in a developing country (according to the definition from the International Monetary Fund, Tajikistan is a developing country because of its lower economic performance) that has steady population growth. International SOS reports that the central government of Tajikistan has extensive influence across the country, though the level of effective state control is lower in areas further from the capital Dushanbe, where the security environment is more volatile, notably in Gorno-Badakhshan Autonomous Oblast (GBAO). Instances of violence by security forces have occurred, notably incidents in GBAO in 2021-22. The Project is controversial internationally, particularly amongst non-governmental organizations (NGOs) and riparian countries. Downstream Uzbekistan has opposed the Project in the past due to fears regarding water availability, although these disagreements have since been resolved and a power purchase agreement (PPA) has been signed. Domestically, data gathered during the preparation of this ESIA suggests a high level of public support, including amongst affected communities, who reported being generally optimistic about resettlement and improved energy supply. There have been some controversies, for example allegations of forced share-buying to fund Project construction in 2009-2010, although this did not result in large-scale protests. A benefits-sharing mechanism, which will invest funds from sale of energy from the Project into social programs for the public, has also been agreed. Widespread or violent protests caused by opposition to the Project are therefore considered unlikely, assuming the implementation of the agreed measures. Labor grievances leading to strikes are another potential cause of demonstrations. The Project has a very large workforce (anticipated to peak at around 20,000), many of whom reside on-site. The 2023 labor audit found evidence of potentially contentious issues, such as salary delays and unresponsive management structures. However, no evidence of strikes on the Project to date was identified. Labor and working conditions surveys have confirmed that workers are generally satisfied with their wages, all of which are higher than the national minimum wage and are considered relatively good in the current Tajikistan labor market. The implementation of the Labor Management Procedure addresses labor issues. **Resettlement sites** The location of resettlement sites is not considered controversial. Resettlement sites are developed to include high-quality new infrastructure, which is also available to the local community. Individual grievances have been noted amongst resettled communities due to delays in compensation payments and the provision of land-use certificates, although this is not a collective grievance. The implementation of the Resettlement Action Plans (RAPs) and Livelihood Restoration Plans (LRPs) will address the issue of household grievances regarding resettlement. This Major Event type is therefore scoped out of further assessment from a Major Events perspective.	N
Technological or Manmade Hazards	Societal	Widespread damage to economies and societies	Tajikistan experienced a devastating civil war in the 1990s, ending in 1997, but has remained largely peaceful since the 1997 peace deal. Tajikistan has experienced border conflict with neighboring Kyrgyzstan in 2021-22, with a peace deal being signed in 2022, although violence was limited to border areas. Small-scale terrorist incidents have also occurred around border regions with Afghanistan and Uzbekistan, although not of sufficient scale or ambition to lead to wider societal or economic damage. Terrorist groups operating from Afghanistan sometimes cross the border, although the reach of	N

Major Event Group	Major Event Category	Major Event Type	Basis of Decision to Scope In / Out	Scope In? Phase
			these groups is currently limited to clashes with military posts around the border. The Project is located 85km from the Afghan border, and 185km from the Kyrgyz border, and is therefore highly unlikely to be affected by these issues. Tajikistan maintains peaceful relations with its other neighbors (Uzbekistan and China). The Project will not lead to widespread damage to societies and economies and is not located in an area that is likely to be affected by such events, therefore this Major Event type has been scoped out.	
Technological or Manmade Hazards	Societal	The need for large-scale multi-faceted humanitarian assistance	The Project will not lead to the requirement for large scale multi-faceted humanitarian assistance therefore this Major Event type has been scoped out.	N
Technological or Manmade Hazards	Societal	The hinderance or prevention of humanitarian assistance by political and military constraints	The Project will not lead to the requirement for large scale multi-faceted humanitarian assistance therefore this Major Event type has been scoped out.	N
Technological or Manmade Hazards	Societal	Significant security risks for humanitarian relief workers in some areas	The Project will not lead to significant security risks for humanitarian relief workers therefore this Major Event type has been scoped out.	N
Technological or Manmade Hazards	Societal	Famine	Tajikistan came close to famine in the early 2000s due to the aftermath of the civil war and a severe drought, however economic conditions and food production have improved significantly in recent decades. Food insecurity, however, remains an issue in the country, which increases the risk of famine occurring. According to 2023 FAO/WFP Crop and Food Security Assessment Mission (CFSAM) to the Republic of Tajikistan, about 1.56 million people were facing acute food insecurity, nearly 50,000 of whom were severely food insecure. However, there has been a reduction in households that experience acute food insecurity, from 20% in 2023 to 16% in 2024. Tajikistan is a highly agricultural economy, where agriculture comprises 22% of GDP and employs 60% of the domestic workforce. Many people also partake in small-scale personal subsidiary farming and have the right to use common pasture. However, 75% of commercial foodstuffs, and 50% of agricultural inputs such as seeds, seedlings, animal breeds, fertilizers, and farm equipment, are imported. Tajikistan therefore remains vulnerable to fluctuations in international food markets. The Project area is also relatively poor, with 19% of household survey respondents indicating that they had insufficient money for food. The Project will not cause famine. There may be localized impacts on food production and prices due to the loss of agricultural land in the flooding zone, however this will be mitigated by the measures outlined in **Volume 1, Chapter 17: Socio-economics**, as well as reduced population in the Project-affected area. Furthermore, in some cases individual households will become more food-secure, as the resettlement plots are of uniform size and therefore all resettlers have access to plots large enough for personal food production. All resettlers retain the right to use pastureland if they choose. Downstream riparian countries, specifically Uzbekistan, expressed concern over water availability and impacts on agriculture. However, the operational modelling of the Vakhsh cascade assumes there is no change to the seasonal operating pattern for flows downstream of Nurek compared with the situation that would exist in the No-Rogun case. As such, based on the maintenance of the stipulated operating pattern, operation of Rogun would not result in impacts downstream. It is therefore considered that this Major Event type can be scoped out of further assessment from a Major Events perspective.	N

Major Event Group	Major Event Category	Major Event Type	Basis of Decision to Scope In / Out	Scope In? Phase
Technological or Manmade Hazards	Societal	Displaced population	There are 69 settlements within the future footprint of the Project, and over 50,000 people are to be resettled. The progressive filling of the reservoir has necessitated a staged program of resettlement for villages and settlements within the Flooding Zone. This program is conducted by DFZ and has been divided into 5 phases covered by Resettlement Action Plans (RAPs). RAP 1 is already complete, while RAP 2 is in progress and is under revision as part of this ESIA. A Resettlement and Livelihood Restoration (RLRF) has also been prepared which will guide the preparation of RAPs 3, 4 and 5. Each RAP is accompanied by a Livelihood Restoration Plan (LRP). PAPs are compensated for lost assets and infrastructure, and evidence to date shows a general improvement in living conditions after resettlement and no significant tensions with host communities. This Major Event type has been scoped out as impacts from resettlement are fully managed by the RAPs and LRPs.	N
Technological or Manmade Hazards	Industrial and urban accidents	Major accident hazard chemical sites	There are no Seveso sites or other hazardous chemical sites within a 3km radius of the Project. Therefore, this Major Event type has been scoped out from further assessment from a Major Events perspective.	N
Technological or Manmade Hazards	Industrial and urban accidents	Major accident hazard pipelines	There are no major accident hazard pipelines within the Project AoI. Line D of the Central Asia–China Gas Pipeline is planned to run through Tursunzoda and Faizobod but is not yet operational. Therefore, this Major Event type has been scoped out from further assessment from a Major Events perspective.	N
Technological or Manmade Hazards	Industrial and urban accidents	Nuclear	Tajikistan currently has no operational nuclear reactors. There are strong radiation sources on Tajik territory because of Soviet-era industrial applications. In its 2012 Environmental Performance Review of Tajikistan, the United Nations Economic Commission for Europe announced that approximately 54.8 million tons of radioactive waste from Soviet-era uranium mining activities (mostly process residue tailings) are housed in unsecured facilities – many of them near the large city of Khujand, approximately 170km north of the Project. The United Nations and the International Atomic Energy Agency have expressed concern over the detrimental impact of this unsecured waste on the environment and ecology of Tajikistan. In response, in July 2014, the leadership of Tajikistan adopted a national concept on the rehabilitation of uranium tailings during the ten-year period from 2014 to 2024. This Major Event type has been scoped out as there are no nuclear facilities or radioactive waste storage facilities within 5km of the Project or any of the resettlement sites.	N
Technological or Manmade Hazards	Industrial and urban accidents	Fuel storage	Fuel is stored at the Rogun HPP construction site; however, this will be handled using standard control measures. Several petrol stations are in Navobod, which is within the Flooding Zone, however these will be removed before the area is flooded and the town resettled. Potential risks associated with the removal of these facilities is identified in **Volume 1, Chapter 12: Soils and Geology** of this ESIA. The removal of these facilities will be undertaken in line with the Good International Industry Practice outlined in the Environmental, Health, and Safety Guidelines for Retail Petroleum Networks (2007). **Resettlement sites** No bulk fuel storage areas are present in the resettlement sites. Small amounts may be present in individual homes, although it is considered that these are unlikely to be large enough to cause a Major Event. As such, the risk is no greater than for any other settlement and therefore this Major Event type has been scoped out from further assessment from a Major Events perspective.	N
Technological or Manmade Hazards	Industrial and urban accidents	Dam breaches	Dam breaches in Tajikistan are rare, however a breach of the temporary dam at the Sargazon reservoir occurred in 1986 due to a large mudflow, resulting in the deaths of over 40 people. Overtopping of the temporary cofferdam at Rogun occurred in 1992. There are 5 hydropower dams in a cascade below the Project on the Vakhsh River. These include the Nurek HPP, located 70 km downstream from the Rogun HPP and, downstream of Nurek, the Baipaza, Sangtuda 1, Sangtuda 2 and Golovnaya Dams. There are currently no dams upstream of Rogun in the Vakhsh cascade, although it is understood that there are plans to develop further upstream dams in the future. There are no downstream communities between Rogun HPP and Nurek HPP. However, the failure of the Rogun dam could potentially trigger cascading failure of the downstream dams. This could impact up to 1 million people living in the Vakhsh River basin across Tajikistan and riparian countries, as well as causing widespread damage to infrastructure and agricultural production. The design and construction of the dam has been carried out in line with the best available information on Major Hazards such as earthquakes and PMF. The normal operation of the Project will also protect the downstream dams from PMF. The cascade EPRP is already in place to manage risks in the unlikely	Y Project site

Major Event Group	Major Event Category	Major Event Type	Basis of Decision to Scope In / Out	Scope In? Phase
			event of overtopping, including communicating risks to downstream countries. This plan will be updated as the dam is raised. DSPoE is also in place to provide expert insight and maximize safety. External hazards which could potentially lead to overtopping and/or dam failure are discussed under 'earthquakes' and 'landslides and mudslides.' Failure may also be due to internal factors and therefore is scoped in. **Resettlement sites** There are a total of 8 major dams in Tajikistan. 5 of these are located within the above-mentioned Vakhsh cascade, 2 are in the Sughd province in the north-west (Farkhad, Kayrakkum), and the natural landslide dam Usoi is in GBAO. None of the resettlement sites are located within downstream areas that are likely to be severely impacted if one of these dams fail. This Major Event type is therefore scoped out of further assessment at the resettlement sites.	
Technological or Manmade Hazards	Industrial and urban accidents	Mines and storage caverns	Tajikistan has large reserves of minerals including coal, gold and silver; however, none are present in the Project AoI. There are no mining activities (except for the aggregates quarry associated with the Rogun HPP construction site) in the Project AoI. No major mining sites are present near the resettlement sites. Therefore, this Major Event type has been scoped out from further assessment from a Major Events perspective. There are several caverns associated with the Project which are being used as part of the construction activities. These caverns are only used by workers and as such, as workers are excluded from the assessment, do not require further consideration. Therefore, caverns associated with the Project have been scoped out from further assessment.	N
Technological or Manmade Hazards	Industrial and urban accidents	Fires	Fires could be initiated by construction related activities which impact areas adjacent to the construction activities. During construction, standard control measures would be implemented by the appointed contractor to manage the risk of fire. The construction of the dam involves storage, transportation and use of explosives. The potential risk associated with explosives will be assessed further and this Major Event type has been scoped in. **Resettlement sites** House fires ignited within resettlers' homes could ignite and spread to host communities, however, this risk is no higher than for any other settlement. Resettlement sites are usually located at some distance (>1km) from host communities). There are no industrial sites near any of the resettlement sites, except the large aluminum plant located approximately 5km from Toichi, Tursunzoda. Given the distance from the plant to Toichi, and the largely rural setting, it is unlikely that a fire at the plant would affect resettlers. Therefore, this Major Event type has been scoped out from further assessment from a Major Events perspective.	Y C Project site
Technological or Manmade Hazards	Transport accidents	Road	Road traffic accidents are a major cause of death in Tajikistan. Between 2017 and 2022, total incidents decreased from 1,303 to 1,096, and mortality decreased from 431 to 416. However, road accidents were the fifth most common cause of death in 2019. During construction there will be an increase in heavy construction plant and equipment on the local road network which may increase the risk of accidents however, this will only be on a temporary basis. Risks due to road traffic are considered in **Volume 1, Chapter 18: Community Health, Safety and Security** and **Volume 1, Chapter 22: Traffic and Transport**. Therefore, this Major Event type has been scoped out from further assessment. **Resettlement sites** A slight increase in heavy vehicle movements may occur during the construction of resettlement sites, however this will be temporary. Once resettlement is complete the risk will be no greater than at any other settlement. Therefore, this Major Event type has been scoped out of further assessment from a Major Events perspective.	N
Technological or Manmade Hazards	Transport accidents	Rail	There are no railways within the Project AoI. **Resettlement sites** A railway track passes directly through the Toichi resettlement site in Tursunzoda. A buffer zone of >400m between the track and residential homes is present on both sides of the track, and >300m between the track and nearby public paved road. However, satellite imagery shows evidence of informal paths created by people crossing the track on foot. The paved road crossing the track is not protected by barriers, traffic lights or any other safety features, which potentially puts people crossing the track at risk from colliding with trains. The railway line passing through Tursunzoda runs services from Dushanbe to Uzbekistan, which runs two passenger services per week (one outwards, and one return), as well as freight services. Rail transport is not extensively	Y C *Tursunzoda District (Toichi)*

Major Event Group	Major Event Category	Major Event Type	Basis of Decision to Scope In / Out	Scope In? Phase
			developed in Tajikistan, but accidents have been known to occur, for example a 2013 incident in which a Tajik passenger service derailed across the Uzbek border, injuring several, and a 2007 incident in which 9 were killed. No other sites are located near to railway infrastructure. This Major Event type has therefore been scoped in for further assessment only at the Toichi site.	
Technological or Manmade Hazards	Transport accidents	Waterways	There are no navigable waterways within Tajikistan. Therefore, this Major Event type has been scoped out from further assessment in this chapter.	N
Technological or Manmade Hazards	Transport accidents	Aviation	There are 12 airports in Tajikistan - 10 civilian and 3 military. The nearest airfields are Kulob International Airport which is approximately 96km to the south of the Project, Dushanbe International Airport which is approximately 110km west of the Project and Jirgatol Airport which is approximately 117km to the east of the Project. **Resettlement sites** The nearest airport to any resettlement site is Bokhtar airport, 42km from the Danghara District site. As there are no airports within the 13km study area this Major Event type has been scoped out from further assessment in this chapter.	N
Technological or Manmade Hazards	Pollution accidents	Land	**Volume 1, Chapter 12: Soils and Geology** of this ESIA identifies that the contaminants associated with the construction and operation activities include hydrocarbon spills from diesel generators, refueling bays, fuel tank farms, trucks and other equipment. It states that during all phases of the Project, soil contamination can and should be prevented, especially as these contaminants will quickly enter the Vakhsh River and Rogun Dam, and potentially groundwater resources. Some soil contamination from earlier Project works has been identified, which has the potential to impact groundwater, although this is localized in nature and unlikely to cause a Major Event. As this risk is considered in detail elsewhere, it has been scoped out from further assessment in this Major Events chapter.	N
Technological or Manmade Hazards	Pollution accidents	Water	During construction water quality may be impacted by: ▪ Increase in suspended solids from construction activities such as excavations or quarrying, or from increases in erosion due to earthworks and other related activities. This would increase the sediment and silt load downstream of any activities; ▪ Potential runoff from oils, lubricants, or other chemicals and substances associated with construction activities and vehicles used; ▪ Interaction of concrete with water may lead to changes in pH which could affect hydrogeochemical processes and/or aquatic life; ▪ Blasting work may result in the presence of nitrogen-species such as nitrate or nitrite from use of explosives, which may be toxic to aquatic life; and ▪ Potential of wastewater inputs to the catchment from construction camps and the workforce on site during construction. These risks are considered in **Volume 1, Chapter 13: Water** and that concluded there will be no significant residual effects after mitigation. This risk is therefore scoped out of further assessment from a Major Events perspective. **Resettlement sites** Resettlement is unlikely to cause a major water pollution event. The presence of the TALCO aluminum plant in Tursunzoda is a potential source of a pollution source that may affect resettlers. Liquid waste is stored in ponds adjacent to the plant, next to a watercourse. Accidents at aluminum plants which affected nearby communities have occurred globally. The most significant incident occurred at the Ajka alumina plant in Hungary in 2010. Liquid waste, red mud', flooded nearby villages after the containment reservoir collapsed. The accident killed 10 and injured 150. About 40km of land and the River Danube were affected. Satellite imagery of the TALCO site suggests its tailings ponds do not contain red mud. The 4 ponds are relatively small; 3 to the west of the plant, each approximately 110x240m in surface area, and another to the south-each, 130x190m. All 4 ponds contain dark-colored liquid. TALCO does not disclose details of its processes and the level of hazard posed by these ponds cannot be definitively stated. The ponds are next to a watercourse which could spread contamination. However, the TALCO site is located 5km from Toichi and the watercourse flows away from the two Tursunzoda District resettlement sites. Therefore, this Major Event type is scoped out.	N

Major Event Group	Major Event Category	Major Event Type	Basis of Decision to Scope In / Out	Scope In? Phase
Technological or Manmade Hazards	Utilities failures	Electricity	Instances of electricity failure (also referred to as power outages or blackouts) due to severe weather, insufficiency of generation relative to demand, or technical faults. In Tajikistan, blackouts are common, particularly in the winter when demand exceeds supply. The primary purpose of the Project is to improve energy generation in Tajikistan and prevent this, as well as to generate excess for export. The Project is currently being powered by electricity generated by the two temporary turbine units. There are also back-up diesel generators should there be power failure. The Project provides a large and increasing proportion of Tajikistan's electricity, as well as energy for export. Failure of the Project could lead to large-scale blackouts across Tajikistan, and potentially internationally. This will be prevented by routine maintenance to prevent technical issues which would impede generation. Total failure due to other external events (e.g., destruction of the dam due to an earthquake) are discussed under other Major Event types. This Major Event type is therefore scoped out from further assessment from a Major Events perspective.	N
Technological or Manmade Hazards	Utilities failures	Gas	Underground and above-ground gas transmission pipelines are not present across the Project study area. Therefore, this Major Event type has been scoped out from further assessment.	N
Technological or Manmade Hazards	Utilities failures	Water supply	The operation of the Rogun HPP will be consistent with existing agreements for water allocation in the Vakhsh River. Issues relating to water supply for reservoir filling are discussed in **Volume 1, Chapter 24: Transboundary Cumulative Impact Assessment** of this ESIA. Workers camps use water from the mains supply for cooking, washing etc. and bottled water for drinking. Mains water is provided from the Rogun City Water Treatment Plant (WTP), which has insufficient treatment capacity relative to demand, leading to frequent water outages. Some of the worker camps have a potable water treatment plant at the camp, although this is small and only serves a small proportion of the workforce. The failure of this infrastructure is unlikely to lead to a Major Event, as the supply of bottled water in the area is generally sufficient to meet basic needs for the workforce and wider population. **Resettlement sites** Problems with mains water supply are relatively common in Tajikistan. Water supply at resettlement sites is covered by the RAPs and are within the remit of DFZ. There were reportedly widespread problems with water at resettlement sites earlier in the Project, however household survey data collected in 2023 shows that these problems have been largely resolved. It is also unlikely that water outages in a residential area would lead to a Major Event. Therefore, this Major Event type has been scoped out from further assessment.	N
Technological or Manmade Hazards	Utilities failures	Sewerage system	All contractors will be required to design and operate facilities in line with the agreed Project Standards. Each contractor's sewage waste is managed in ponds / sumps. Current waste management practices are below international standards. Liquid is generally infiltrated into the ground and solids are reportedly removed by a hauler for treatment in the Rogun City Wastewater Treatment Plant (WWTP). A contractor has installed a treatment system plant to treat sanitary water from Construction Camp 1, although this is very small and only serves a small number of workers. It will be removed before flooding in 2026 and relocated for use elsewhere. The HPP also has a small plant that will be sufficient through full operation. Management measures for liquid waste are presented in **Volume 1, Chapter 21: Materials and Waste** and are therefore scoped out of further assessment from a Major Events perspective. **Resettlement sites** The resettlement sites have no connection to a centralized sewerage system, with most households employing septic tanks. This is the norm in rural Tajikistan, and the risk is therefore no higher than similar settlements. This risk is therefore scoped out of further assessment from a Major Events perspective at both the Project site and resettlement sites.	N
Technological or Manmade Hazards	Malicious attacks	Unexploded ordnance (UXO)	Tajikistan inherited an enormous stockpile of aging ammunition, including large-calibre ordnance and other explosives, following the collapse of the Soviet Union. Due to its porous borders with Afghanistan, large quantities of poorly-secured small arms and light weapons and ammunition continue to present a real threat to national and regional security. Tajikistan also has extensive landmine contamination along its southern, western, and northern borders from both its civil war in the 1990s and Soviet and more recent attempts to prevent border crossings by Islamist militants and narcotics traffickers. During its civil war fought from 1992 to 1997, Tajikistan's Central Rasht Valley region was heavily contaminated with landmines and UXO. Tajikistan is successfully managing aging stockpiles of weapons and ammunition. The nation has also been adept at clearing landmines and other explosive hazards along its borders and within the central Rasht Valley region.	Y C *Tursunzoda District (Toichi, Namuna)*

Major Event Group	Major Event Category	Major Event Type	Basis of Decision to Scope In / Out	Scope In? Phase
			To date and on the Rogun HPP construction site no UXO have been found to be present, however, there is the risk that landmines and/or other explosive hazards may be encountered during construction of any associated roads, bridges resettlement areas etc., as the Project is located within the Rasht Valley region. **Resettlement sites** The risk of encountering unexploded ordnance is significant in some resettlement sites. The Nurobod District and Rogun District sites are located within the Rasht Valley which was heavily impacted during the Tajik civil war in the 1990s (U.S. Department of State). The Tursunzoda District Toichi and, especially, Namuna sites are located close to the Uzbek border (15km and 1km respectively), which was affected by land mines planted to deter cross-border attacks by the Islamic Movement of Uzbekistan. The two states are cooperating on de-mining efforts, which are ongoing, although the level of progress has not been officially shared. Mined areas are demarcated by the GoT, although the presence of mines outside of these areas cannot be ruled out. Resettlement sites, and, in some cases, associated agricultural areas are constructed on greenfield land. UXO risk is much lower in the Faizobod District and Danghara District sites. This Major Event type is therefore scoped in only at the Tursunzoda District, Nurobod District and Rogun City District sites.	*Nurobod District (Darband, potential new sites)* *Rogun City District (Saidoni Nav, Yoli Garmoba)*
Technological or Manmade Hazards	Malicious attacks	Attacks: Chemical Biological Radiological Nuclear	Extremists remain interested in Chemical, Biological, Radiological and Nuclear (CBRN) materials, however alternative methods of attack such as employing firearms or conventional explosive devices remain far more likely. The main terrorist risk in Tajikistan arises from Islamist militants operating across the Afghan border, where terrorist groups have generally focused on conventional weapons attacks on Tajik military targets. Historical use of CBRN weaponry by terrorists has been in closed, densely occupied structures (underground, buildings) or targeted at specific individuals. The Project has security in place to prevent non-authorized personnel from accessing the Project site. In addition, a Security Management Plan is currently under development as part of this ESIA. Such attacks may also occur during wartime. It is considered highly unlikely that a major war in which combatants employ CBRN weapons will occur in Tajikistan. The only one of Tajikistan's neighbors with this capability is China, with which Tajikistan maintains good relations. The 2021-2 conflict with Kyrgyzstan (which possesses no CBRN weapons) was limited to conventional weapons attacks in border regions. Such attacks in wartime have also historically focused on densely populated areas, unlike the Project area or resettlement sites. This risk is therefore scoped out on the basis that: potential malicious attackers within Tajikistan do not have the capability to carry out such attacks and are unlikely to gain this capability in the foreseeable future; attackers with the ability to carry out such an attack are unlikely to target the Project; and the Security Management Plan will manage this risk. Therefore, this Major Event type has been scoped out from further assessment.	N
Technological or Manmade Hazards	Malicious attacks	Transport systems	Potential systems would include (but are not limited to) railways, buses, passenger ferries, cargo vessels and aircraft. The Project will not impact any major transport systems. The reconstructed roads and bridges are unlikely to be a target for malicious attacks due to the low number of exposed targets. **Resettlement sites** The resettlement sites do not include the construction of transport infrastructure beyond local roads. The Tursunzoda site is adjacent to a railway, however there is no station and services in Tajikistan are highly irregular. This remote section of rural railway is unlikely to be a target for malicious attacks. Therefore, this Major Event type has been scoped out from further assessment.	N
Technological or Manmade Hazards	Malicious attacks	Crowded places	The Project does not fall within the definition of a crowed place, i.e., pedestrian routes and other thoroughfares as well as sports arenas, retail outlets and entertainment spaces. **Resettlement sites** The resettlement sites are small settlements of a rural or pre-urban nature which contain no areas meeting the definition of a crowded place. Therefore, this Major Event type has been scoped out from further assessment.	N
Technological or Manmade Hazards	Malicious attacks	Cyber	Cyber-attacks occur almost constantly on key national and commercial electronic information, control systems and digital industries. Tajikistan is considered an attractive target for cyberattacks as its defenses against such an attack are thought to be weak. The high profile and critical importance of the Project mean that it could, in theory, be a target. Notwithstanding this, the Project is not considered to be more vulnerable to attack than similar infrastructure installed and running on other existing hydropower plants in Tajikistan. Cyber security will also be considered in the Security Management Plan which is under development as part of this ESIA. **Resettlement sites** The resettlement sites have no greater reliance on digital technology than any other residential settlement. Therefore, this Major Event type has been scoped out from further assessment.	N

Major Event Group	Major Event Category	Major Event Type	Basis of Decision to Scope In / Out	Scope In? Phase
Technological or Manmade Hazards	Malicious attacks	Infrastructure	The risk of terrorism in Tajikistan is largely associated with the Afghan border. Armed incursions by terrorist groups across the Afghan border are a periodic occurrence. The main organizations of concern for the Tajik state are ISIS-K and Jamaat Ansarullah, which aim to overthrow the GoT and establish an Islamist regime, and stage attacks across the Tajikistan-Afghanistan border. Active recruitment by terrorist groups (particularly ISIS-K) targeting Tajik citizens has increased in recent years. The GoT actively participates in domestic and international counter-terrorism efforts and stated that 31 terrorist actions were prevented in 2022. **Project site** Malicious attacks on electrical infrastructure have been known to occur globally, for example a series of small-scale attacks in the USA. Such attacks have not occurred in Tajikistan. Prevention of access by unauthorized personnel will be within the scope of the Security Management Plan which is under development as part of this ESIA and is therefore scoped out of further assessment in this chapter. **Resettlement sites** The resettlement sites do not contain critical infrastructure that would be a likely target for malicious attacks. Therefore, this Major Event type has been scoped out from further assessment.	N
Technological or Manmade Hazards	Engineering accidents and failures	Bridge failure	There are existing bridges present in the Project area which will be removed as a result of inundation. 12 new bridges will be constructed as part of the Project, including the approximately 900m package 3 bridge at Darband. These bridges are funded as separate Projects and are therefore scoped out of further assessment in this ESIA. No bridges are planned at resettlement sites.	N
Technological or Manmade Hazards	Engineering accidents and failures	Flood defense failure	Upstream of the Project, the Vakhsh river has formed extensive floodplains in the wider sections of the valley, which provides natural flood mitigation. The Project itself has been designed to withstand PMF. The Project-site and cascade EPRPs are also in place to manage and respond to flooding and are being continually updated as the Project progresses. As outlined in **Volume 1, Chapter 3: Project Description** of this ESIA, diversion tunnels (DTs) have been constructed to divert and discharge flood water from the construction area. Four DTs are currently operational. Two High Level Outlets (HLOs) are also operational, although they will eventually lose functionality due to siltation and be replaced by Remote Tunnel Spillways (RTS). The RTS have a higher discharge capacity than the HLOs and are designed to cope with PMF. An updated hydrological study commenced in September 2024. This study is designed to take account of the most recent climate change predictions and models in line with Good Practice. Where any changes to the design or operation of the project are identified as a result of potential hydrological changes, these will be incorporated during the construction phase as appropriate through a Management of Change Process which is a requirement of the ESMP. This risk is therefore scoped out of further assessment.	N
Technological or Manmade Hazards	Engineering accidents and failures	Mast and tower collapse	There are no towers or masts near the Project or being built as part of the Project. Some small towers associated with utilities will be constructed at the resettlement sites (e.g., low-voltage overhead lines, mobile phone towers), but the risks are no higher than for any other residential settlement. Therefore, this Major Event type has been scoped out from further assessment.	N
Technological or Manmade Hazards	Engineering accidents and failures	Property or bridge demolition accidents	The Project involves demolition works including taking down buildings, roads and bridges. This is managed in line with national standards by professional contractors. Resettlers are allowed to retain salvage materials after demolition; risks associated with this, including management of asbestos, are discussed in **Volume 1, Chapter 18: Community Health, Safety and Security** of this ESIA. Resettlement sites are located on greenfield land and no demolition will take place for their construction. This risk is therefore scoped out of further assessment from a Major Events perspective.	N
Technological or Manmade Hazards	Engineering accidents and failures	Tunnel failure / fire	The Project involves the construction of around 15km tunnels including: Diversion tunnels have been excavated at the left bank, crossing the valley under the dam area and continuing at the right bank. The downstream part will be used as tailrace tunnels during operation. Six independent headrace tunnels and penstocks which will guide the water from the intakes to the powerhouse at the left bank. Several access tunnels to the powerhouse as well as transformer caverns, gate chambers etc.	N

Major Event Group	Major Event Category	Major Event Type	Basis of Decision to Scope In / Out	Scope In? Phase
			The design of tunnels to good international standards is managed by the detailed design and therefore scoped out of further assessment from a Major Events perspective. No tunnels are present within the resettlement sites.	

21.6. ASSESSMENT OF POTENTIAL MAJOR ACCIDENT EVENTS

21.6.1. The Long List in **Table 21-6** above, presents all the Major Event categories and types which have been considered as part of the assessment. Those Major Event types which could not be scoped out have been further assessed, the output of which is presented in **Table 21-7** to **Table 21-34** below. These tables are a record of all potential Major Events considered as part of the assessment process. Where necessary, the assessment has identified precautionary mitigation actions in addition to the management measures already integrated into the design and execution of the Project to ensure that risks are managed to be ALARP.

Table 21-7 - Risk Record for Screening Major Event 1

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	Reasonable Worst Consequence if Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
1	Geophysical	Ground collapse	Rogun Dam construction area	Earthquake	C	The Project is located in a seismically active zone. An earthquake could cause a landslide / ground collapse at the construction area.	The Project is located on/in close proximity to 3 fault lines.	Construction OHSMP Slope stability assessment Seismicity assessment DSPoE Reports Construction EPRP STUKY Main Dam Phase 1 - 1200 Emergency Action Plan (2021)	Death / injury to construction workers and damage to onsite structures.	N	N	Y	N	N	Y	N	N	N	N	N

Management measures in place: The safety of on-site workers in the construction area is managed by the OHSMP and construction EPRP. The site will be evacuated in the event of emergency.

Could this constitute a Major Event in the context of the Project? No

Justification: The reasonable worst consequence of this event does not meet the criteria of a Major Event. The only potential receptors of harm are construction / maintenance workers.

Is this ALARP with existing management measures? N/A

Justification: Not identified as a potential Major Event for the Project.

Table 21-8 - Risk Record for Screening Major Event 2

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	Reasonable Worst Consequence if Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
2	Geophysical	Ground collapse	Rogun Dam construction area	Earthquake	C	The Project is located in a seismically active zone; an earthquake could cause the destruction of the worker camps.	The Project is located on / in close proximity to 3 fault lines.	Construction LMP Slope stability assessment Seismicity assessment DSPoE Reports Construction EPRP STUKY Main Dam Phase 1 - 1200 Emergency Action Plan (2021)	Death / injury to construction workers and damage to onsite structures.	N	N	Y	N	N	Y	N	N	N	N	N

Management measures in place: The safety of workers residing in on-site accommodation is managed by the LMP and construction EPRP. The worker camp will be evacuated in the event of emergency.

Could this constitute a Major Event in the context of the Project? No

Justification: The reasonable worst consequence of this event does not meet the criteria of a Major Event. The only potential receptors of harm are construction / maintenance workers.

Is this ALARP with existing management measures? N/A

Justification: Not identified as a potential Major Event for the Project.

Table 21-9 - Risk Record for Screening Major Event 3

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
3	Geophysical	Collapse / damage to structures	Rogun Dam	Earthquake	O, M	Failure of / damage (cracks in the wall) to the dam in the event of an earthquake leading to a large-scale loss of containment.	The Project is located on/in close proximity to 3 fault lines.	Slope stability assessment Seismicity assessment DSPoE Reports Cascade EPRP	Death / injury to members of the public (downstream communities).	N	N	Y	Y	Y	Y	N	N	Y	N	Y

Management measures in place: The dam has been designed to accommodate MCE. DSPoE continue to review the safety of the dam, and a seismicity assessment and slope stability assessment have been undertaken. A cascade EPRP is in place and will be updated continually as construction of the Project progresses.

Could this constitute a Major Event in the context of the Project? Yes

Justification: Could cause loss of life or permanent injury which requires ongoing disability support.

Is this ALARP with existing management measures? Yes

Justification: Considered to be ALARP if all management measures outlined are correctly implemented, including implementation of mitigation measures identified during ongoing studies.

Table 21-10 - Risk Record for Screening Major Event 4

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
4	Geophysical	Collapse / damage to structures	Rogun Dam	Earthquake / Reservoir induced seismicity	C, O, M	Landslide into the reservoir may cause impulse / bore-like waves leading to overtopping of the dam wall and flooding downstream.	Slope failure leading to overtopping of the dam and flooding of the cascade.	Reservoir slope stability assessment undertaken as part of this ESIA (Annex 13.2) Seismicity assessment DSPoE Reports Cascade EPRP	Death / injury to members of the public (downstream communities).	N	N	Y	Y	Y	Y	N	N	Y	N	Y

Management measures in place: Risk has been reviewed in the DSPoE studies. Cascade EPRP and water level monitoring system in place. The cascade EPRP includes measures to notify riparian countries in case of overtopping.

Could this constitute a Major Event in the context of the Project? Yes

Justification: Could cause loss of life or permanent injury which requires ongoing disability support.

Is this ALARP with existing management measures? Yes

Justification: Considered to be ALARP if all management measures outlined are correctly implemented, including implementation of mitigation measures identified during ongoing studies.

Table 21-11 - Risk Record for Screening Major Event 5

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	Reasonable Worst Consequence if Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
5	Geophysical	Collapse / damage to structures	HPP	Earthquake / Reservoir induced seismicity	C, O, M	Loss of power due to damage to generating equipment.	Earthquake leading to damage to power generating equipment.	Slope stability assessment Seismicity assessment DSPoE Reports Cascade EPRP	Nuisance only.	N	N	Y	N	N	N	N	N	N	N	N

Management measures in place: Back-up generator for the safe shut-down of the hydropower plant. Back-up power is currently supplied by the existing turbines 5 and 6, diesel generators and a direct power source from Nurek HPP.

Could this constitute a Major Event in the context of the Project? No

Justification: The reasonable worst consequence of this event does not meet the criteria of a Major Event. Nuisance only.

Is this ALARP with existing management measures? N/A

Justification: Not identified as a potential Major Event.

Table 21-12 - Risk Record for Screening Major Event 6

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
6	Geophysical	Collapse / damage to structures	HPP	Earthquake / Reservoir induced seismicity	O, M	Damage to powerhouse and transformer caverns leading to injury of workers.	Earthquake leading to damage to the powerhouse and transformer caverns.	Slope stability assessment Seismicity assessment DSPoE Reports Cascade EPRP	Death / injury to maintenance workers / operators and damage to onsite structures.	N	N	Y	N	N	Y	N	N	N	N	N

Management measures in place: The dam has been designed to accommodate MCE. The safety of on-site workers is managed by the OHSMP and operational EPRP.

Could this constitute a Major Event in the context of the Project? No

Justification: The reasonable worst consequence of this event does not meet the criteria of a Major Event. The only potential receptors of harm are operators / maintenance workers.

Is this ALARP with existing management measures? N/A

Justification: Not identified as a potential Major Event.

Table 21-13 - Risk Record for Screening Major Event 7

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
7	Geophysical	Collapse / damage to structures	Rogun Dam	Reservoir induced seismicity	C, O, M	Earthquake leading to damage / failure of the dam wall resulting in a large-scale loss of containment event.	Impoundment and / or filling of the reservoir causing an earthquake.	Slope stability assessment Seismicity assessment DSPoE Reports Cascade EPRP	Death / injury to members of the public (downstream communities).	N	N	Y	Y	Y	Y	N	N	Y	N	Y

Management measures in place: The dam has been designed to accommodate MCE. A seismicity assessment and slope stability assessment have been undertaken. DSPoE continue to review the safety of the dam. A cascade EPRP is in place and will be updated continually as construction of the Project progresses. The cascade EPRP includes measures to notify riparian countries in case dam breach.

Could this constitute a Major Event in the context of the Project? Yes

Justification: Could cause loss of life or permanent injury which requires ongoing disability support.

Is this ALARP with existing management measures? Yes

Justification: Considered to be ALARP if all management measures outlined are correctly implemented, including implementation of mitigation measures identified during ongoing studies.

Table 21-14 - Risk Record for Screening Major Event 8

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	Reasonable Worst Consequence if Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
8	Geophysical	Collapse / damage to structures	Resettlement sites: Nurobod District (Darband)	Earthquake	C	The Project is located in a seismically active zone. Earthquakes could lead to structural damage to buildings.	Collapsed buildings or falling debris during an earthquake causing death, injury or entrapment	Slope stability assessment Seismicity assessment Cascade EPRP	Death/injury to resettlers or other members of the public who may be present (e.g., hired construction workers)	N	N	Y	N	N	Y	N	N	N	N	N

Management measures in place: Darband is located on the reservoir banks and will benefit from some works undertaken for the Project, e.g., slope stabilisation works. Seismic hazard is considered in site selection. All public buildings and infrastructure in use at the site is complete, with no partially built structures in use.

Could this constitute a Major Event in the context of the Project? Yes

Justification: Could cause loss of life or permanent injury which requires ongoing disability support and/or damage to a receptor.

Is this ALARP with existing management measures? Yes

Justification: Considered to be ALARP if all management measures outlined are correctly implemented, including implementation of mitigation measures identified during ongoing studies. If any new public buildings are required, these must be fully constructed and structurally sound before use by the public is allowed.

Table 21-15 - Risk Record for Screening Major Event 9

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	Reasonable Worst Consequence if Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
9	Geophysical	Collapse / damage to structures	Resettlement sites: Tursunzoda District (Toichi)	Earthquake	C	The Project is located in a seismically active zone. Earthquakes could lead to structural damage to buildings.	Collapsed buildings or falling debris during an earthquake causing death, injury or entrapment	Site selection documentation	Death/injury to resettlers or other members of the public who may be present (e.g. hired construction workers)	N	N	Y	N	N	Y	N	N	N	N	N

Management measures in place: Seismic hazard is considered in site selection. All public buildings and infrastructure in use at the site is complete, with no partially built structures in use.

Could this constitute a Major Event in the context of the Project? Yes

Justification: Could cause loss of life or permanent injury which requires ongoing disability support and/or damage to a receptor.

Is this ALARP with existing management measures? Yes

Justification: Considered to be ALARP if all management measures outlined are correctly implemented. If any new public buildings are required, these must be fully constructed and structurally sound before use by the public is allowed.

Table 21-16 - Risk Record for Screening Major Event 10

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
10	Geophysical	Collapse / damage to structures	Resettlement sites: Tursunzoda District (Namuna)	Earthquake	C	The Project is located in a seismically active zone. Earthquakes could lead to structural damage to buildings.	Collapsed buildings or falling debris during an earthquake causing death, injury or entrapment	Site selection documentation	Death/injury to resettlers or other members of the public who may be present (e.g. hired construction workers)	N	N	Y	N	N	Y	N	N	N	N	N

Management measures in place: Seismic hazard is considered in site selection.

Could this constitute a Major Event in the context of the Project? Yes

Justification: Could cause loss of life or permanent injury which requires ongoing disability support and/or damage to a receptor.

Is this ALARP with existing management measures? No

Justification: Partially-constructed public buildings are potentially unstable and are already in use.

Mitigation: All newly constructed public buildings are to comply with the seismic codes. The practice of allowing partially constructed buildings to be used by resettlers should be discontinued. No in-migration into site is to take place until all public buildings are fully constructed.

Is this ALARP with the application of the identified mitigation measures? Yes

Justification: Considered to be ALARP if all mitigation measures outlined are correctly implemented.

Table 21-17 - Risk Record for Screening Major Event 11

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
11	Geophysical	Collapse / damage to structures	Resettlement sites: Faizobod District (Sebiston)	Earthquake	C	The Project is located in a seismically active zone. Earthquakes could lead to structural damage to buildings.	Collapsed buildings or falling debris during an earthquake causing death, injury or entrapment	Site selection documentation	Death/injury to resettlers or other members of the public who may be present (e.g. hired construction workers)	N	N	Y	N	N	Y	N	N	N	N	N

Management measures in place: Seismic hazard is considered in site selection. Very few resettlers currently reside at the site and no structurally incomplete buildings are in use.

Could this constitute a Major Event in the context of the Project? Yes

Justification: Could cause loss of life or permanent injury which requires ongoing disability support and/or damage to a receptor.

Is this ALARP with existing management measures? Yes

Justification: Considered to be ALARP if all management measures outlined are correctly implemented. If any new public buildings are required, these must be fully constructed and structurally sound before use by the public is allowed.

Table 21-18 - Risk Record for Screening Major Event 12

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
12	Geophysical	Harm to people	Rogun Dam construction area	Landslide and mudslide	C	Rockfall into the construction area may cause death and/or injury to workers.	Slope failure.	OHSMP Slope stability assessment Seismicity assessment Construction EPRP DSPoE reports	Death / injury to construction workers and damage to onsite structures.	N	N	Y	N	N	Y	N	N	N	N	N

Management measures in place: Reservoir slope stability addressed in the geotechnical design. DSPoE studies, seismicity studies, and a slope stability assessment (see **Volume 2, Annex 13.2: Reservoir Slope Stability** of this ESIA) are in place to identify and provide mitigation measures for these hazards. The OHSMP and Construction EPRP are in place to protect the construction workforce. Water levels are monitored by the Project to detect anomalies indicative of upstream landslides.

Could this constitute a Major Event in the context of the Project? No

Justification: The reasonable worst consequence of this event does not meet the criteria of a Major Event. The only potential receptors of harm are construction workers.

Is this ALARP with existing management measures? N/A

Justification: Not identified as a potential Major Event.

Table 21-19 - Risk Record for Screening Major Event 13

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
13	Geophysical	Harm to people	Rogun Dam	Landslide and mudslide	C, O, M	Landslide into the reservoir may cause impulse waves, leading to overtopping of the dam wall and flooding downstream.	Slope failure leading to overtopping of the dam and flooding of the cascade.	Slope stability assessment Seismicity assessment Cascade EPRP DSPoE reports Volume 1, Chapter 10: Climate Change and Volume 2, Annex 13.2: Reservoir Slope Stability Stage 1 Dam. Dam Break Analysis - Methodology, Simulation and Results A further dam break analysis is currently under preparation for the full reservoir height at 1290 masl	Death / injury to members of the public (downstream communities).	N	N	Y	Y	Y	Y	N	N	N	N	Y

Management measures in place: Reservoir slope stability addressed in the geotechnical design. DSPoE missions, seismicity studies, and a slope stability assessment (see Annex 13.2 of this ESIA) are in place to identify and provide mitigation measures for these hazards. The Cascade EPRP is in place to manage risks in the event of overtopping. Water levels are monitored by the Project to detect anomalies indicative of upstream landslides.

Could this constitute a Major Event in the context of the Project? Yes

Justification: Could cause loss of life or permanent injury which requires ongoing disability support and/or damage to a receptor.

Is this ALARP with existing management measures? No

Justification: Risk could be further reduced with the implementation of mitigation measures.

Mitigation: The report "Stage 1 Dam. Dam Break Analysis - Methodology, Simulation and Results" provides the basis of the “Main Dam Phase 1 - 1200 Emergency Action Plan” (2021) that details the Early Warning System to be implemented.

Is this ALARP with the application of the identified mitigation measures? Yes

Justification: Considered to be ALARP if all mitigation measures outlined are correctly implemented.

Table 21-20 - Risk Record for Screening Major Event 14

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
14	Geophysical	Harm to people	Reservoir Resettlement sites: Nurobod District (Darband) Rogun City District (Saidoni Nav)	Landslide and mudslide	C, O, M	Landslide into the reservoir may cause impulse waves affecting reservoir banks.	Upstream landslide or reservoir slope collapse causes impulse waves flooding settlements on the reservoir shore.	Slope stability assessment Seismicity assessment DSPoE reports EPRP	Death / injury to members of the public (residents of settlements on the reservoir banks).	N	N	Y	Y	Y	Y	N	N	N	N	Y

Management measures in place: The suitability of resettlement sites is considered in accordance with regulatory requirements. Before land acquisition for the development of resettlement sites can commence, the site must be approved as safe and suitable by the site selection committee and subject to required approvals from appropriate governmental agencies (e.g. the Ministry of Environmental Protection should confirm that the site is not vulnerable to, and will not cause, significant environmental risks). Site selection is also aligned with central government planning for social and economic development. Sites are selected in areas where additional population will not cause strain on local resources, where earthquake, landslide and climate-related risks are low. Reservoir slope stability has been addressed in the geotechnical design to the Stage 1 dam design (1100 masl). The dam break assessment for FSL (1290 masl) will consider the risk of a landslide of sufficient scale to generate a wave which could cause overtopping during construction. Table 3-15: Reservoir Inundation Levels of **Volume 1, Chapter 3: Project Description** outlines the proposed incremental filling of Rogun reservoir. Once the dam break assessment report is available this risk will be reviewed. DSPoE missions, seismicity studies, and a slope stability assessment (see **Volume 2, Annex 13.2: Reservoir Slope Stability** of this ESIA) are in place to identify and provide mitigation measures for these hazards.

Could this constitute a Major Event in the context of the Project? Yes

Justification: Could cause loss of life or permanent injury which requires ongoing disability support and/or damage to a receptor.

Is this ALARP with existing management measures? No

Justification: The Cascade EPRP does not address risks to upstream communities.

Mitigation: The Project must liaise with appropriate authorities (local authorities, Committee for Committee of Emergency Situations and Civil Defence of Tajikistan) to develop plans for settlements which would be impacted in a reasonable worst-case scenario. Standard Operating Procedures (SOPs) to be developed for early warnings to, and evacuation and safe re-occupation of at-risk settlements. This must be incorporated into the Cascade EPRP. Provision of training to workers and other stakeholders outlining the response to various emergency scenarios including, safe evacuation, inspection of structures after a hazard event, and re-occupancy.

Is this ALARP with the application of the identified mitigation measures? Yes

Justification: Considered to be ALARP if all mitigation measures outlined are correctly implemented, including implementation of mitigation measures identified during ongoing studies.

Table 21-21 - Risk Record for Screening Major Event 15

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
15	Geophysical	Harm to people	Resettlement sites: Nurobod District (Darband) Rogun City District (Saidoni Nav)	Landslide and mudslide	C	Darband and Saidoni Nav are located on the reservoir bank and could be damaged in the event of slope collapse	Slope collapse on the reservoir bank below the settlements	Slope stability assessment Seismicity assessment DSPoE reports	Death/injury to resettlers or other members of the public who may be present (e.g. hired construction workers)	N	N	Y	N	N	Y	N	N	N	N	N

Management measures in place: Reservoir slope stability addressed in the geotechnical design. DSPoE missions, seismicity studies, and a slope stability assessment (see **Volume 2, Annex 13.2: Reservoir Slope Stability** of this ESIA) are in place to identify and provide mitigation measures for these hazards.

Could this constitute a Major Event in the context of the Project? Yes

Justification: Could cause loss of life or permanent injury which requires ongoing disability support and/or damage to a receptor.

Is this ALARP with existing management measures? Yes

Justification: Considered to be ALARP if all mitigation measures outlined are correctly implemented, including implementation of mitigation measures identified during ongoing studies.

Table 21-22 - Risk Record for Screening Major Event 16

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
16	Geophysical	Harm to people	Resettlement sites: Faizobod District (Sebiston)	Landslide and mudslide	C	Sebiston is located on a steep riverbank which may experience landslides	Slope collapse at the riverbank causes damage to buildings and public roads	Site selection documentation	Death/injury to resettlers or other members of the public who may be present (e.g. hired construction workers)	N	N	Y	N	N	Y	N	N	N	N	N

Management measures in place: All houses and public roads are located at least 100m from the steepest part of the slope.

Could this constitute a Major Event in the context of the Project? No

Justification: The reasonable worst consequence of this event does not meet the criteria of a Major Event. Unlikely to lead to fatality or long-term harm/disability.

Is this ALARP with existing management measures? N/A

Justification: Not identified as a potential Major Event.

Table 21-23 - Risk Record for Screening Major Event 17

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
17	Geophysical	Harm to people	Resettlement sites: Rogun City District (Yoli Garmoba)	Landslide and mudslide	C	Yoli Garmoba is located on a slope with steep slopes at either side of the settlement, which may be unstable	Slope collapse	Site selection documentation	Death/injury to resettlers or other members of the public who may be present (e.g. hired construction workers)	N	N	Y	N	N	Y	N	N	N	N	N

Management measures in place: The steep slopes adjacent to Yoli Garmoba are in agricultural use and have been landscaped into tiers to prevent erosion and landslides. The slopes are also vegetated which will further reduce risk.

Could this constitute a Major Event in the context of the Project? No

Justification: The reasonable worst consequence of this event does not meet the criteria of a Major Event. Unlikely to lead to fatality or long-term harm/disability.

Is this ALARP with existing management measures? N/A

Justification: Not identified as a potential Major Event.

Table 21-24 - Risk Record for Screening Major Event 18

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
18	Geophysical	Ground collapse	Rogun Dam	Oscillations in reservoir water levels increase the risk of landslide and erosion	C, O, M	Erosion of mountain sides with resultant landslide into the reservoir causing impulse waves leading to overtopping of the dam wall and flooding downstream.	Slope failure leading to overtopping of the dam and flooding of the cascade.	Slope stability assessment Seismicity assessment Cascade EPRP DSPoE reports	Death / injury to members of the public (downstream communities).	N	N	Y	Y	Y	Y	N	N	Y	N	Y

Management measures in place: Reservoir slope stability addressed in the geotechnical design. DSPoE missions, seismicity studies, and a slope stability assessment (see **Volume 2, Annex 13.2: Reservoir Slope Stability** of this ESIA) are in place to identify and provide mitigation measures for these hazards. Water levels are monitored by the Project to detect anomalies indicative of upstream landslides.

Could this constitute a Major Event in the context of the Project? Yes

Justification: Could cause loss of life or permanent injury which requires ongoing disability support.

Is this ALARP with existing management measures? Yes

Justification: Considered to be ALARP if all management measures outlined are correctly implemented, including implementation of mitigation measures identified during ongoing studies.

Table 21-25 - Risk Record for Screening Major Event 19

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
19	Geophysical	Ground collapse	Rogun Dam	Superficial landslides as a result of dissolution of salt deposits	C, O, M	Impounding results in the formation of sinkholes and the initiation of superficial landslides causing damage to buildings (e.g. Rogun City).	Superficial landslides causing damage to buildings.	Slope stability assessment DSPoE reports	Damage to property. Minor injury to member of the public present on the reservoir banks	N	N	Y	N	N	Y	N	N	N	N	N

Management measures in place: Risk considered in DSPoE studies, including requirements for ongoing monitoring. Reservoir slope stability assessment undertaken as part of this ESIA (**Volume 2, Annex 13.2: Reservoir Slope Stability** of this ESIA).

Could this constitute a Major Event in the context of the Project? No

Justification: The reasonable worst consequence of this event does not meet the criteria of a Major Event. Unlikely to lead to fatality or long-term harm/disability.

Is this ALARP with existing management measures? N/A

Justification: Not identified as a potential Major Event.

Table 21-26 - Risk Record for Screening Major Event 20

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
20	Geophysical	Ground collapse	Resettlement sites: Nurobod District (Darband) Rogun City District (Saidoni Nav, Yoli Garmoba)	Superficial landslides as a result of dissolution of salt deposits	C, O	Formation of spontaneous sinkholes due to impoundment and/or other conditions (e.g. heavy rain), causing superficial landslides and building collapse	Superficial landslides as a result of the formation of sinkholes in the halide karst.	Site selection documentation	Damage to property. Minor injury to member of the public present on the reservoir banks	N	N	Y	N	N	Y	N	N	N	N	N

Management measures in place: Risk considered in DSPoE studies. Reservoir slope stability assessment undertaken as part of this ESIA (**Volume 2, Annex 13.2: Reservoir Slope Stability** of this ESIA).

Could this constitute a Major Event in the context of the Project? No

Justification: The reasonable worst consequence of this event does not meet the criteria of a Major Event. Unlikely to lead to fatality or long-term harm/disability.

Is this ALARP with existing management measures? N/A

Justification: Not identified as a potential Major Event.

Table 21-27 - Risk Record for Screening Major Event 21

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
21	Climatological and Meteorological	Extreme weather (flood)	Resettlement sites: Tursunzoda District (Toichi)	Heavy rain leading to overwhelming of drainage capacity in the peri-urban Toichi site	C, O	Flooding of the site, damage to buildings.	Heavy rain overwhelms urban drainage system, causing flooding of the site.	Site selection documentation	Damage to property Contamination of agricultural areas and gardens and ecological receptors	N	N	Y	N	N	Y	N	N	N	N	Y

Management measures in place: Flood risk considered during site selection.

Could this constitute a Major Event in the context of the Project? No

Justification: Unlikely to cause serious harm to people or ecological receptors due to the slow-developing nature of pluvial flooding. Some contamination due to urban waste and sewage may occur.

Is this ALARP with existing management measures? N/A

Justification: Not identified as a potential Major Event.

Table 21-28 - Risk Record for Screening Major Event 22

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	Reasonable Worst Consequence if Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
22	Climatological and Meteorological	Avalanche	Resettlement sites: Nurobod District (Darband) Rogun City District (Saidoni Nav)	Avalanche	C	Avalanche from upper slopes hits the resettlement site causing damage to buildings and property, and harm to people.	Avalanche from upper slope collides with and /or buries settlements or parts of the settlement	Site selection regulatory requirements	Death/injury to resettlers or other members of the public who may be present (e.g. hired construction workers)	N	N	Y	Y	N	Y	N	N	N	N	N

Management measures in place: The suitability of resettlement sites is considered in accordance with regulatory requirements. Before land acquisition for the development of resettlement sites can commence, the site must be approved as safe and suitable by the site selection committee and subject to required approvals from appropriate governmental agencies (e.g. the Ministry of Environmental Protection should confirm that the site is not vulnerable to, and will not cause, significant environmental risks). Site selection is also aligned with central government planning for social and economic development. Sites are selected in areas where additional population will not cause strain on local resources, where earthquake, landslide and climate-related risks are low.

Could this constitute a Major Event in the context of the Project? Yes

Justification: Could cause loss of life or permanent injury which requires ongoing disability support and / or damage to a receptor.

Is this ALARP with existing management measures? No

Justification: Risk could be further reduced with the implementation of mitigation measures.

Mitigation: Undertake a risk assessment to understand avalanche risk at each of the resettlement sites and implement recommendations from the risk assessment, including appropriate mitigation measures if required.

Is this ALARP with the application of the identified mitigation measures? Yes

Justification: Considered to be ALARP if all mitigation measures outlined are correctly implemented.

Table 21-29 - Risk Record for Screening Major Event 23

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
25	Industrial and Urban Accidents	Collapse / damage to structures	Rogun Dam	Breach or overtopping of the Rogun Dam	C, O, M	Unforeseen event causes breach or overtopping.	Dam wall failure or overtopping leading to the loss of containment of the reservoir.	Cascade EPRP DSPoE reports	Death / injury to members of the public (downstream communities). Cascade failure of downstream cascade	N	N	Y	Y	N	N	N	N	N	N	Y

Management measures in place: Risk addressed in design, DSPoE studies and Cascade EPRP. The cascade EPRP includes measures to notify downstream riparian countries in case of dam failure (See risk record entries 1-11 for risks related to seismicity, and entries 12-20 for risks related to landslides).

Could this constitute a Major Event in the context of the Project? Yes

Justification: Could cause loss of life or permanent injury which requires ongoing disability support.

Is this ALARP with existing management measures? Yes

Justification: Considered to be ALARP if all management measures outlined are correctly implemented and any recommendations from these management measures are implemented.

Table 21-30 - Risk Record for Screening Major Event 24

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
26	Industrial and Urban Accidents	Transport accidents	Resettlement sites: Tursunzoda District (Toichi)	Train collision	C	Collision between train and pedestrians or vehicles at the unprotected crossings	Train on the track collides with pedestrians or vehicles at the unprotected crossing	Site selection documentation	Death/injury to resettlers or other members of the public who may be present (e.g. hired construction workers)	N	N	Y	N	N	N	N	N	N	N	N

Management measures in place: A buffer zone of >400m between the track and residential homes is present on both sides of the track, and >300m between the track and nearby public paved road.

Could this constitute a Major Event in the context of the Project? Yes

Justification: Could cause loss of life or permanent injury which requires ongoing disability support and / or damage to a receptor.

Is this ALARP with existing management measures? No

Justification: Risk could be further reduced with the implementation of mitigation measures.

Mitigation: DFZ to liaise with Tajik Railway to identify appropriate measures to ensure safety at the crossing. This could include safety barriers, lights, and / or a footbridge at the informal pedestrian crossing. The appropriate measures are to be determined by qualified railway safety experts. Information sessions on railway safety to be held with resettled communities, including children in school, organized by DFZ.

Is this ALARP with the application of the identified mitigation measures? Yes

Justification: Considered to be ALARP if all mitigation measures outlined are correctly implemented.

Figure 21-6 - Dushanbe-Denov railway, Toichi, including the formal road crossing (red) and informal pedestrian crossing (yellow)

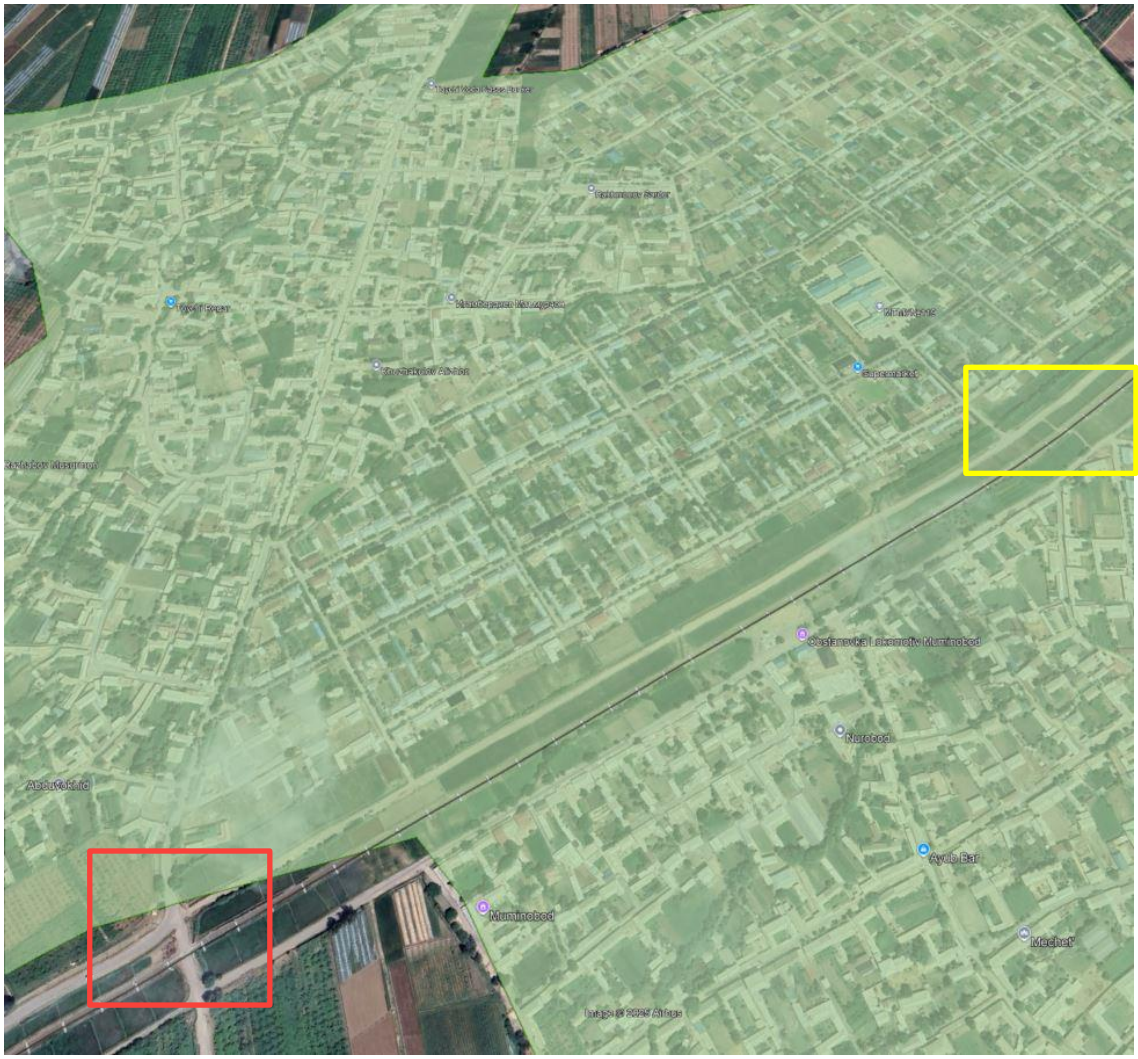


Table 21-31 - Risk Record for Screening Major Event 25

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
27	Malicious attacks	Fire and / or explosion or release of harmful gas	Rogun Dam construction area	Presence of unexploded ordnance (UXO).	C	Striking UXO resulting in an explosion.	Encountering UXO during construction or agricultural activities.	Construction EPRP OHSMP	Fire and / or explosion affects site infrastructure and / or construction workers in the immediate area with possible death and / or injury.	N	N	Y	N	N	Y	N	N	N	N	N

Management measures in place: Construction EPRP, OHSMP

Could this constitute a Major Event in the context of the Project? No

Justification: The reasonable worst consequence of this event does not meet the criteria of a Major Event. The only potential receptors of harm are construction workers.

Is this ALARP with existing management measures? N/A

Justification: Not identified as a potential Major Event.

Table 21-32 - Risk Record for Screening Major Event 26

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
28	Malicious attacks	Fire and / or explosion or release of harmful gas	Resettlement sites: Tursunzoda District (Namuna) Nurobod District (Darband) Rogun City District (Saidoni Nav, Yoli Garmoba)	Presence of unexploded ordnance (UXO).	C	Striking UXO resulting in an explosion during house or infrastructure construction, or farming activities. Particular risks at Namuna, where currently vacant land adjacent to the Uzbekistan border will be brought into cultivation.	Encountering UXO during construction and farming activities.	Site selection documentation	Death/injury to resettlers or other members of the public who may be present (e.g. hired construction workers)	N	N	Y	N	N	Y	N	N	N	N	N

Management measures in place: Mine clearance works at the border have been undertaken by the governments of Tajikistan and Uzbekistan.

Could this constitute a Major Event in the context of the Project? Yes

Justification: Could cause loss of life or permanent injury which requires ongoing disability support.

Is this ALARP with existing management measures? No

Justification: Risk could be further reduced with the implementation of mitigation measures.

Mitigation: Carry out a UXO study at the affected sites and communicate the results to the public. Namuna and Darband are to be prioritized, as in-migration of new households continues, and more ground disturbance will occur. If UXO is identified, DFZ are to ensure it is safely removed by trained professionals. UXO study to be carried out at any new greenfield sites in the affected Districts, including the area within Nurobod District dedicated for additional resettlement plots, including any agricultural areas. No construction or farming to commence until the area has been confirmed to be free of UXO.

Is this ALARP with the application of the identified mitigation measures? Yes

Justification: Considered to be ALARP if all mitigation measures outlined are correctly implemented.

Table 21-33 - Risk Record for Screening Major Event 27

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
29	Industrial and Urban Accidents	Fire and / or explosion or release of harmful gas	Explosives store	Presence of explosives	C	Uncontrolled explosion causing severe damage to property, injury, and/or fatalities	Storage of explosives.	Blasting and Explosives Management Plan	Death/injury to construction workers.	N	N	Y	N	N	N	N	N	N	N	N

Management measures in place: Explosives are stored in secure purpose-built buildings in an isolated location. Implementation of the Blasting and Explosives Management Plan.

Could this constitute a Major Event in the context of the Project? No

Justification: The reasonable worst consequence of this event does not meet the criteria of a Major Event. The only potential receptors of harm are construction workers.

Is this ALARP with existing management measures? N/A

Justification: Not identified as a potential Major Event.

Table 21-34 - Risk Record for Screening Major Event 28

Risk Record Entry No	Major Event Category	Risk Event Type	Section of the Project	Hazard Description	Applicable Phases (Construction, Operation, Maintenance) *	Risk Description	Hazard Sources and/or Pathways	Documentation in which the Event is/will be Addressed	**Reasonable Worst Consequence if** Event did Occur and Receptor(S)	Air Quality	Climate	People & Communities	Biodiversity	Cultural Heritage	Geology and Soils	Landscape & Visual	Noise & Vibration	Transport	Material Resources	Road Drainage & Water
30	Industrial and Urban Accidents	Fire and / or explosion or release of harmful gas	Rogun Dam construction area	Transportation of explosives.	C	Uncontrolled explosion causing severe damage to property, injury, and/or fatalities	Transport of explosives from the explosives store to the point of use along public roads.	Blasting and Explosives Management Plan Construction EPRP Traffic and Transport Management Plan	Death / injury to members of the public	N	N	Y	N	N	N	N	N	Y	N	N

Management measures in place: Blasting and Explosives Management Plan which outlines measures to be taken when transporting explosives, Construction EPRP and Traffic and Transport Management Plan.

Could this constitute a Major Event in the context of the Project? Yes

Justification: Could cause loss of life or permanent injury which requires ongoing disability support.

Is this ALARP with existing management measures? Yes

Justification: Considered to be ALARP if all management measures outlined are correctly implemented.

21.6.2. The following section presents a summary of the identified Risk Events, during construction and operation phases, which have been considered considering any relevant management measures in place prior to the assessment.

CONSTRUCTION PHASE

21.6.3. Major Events to which the Project may be vulnerable during the construction phase are summarized in **Table 21-35** below, which lists those Risk Events whose impact on a receptor has the potential to be a major event as defined in **Table 21-2**. All considered events are set out in **Table 21-7**.

Table 21-35 - Potential Major Accident and / or Disaster Events during Construction Grouped by High Level Risk Event

Risk Record Entry Number	Risk Description	Risk Event (High Level)	Reasonable Worst Consequence if Event did Occur
4	Landslide into the reservoir may cause impulse / bore-like waves leading to overtopping of the dam wall and flooding downstream.	Collapse / damage to structures	Death/injury to members of the public (downstream communities).
7	Earthquake leading to damage / failure of the dam wall resulting in a large-scale loss of containment event.	Collapse / damage to structures	Death/injury to members of the public (downstream communities).
8, 9, 10, 11	The Project is located in a seismically active zone. Earthquakes could lead to structural damage to buildings at resettlement sites.	Collapse / damage to structures	Death/injury to resettlers or other members of the public who may be present (e.g., hired construction workers)
13	Landslide into the reservoir may cause impulse / bore-like waves, leading to overtopping of the dam wall and flooding downstream.	Dam overtopping	Death / injury to members of the public (downstream communities).
14	Landslide into the reservoir may cause impulse waves affecting reservoir banks.	Impulse wave in the reservoir	Death / injury to members of the public (residents of settlements on the reservoir banks).
15	Darband and Saidoni Nav are located on the reservoir bank and could be damaged in the event of slope collapse	Collapse / damage to structures	Death/injury to resettlers or other members of the public who may be present (e.g., hired construction workers)
18	Erosion of mountain sides with resultant landslide into the reservoir causing impulse waves leading to overtopping of the dam wall and flooding downstream.	Dam overtopping	Death / injury to members of the public (downstream communities).

Risk Record Entry Number	Risk Description	Risk Event (High Level)	Reasonable Worst Consequence if Event did Occur
22	Avalanche from upper slopes hits the resettlement site causing damage to buildings and property, and harm to people.	Collapse / damage to structures	Death/injury to resettlers or other members of the public who may be present (e.g., hired construction workers)
23	Breach or overtopping of the Rogun Dam	Dam breach	Death / injury to members of the public (downstream communities). Cascade failure of downstream cascade
24	Collision between trains and pedestrians or vehicles at the unprotected crossings	Train collision	Death/injury to resettlers or other members of the public who may be present (e.g. hired construction workers)
26	Striking UXO resulting in an explosion during house or infrastructure construction, or farming activities. Particular risks at Namuna, where currently vacant land adjacent to the Uzbekistan border will be brought into cultivation.	UXO incident	Death/injury to resettlers or other members of the public who may be present (e.g. hired construction workers)
28	Uncontrolled explosion, causing severe damage to property, injury, and/or fatalities during transportation of explosives from the explosives store to the point of use on the Rogun Dam construction area.	Fire and / or explosion or release of harmful gas	Death / injury to members of the public

OPERATION PHASE

21.6.4. Major Events to which the Project may be vulnerable during the operational phase are summarized in **Table 21-36** below, which lists those Risk Events whose impact on a receptor has the potential to be a major event in section in **Table 21-2**. All considered events are set out in **Table 21-7**.

Table 21-36 - Potential Major Accident and / or Disaster Events during Operation Grouped by High Level Risk Event

Risk Record Entry Number	Risk Description	Risk Event (High Level)	Reasonable Worst Consequence if Event did Occur
3	Failure of / damage (cracks in the wall) to the dam in the event of an	Collapse / damage to structures	Death/injury to members of the public

Risk Record Entry Number	Risk Description	Risk Event (High Level)	Reasonable Worst Consequence if Event did Occur
	earthquake leading to a large-scale loss of containment.		(downstream communities)
4	Landslide into the reservoir may cause impulse / bore-like waves leading to overtopping of the dam wall and flooding downstream.	Collapse / damage to structures	Death/injury to members of the public (downstream communities).
7	Earthquake leading to damage / failure of the dam wall resulting in a large-scale loss of containment event.	Collapse / damage to structures	Death/injury to members of the public (downstream communities).
13	Landslide into the reservoir may cause impulse / bore-like waves, leading to overtopping of the dam wall and flooding downstream.	Dam overtopping	Death / injury to members of the public (downstream communities).
14	Landslide into the reservoir may cause impulse waves affecting reservoir banks.	Impulse wave in the reservoir	Death / injury to members of the public (residents of settlements on the reservoir banks).
18	Erosion of mountain sides with resultant landslide into the reservoir causing impulse waves leading to overtopping of the dam wall and flooding downstream.	Dam overtopping	Death / injury to members of the public (downstream communities).
23	Breach or overtopping of the Rogun Dam	Dam breach	Death / injury to members of the public (downstream communities). Cascade failure of downstream cascade

21.7. SUMMARY

21.7.1. This Chapter has identified Major Events relevant to the Project and determined which are ALARP considering measures already in place, and which require mitigation. It is deemed that the risks are anticipated to be ALARP if the identified mitigation is implemented.

22. REFERENCES

Association of Dam Safety Officials. (n.d.). *Vajont Dam (Italy, 1963)*. Retrieved from https://damfailures.org/case-study/vajont-dam-italy-1963/

DSPoE. (2024). *DSPoE's 6th Report - Draft Report on Site Visit and Documents Reviewed, Rev 01.*

International Federation of Red Cross and Red Crescent Societies. (2008). *Early Warning, Early Action.* Retrieved from https://www.climatecentre.org/downloads/files/reports/Early%20Warning%20Early%20Action%202008.pdf

Magdalena Vassileva, M. M. (2023). Reactivation of an old landslide in north–central Iran following reservoir impoundment: Results from multisensor satellite time-series analysis. *Engineering Geology*.

Seister Seismic Engineering Solutions. (2024). *Seismic Hazard Update Study at Rogun Dam (Republic of Tajikistan).*

U.S. Department of State. (n.d.). *2015 To Walk the Earth in Safety: Tajikistan.* Retrieved from https://2009-2017.state.gov/t/pm/rls/rpt/walkearth/2015/248818.htm

World Bank Group. (2022). *Task 7 - Landslide Scenario Assessment.* Retrieved from Data Catalog: https://datacatalogfiles.worldbank.org/ddh-published/0064119/DR0090815/Task7_LnHaz_Report_r5_EN.pdf?versionId=2023-07-21T17:45:03.0592674Z

PUBLIC

JSC “Rogun HPP”

State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT – UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Volume 1, Chapter 22: Traffic and Transport



JUNE 2025

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Figure 22-2 – Roads within the Area of Influence **Error! Bookmark not defined.**

22 TRAFFIC AND TRANSPORT

22.1 INTRODUCTION

22.1.1. This chapter presents the assessment of potential impacts of the Project activities on traffic and transport, in line with the requirements of the WB ESS1: Assessment and Management of Environmental and Social Risks and Impacts, ESS3: Resource Efficiency and Pollution Prevention and Management and ESS4: Community Health, Safety and Security.

22.1.2. A comprehensive description of baseline conditions is presented in **Volume 2, Annex 7.1: Baseline Conditions Report** and a summary is provided in **Volume 1, Chapter 7** of this ESIA. An assessment of the potential Project impacts on traffic and transport and receptors presented in **Section 22.5.** Project impacts relating to Severance are presented in **Volume 2, Annex 17-3: Severance Impact Assessment** of this ESIA. Where necessary, mitigation measures for the avoidance of impact, impact minimization and/or long-term management are included in **Section 22.6**.

22.1.3. Previous assessments of the Project have been undertaken including an ESIA completed in 2014.

POYRY (2014) ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR ROGUN HYDRO POWER PLANT

22.1.4. The 2014 ESIA report discusses the findings of assessment of the impact of traffic movements within the Project site and the Project area of influence (AoI). The conclusions from the assessment focused on traffic and transport are summarized as:

- There is increased traffic passing through the villages travelling to the project site, and prior to the construction of the M41 Obigarm-Nurobod Road Realignment Project, there was an increased reliance on the local road network in the villages for logistical routes to the project site. The 2014 ESIA recommended a Traffic Management Plan to develop procedures for on-site traffic movements.

22.2 LEGISLATIVE FRAMEWORK, POLICY AND GUIDANCE

The Code of Road Transport of 2020, Republic of Tajikistan (Law No. 1689)

22.2.1. The Code of Road Transport of 2020, Republic of Tajikistan (Law No. 1689) provides regulations concerning the transportation of goods and passengers and the transportation of hazardous, oversized and heavy cargo.

22.2.2. Article 3 of the Road Transport Code sets out the road transport activities that are subject to mandatory licensing, this includes:

- outlining a requirement for a permit for transporting hazardous, oversized or perishable goods; ensuring compliance with the specific safety and regulatory standards
- licensing requirements are designed to ensure the safety, reliability, and efficiency of road transport services within Tajikistan.

22.2.3. Article 5 of the Road Transport Code sets out the responsibilities and requirements for transporting hazardous materials in emergency response activities as directed by state bodies.

Law on Road Safety of the Republic of Tajikistan (2020)

22.2.4. The Law on Road Safety aims to enhance road safety and reduce accidents, as follows:

- The law mandates a range of measures to ensure the safety of road users, including the installation of traffic signs, signals, and road markings. It also includes provisions for the maintenance and improvement of road infrastructure.
- The law sets out requirements for driver qualifications, vehicle standards, and regular vehicle inspections to ensure that all vehicles on the road are safe and roadworthy.
- The law provides for strict enforcement of traffic rules and regulations. It includes penalties for violations such as speeding, driving under the influence, and not wearing seat belts.
- The law emphasizes the importance of public awareness and education campaigns to promote safe driving practices and inform road users about traffic rules.

INTERNATIONAL LENDER REQUIREMENTS

22.2.5. World Bank ESS1 sets out the borrower's responsibilities for assessing, managing and monitoring of environmental and social risks and impacts associated with each stage of a project.

22.2.6. World Bank ESS4 requires the avoidance or minimization of potential traffic and road safety risks to workers, affected communities and road users throughout the Project lifecycle. Where appropriate, measures and plans will be developed to address impacts identified by the assessment.

22.2.7. In general, all lender Environmental and Social Standards/Guidelines, including ADB and AIIB are broadly consistent with the World Bank ESS.

22.2.8. Typical Good International Industry Practice (GIIP) is set out in the World Bank EHS General and associated Sector Specific Guidelines. Key measures relating to Traffic and Transport are:

- Section 3.4 of the General EHS Guidelines provides detailed GIIP for managing road safety initiatives with the goal of preventing traffic accidents and minimizing injuries suffered by project personnel and the public.
- Section 3.5 of the General EHS Guidelines provides a detailed description of the transportation of Hazardous Materials with compliance to local laws and international requirements.

22.2.9. World Bank EHS Guidelines on Toll Roads set out examples of GIIP tailored to address project hazards and risks

- Section 1.3 provides detail on the community health safety issues during construction of roads at large construction sites, with particular focus on pedestrian safety, traffic safety and emergency preparedness.

Institute of Environmental Management and Assessment (IEMA) 'Environmental Assessment of Traffic and Movement' Guidelines (2023)

22.2.10. The Institute of Environmental Management and Assessment (IEMA) 'Environmental Assessment of Traffic and Movement' (2023) (EATM) Guidelines have informed this assessment. The Guidelines provide information on the identification of receptors sensitive to traffic and transport effects, set out a list of effects that should be assessed and suggest thresholds for assessing the impact on the existing road network.

22.3 ASSESSMENT METHODOLOGY

STUDY AREA

22.3.1. The Institute for Environmental Management and Assessment: Environmental Assessment of Traffic and Movement (IEMA EATM) Guidelines on the identification of sensitive locations, defined as receptors that are sensitive to traffic include: hospitals, places of worship, schools and historic buildings. The Guideline also identify the need to consider the adequacy of footways and road crossing facilities.

22.3.2. The identification of the study area and sensitive receptors should be informed by the location of populations, facilities, amenities and attractions surrounding the Project. Consideration should be given to groups of:

- People at home;
- People at work (e.g. construction workers);
- Vulnerable populations (e.g. older people, younger people);
- Locations with concentrations of vulnerable users (e.g. schools, hospitals);
- Routes with existing safety concerns; and

22.3.3. The Area of Influence (AoI) for the traffic and transport study for this ESIA includes:

- M41 Highway between Dushanbe-Obigarm (approx. 97.5 km)
- M41 Highway between Obigarm-Nurobod (approx. 75 km)
- 920 m Long Bridge at Darband connecting to M41 Obigarm-Nurobod (and temporary bridge)
- Local Road (Рц001) between Obigarm-Rogun City (approx. 12 km)
- Left-Bank Road between Roghuni Bolo-Darband (approx. 55 km)
- Right-Bank Road between Darband-Kamarob Valley-Gharm.
- Roads at Rogun HPP construction site
- New local roads at resettlement sites

RECEPTOR SENSITIVITY

22.3.4. The guideline approach to assessing the sensitivity of the receptor is to assign the receptor to the nearest highway link and examine the relationship of the receptor to the highway link to understand the sensitivity to change.

22.3.5. The range of receptors that could be sensitive to changes in traffic conditions include:

- Pedestrians (including workers at the Rogun construction site)
- Motorists and freight vehicles;
- Highways with inadequate infrastructure and high-risk junctions; and
- People living in communities adjacent to roads in rural and urban areas.

22.3.6. The categories of receptor sensitivity used in this assessment are described in **Table 22-1**.

Table 22-1 – Receptor Sensitivity Categories

Sensitivity Categories	Definition and Examples
High	Communities for which no alternative transport routes are easily available. Transport infrastructure in residential areas or with adjacent land-uses connected to vulnerable groups and/or locations e.g., hospitals, schools, nursing homes or similar facilities. Transport infrastructure with physical restrictions (e.g., limited width, poor visibility) that would not accommodate Project traffic. Transport infrastructure without non-motorised user infrastructure where non-motorised user flows are anticipated, for example within residential areas.
Medium	Communities for which a limited number of alternative transport routes are available. Transport infrastructure in commercial or industrial areas. Highways and junctions that may experience congestion. Transport infrastructure with physical restrictions such as narrow footways.
Low	Communities for which convenient alternative transport routes are available. Transport infrastructure that is physically capable of accommodating Project traffic Adequate separation of non-motorised and motorised road users Receptors located sufficiently distant from the highway and junctions affected by changes in traffic volumes.

IMPACT MAGNITUDE

22.3.7. The categories of traffic and transport impact magnitude and their respective descriptions are described in **Table 22-2**. The category descriptions are informed by the Guideline criteria, the traffic and transport conditions described in **Volume 2, Annex 7.1: Baseline Conditions Report** of this ESIA and as seen during in-country visits, to distinguish the magnitude of change for the likely traffic and transport impacts.

Table 22-2 – Impact Magnitude Categories

Magnitude	Definition / Examples
Large	Major increase in traffic flow or HGVs Permanent effect on travel times that cannot be mitigated through non-government authority intervention (i.e., strategic improvements are required such as road upgrades, traffic calming measures alternative transport provision requiring governmental support). Deterioration in transport network, requiring government authority maintenance and/or upgrades. Permanent closure of roads or pedestrian routes, with high/pedestrian flows. Unacceptable detrimental impacts on non-motorised users and highway safety, particularly in areas where non-motorised user flows are high and there is not sufficient separation of road user groups, vulnerable groups are present and existing highway safety concerns are present.
Medium	Moderate increase in traffic flow or HGVs Permanent or long term (>12 months) effect on travel time which can be mitigated without government authority intervention. Deterioration in transport infrastructure conditions, requiring periodic and minor levels of government authority maintenance. Permanent closure of roads or pedestrian routes, with moderate pedestrian flows or temporary closure of roads or pedestrian routes, with high pedestrian flows. Detrimental impacts on non-motorised users and highway safety, potentially in areas where non-motorised user flows are anticipated to be high and/or are anticipated to be low without there is not sufficient road user separation, vulnerable groups are not anticipated to be present and there are no existing highway safety concerns.
Small	Minor increase in traffic flow or HGVs Temporary effect (between 6 and 12 months duration) on travel time which can be mitigated without government authority intervention. Temporary closure of roads or pedestrian routes, with moderate or low pedestrian flows. Deterioration in transport infrastructure conditions, which can be mitigated without government authority maintenance. Detrimental impacts on non-motorised users and highway safety, in areas where non-motorised user flows are not anticipated and separation between road user types is adequate, vulnerable groups are not anticipated to be present and there are no existing highway safety concerns.
Very small / Negligible	Negligible increase in traffic flow or HGVs. Temporary effect (up to 6 months duration) on travel time which can be mitigated without government authority intervention. Detrimental impacts on non-motorised users and highway safety, in areas where non-motorised user flows are not anticipated and separation between road user types is adequate, vulnerable groups are not anticipated to be present and/or are sufficiently set back and there are no existing highway safety concerns.

Magnitude	Definition / Examples
Beneficial	New or upgraded transport infrastructure. Reduction in traffic flows and/or HGV numbers

SIGNIFICANCE OF EFFECTS

22.3.8. The overall significance of effects resulting from traffic and transport impacts is determined by the interaction of the categories assigned to receptor sensitivity and impact magnitude. The significance matrix provided in **Volume 1, Chapter 5: ESIA Methodology** of this ESIA shows the levels of interaction and is reproduced in **Table 22-3**.

Table 22-3 – Significance Matrix

Impact Magnitude	Receptor Sensitivity		
	Low	**Medium**	**High**
Beneficial	Positive	Positive	Positive
Very Small	Negligible	Negligible	Minor
Small	Negligible	Minor	Moderate
Medium	Minor	Moderate	Major
Large	Moderate	Major	Major

22.3.9. For this ESIA, major and moderate impacts are deemed to be significant, while minor impacts are not considered significant pre-mitigation.

22.4 SCOPE OF THE ASSESSMENT

22.4.1. Using the IEMA EATM Guidelines, the following potential traffic and movement impacts will be assessed:

- Severance of communities;
- Vehicle delay;
- Community safety;
- Road user and pedestrian safety; and
- Hazardous/large loads.

22.4.2. Traffic and movement from the Project can potentially impact human health, through impacts on air quality, water and noise. Impacts on these factors are considered in **Volume 1, Chapter 8: Air Quality**, **Volume 1, Chapter 11: Noise & Vibration**, and **Volume 1, Chapter 13: Water.**

22.5 POTENTIAL IMPACTS AND EFFECTS

22.5.1. The assessment of impacts considers the sensitivity of the receptors that have been identified, the magnitude of the impact and consolidates these factors to assess the significance of the effect. Adverse impacts during the construction phase include driver delay, risks to community safety, degradation of road conditions, road safety, and from the movement of hazardous and large loads. Impacts during operation would be confined to road condition and driver delay.

CONSTRUCTION

22.5.2. As described in **Chapter 3: Project Description**, dam construction resumed in 2016 and is scheduled to be completed in about 2032. As the construction process nears completion, it is expected that construction-related traffic and transport activities will start to diminish.

As described in **Chapter 3: Project Description**, and **Chapter 7: Baseline Conditions**, all traffic into and out of the site comes through the main gate or over a temporary construction bridge (the Sicharog bridge), which will be dismantled in late 2025 or 2026. In general, most Project-related traffic comes through the main gate and consists of vehicles bringing materials and goods to the site and workers being transported to and from the site. In addition, a small number of passenger vehicles and pedestrians from two villages on the left bank are allowed to cross the Sicharog bridge. Driver Delay

22.5.3. Driver delay occurs due to additional Project-related traffic on the road network delaying non-Project traffic. Additional delays caused by Project-related traffic are only likely to be significant if the traffic on the network is already at, or close to, capacity.

M41 Highway Dushanbe-Obigarm

22.5.4. The primary route used by HGVs to deliver materials and goods to Rogun HPP is the M41 Highway between Dushanbe-Obigarm. This route is a 97.5 km section of national highway with a travel-time of approximately 2 hours from Dushanbe to Rogun HPP. This highway is a free-flowing single carriageway with varying pavement quality. It was upgraded and resurfaced in 2014 to accommodate the anticipated increase in construction traffic. Sections have been upgraded or improved in recent years.

22.5.5. On average, there is about 150 HGVs delivering materials and goods to the site daily, with the majority travelling from Dushanbe. According to the Ministry of Transport, the total number of vehicles per day is low for the capacity of the highway, which is reported to have an average daily traffic count of 3,738 vehicles in both directions.

22.5.6. As transport infrastructure is physically capable of accommodating Project traffic, the sensitivity is **low.** The magnitude of this impact is **medium**, as there will be a moderate increase in traffic flow or HGVs due to the scale of the Project, and therefore the significance of the effect is **minor.**

Рц001 Local Road Obigarm-Rogun City

22.5.7. The road connection (known as ‘Рц001’) Obigarm-Rogun City is the main access road between the M41 highway and the site entrance gate at Rogun HPP. It is a single carriageway road with steep gradients and sharp turning sections and resurfaced in November 2024. This is the primary route for access to Rogun City and the site entrance gate and experiences heavy traffic, particularly on a shift changeover day.

22.5.8. During shift changeover day (occurring every 15 days), there are high levels of traffic in Rogun City and at the site entrance gate. Dozens to hundreds of taxis and private vehicles drop and pick up workers at the site on shift-change day. While the local road has capacity to manage the flows of traffic, upon arrival at the site entrance gate, there is limited infrastructure to facilitate drop-off, pick-ups and parking.

22.5.9. Traffic flows through the site entrance gate on 15th September 2024 were counted and indicates movements of vehicles and pedestrians to/from the site on a shift changeover day.

- 1664 cars (including Project vehicles, taxis and private cars entering/exiting the site)
- 143 HGVs (including construction vehicles exceeding 3.5 tonnes);
- 5671 pedestrians on foot, many of whom had been dropped off outside of the Site entrance gate.

22.5.10. Additional traffic with potential to delay non-Project traffic was observed at the start and end of workers shifts. In some cases, workers hitchhiked or relied on taxis for transport from the site to their off-site accommodation. Workers are driving personal vehicles and parking near the site entrance or in Rogun City. Due to a lack of parking, vehicles park on verges and on pedestrian sidewalks. This is exacerbated on shift changeover days due to the volume of traffic arriving and departing the site.

22.5.11. The magnitude of Project-related traffic and transport impact is **medium** and, as the sensitivity of receptors is **medium**, the significance of the effect is **moderate**.

COMMUNITY SAFETY

22.5.12. A change in total volume of traffic, heavy vehicle composition, speed of vehicles, proximity of traffic to people and lack of road safety infrastructure can affect the safety of communities.

22.5.13. There are approximately 17,000 workers employed at the Rogun HPP site; to cater for the movement of workers between accommodation camps and construction areas, Lot 2 Contractor WeBuild operate a shuttle bus. However shuttle buses often stop in hazardous locations, including intersections and tunnels, creating risk for pedestrians and other vehicles. Additionally, other contractors do not operate transport to/from the site and accommodation.

22.5.14. There is no route reserved for pedestrians entering the main gate, so vehicle-pedestrian interactions are not segregated or controlled. At daily and 15-day shift changes, there are significant increases in vehicle and pedestrian traffic in the gate area. There is a village (Pasi Muhraho, population of 580 as of October 2023) situated within the construction site approximately 300 m from the site entrance gate accessible by an unpaved road (Rohe Mazor). The unpaved road is the only access point for future Construction Site 2 and the main dam area. Residents of Pasi Muhraho frequently drive and walk to Rogun City via the access gate, including lone children walking to/from school.

22.5.15. Once Construction Site 1 is inundated by about 2028, a Contractor will develop accommodations, offices, and other facilities in Construction Site 2. there will be an increase in vehicle movements on the road that passes through Pasi Muhraho

22.5.16. With transport infrastructure in residential areas connected to vulnerable groups and locations e.g., schools, the receptor sensitivity is **high**, the impact is **large**, and the potential significance of the effect is **major**.

ROAD CONDITIONS

M41 Highway Dushanbe-Obigarm

22.5.17. Damage to road edges and general 'wear and tear' of the road may occur through increased traffic, especially HGV movements and the transport of any abnormal loads. Average daily traffic movements on the logistic routes between Dushanbe-Rogun is 3,738 total vehicles, of which 840 were identified as HGVs (22.5% of total vehicles).

22.5.18. It is difficult to identify the extent to which damage to road edges and general wear and tear will occur, in addition, to the exact destinations of all HGVs on the logistic route. On average, there are 150 HGVs delivering materials and goods to the site daily, with the majority travelling on M41 Dushanbe-Obigarm. As the highway was upgraded in 2014, there is sufficient capacity to support traffic volumes, therefore; the magnitude of this impact would be **small**, and as the sensitivity of receptors is **low**, the significance of the effect is **Negligible**.

ROAD SAFETY

22.5.19. The Tajik national mortality rate caused by road traffic accidents is 13.9 per 100,000 population (2021). IEMA EATM Guidelines do not recommend the use of thresholds for identifying significance of effects relating to the risk of accidents; but the magnitude of change to the mortality rate for road traffic accidents can be used as an indicator of road safety.

M41 Highway (Dushanbe-Obigarm-Nurobod)

22.5.20. Despite the increase in traffic on M41 Highway from the Project, existing transport infrastructure between Dushanbe-Obigarm is capable of accommodating Project traffic.

22.5.21. Due to the inundation of the reservoir to 1290 masl, the existing M41 highway between Obigarm-Nurobod will be flooded before 2032, and a new realigned section, approximately 75 km, will be operational from 2025. The safety for rural roadside community facilities and dwellings will be greatly improved, with increased highway vehicle capacity and road safety infrastructure such as lighting, safety barriers and emergency stopping areas. In urban areas, there will be pedestrian walkways, designated crossing points, and reduced speed limits from 80 km/hr to 40 km/hr in urban areas.

22.5.22. Roads within resettlement areas will also be constructed to this standard with improved road safety infrastructure, pedestrian walkways, designated crossing points and speed limits of 40 km/hr. In addition, to bus / taxi stops with designated shelters for pedestrians to wait for transport.

22.5.23. With the in-progress separation of non-motorised and motorised road users, the receptor sensitivity is **low**. Considering improved transport infrastructure with new road safety infrastructure, the magnitude of the impact is **beneficial**, and the significance of the effect is **positive**.

Rogun HPP Construction Site

22.5.24. Tunnels are used for vehicular access to various zones of the site. OHS audits have found that in tunnels lighting is poor, and reflective markers are missing in some high-risk areas, such as sharp bends. Flaggers have been assigned in some locations to direct and stop traffic, but they are at risk from passing traffic in some areas where they are positioned in areas of low visibility or in the roadway.

22.5.25. Many vehicles in tunnels, including HGVs, exceed speed limits and overtake in tunnels or other unsafe locations. In addition, there are many roads where there are no barriers to prevent vehicles from leaving the roadway and falling down slopes.

22.5.26. At shift changes, workers sometimes walk long distances on site, and they often ride on construction equipment or in the back of pickup trucks or other vehicles not designed for passengers.

22.5.27. The magnitude of impact is **large**, and the potential significance of the effect is **major**.

HAZARDOUS AND LARGE LOADS

22.5.28. The transportation of hazardous or abnormal loads by road is required for the Project construction phase.

22.5.29. As noted, about 150 HGVs come to the site each day. Relatively small amounts of hazardous materials are used, with concrete being the most significant.

22.5.30. In 2024, three “abnormal” (very large) loads of turbine parts were transported to the site. There are currently five abnormal loads planned for 2025, and the expectation of further abnormal loads for duration of the construction phase until 2032.

22.5.31. A special one-time permit is required to undertake transport of abnormal loads and requires authorization by the Ministry of Transport in Tajikistan. All abnormal loads are transported from Dushanbe to the site and require a police escort organised by each local authority. This includes road closures in sections along the M41 road with advance notification to communities communicated to Jamaats with a pre-determined route planned. Oversized loads must adhere to reduce speed limits, consideration of weight and dimensions of vehicles complying with bridge, overpass and tunnel restrictions. Abnormal load deliveries are done during hours of lowest traffic, during daylight hours only and in good weather conditions.

22.5.32. The receptor sensitivity would be considered **medium** and the magnitude of the impact is **small**, the significance of the effect is **minor**.

OPERATION

22.5.33. The Project is partly operational at present, with generation capacity increasing to full capacity by 2032, and actual generation reaching its capacity by 2038.

ROAD CONDITIONS

22.5.34. Once the Project construction phase is completed in 2032, Project-related utilization of off-site roads will diminish substantially as the majority of the operational workforce of approximately 800 personnel will live locally in Rogun City or nearby areas.

22.5.35. The proportion of HGV on the highway between Dushanbe and Rogun will be reduced to delivery of goods and materials for maintenance purposes, and it is likely that the proportion of HGV will decrease to less than 10% of the current level.

22.5.36. The impact of HGV on the highway condition will be minimal and the sensitivity or the receptor is **low**, the magnitude of the impact is **small,** and the significance of the effect is **negligible**.

DRIVER DELAY

22.5.37. As the construction phase winds down, even the minor delays caused by construction-related traffic will be substantially reduced, including especially at shift changes due to the reduced workforce size.

22.5.38. The impact of operational traffic on the sensitivity of driver delay is **low**, the magnitude of the impact is **very small**, and the significance of the effect is **negligible**.

22.6 MITIGATION AND ENHANCEMENT MEASURES

22.6.1. Mitigation measures to be implemented for the Project as mitigation is summarised in **Table 22-4**.

Table 22-4 – Mitigation Measures

AM	Overview of Mitigation Measure
AM22-1	**Implementation of a Traffic Management Plan (TMP)** ▪ A Traffic Management Plan will be implemented by Rogun JSC to outline requirements of each contractor. The site-wide plan will apply across the site, including areas controlled by Rogun HPP. It will also require Contractors to develop detailed plans for management of traffic in their respective areas and for their respective activities, to be approved by the Employer's Representative/Project Management Consultant. Plans have to be approved within six months of the effective date for EPC Contractors for Lots 1 and 2 and the Lot 4 "early works Contractors, and by the time future EPC Contractors for Lots 1, 3A, and 4 mobilize to the site. Contractor Plans will be based on detailed traffic surveys and analysis of their own traffic and transport practices and needs. The plans/procedures will include such requirements as: o Route and traffic planning for tother oversize loads, to include escorts, signals, and other measures to minimize the effects on other traffic. o Journey plans and details of the materials delivery routes. o Strict speed limits and speed control measures, including speed humps at the Pasi Muhraho Village near Construction Camp 2, and introduction of 40 km/hr speed limit for the village (30 km/hr for a 300m stretch of road outside the local school). A dedicated pedestrian walkway shall be constructed between the village and the entrance gate with pedestrian crossing points. o Enforcement of one-way traffic o Workers to be transported only in vehicles with safety belts, and required to use them o Drivers to be licensed by Contractors for the vehicles they will operate and trained on the requirements of the TMP. o All vehicles used by the Project will be fit for purpose based on an assessment of usage and be maintained in safe working order in line with manufacturers' specifications, UN vehicle safety regulations and all applicable national legal requirements. o Daily pre-start checklists by operators o Intact glass in windshields and windows, working lights, reverse alarms, working brakes, treaded tyres, charged fire extinguisher, and other safety features Identification and demarcation of approved access routes. o Segregation of incoming and outgoing traffic to reduce risk of collisions or overuse o Overtaking and pedestrian access in tunnels will be prohibited o Automated traffic signalling in some locations o Enforcement by senior managers, HSE Managers and specialists, ER/PMC, and Traffic Department
AM22-2	**Road Safety Campaign in Rogun City and Pasi Muhraho Village**

AM	Overview of Mitigation Measure
	▪ For all upgrade / improvement works to the proposed transport route, the Occupational Health, and Safety Plan and TMP will be adhered to. A safety training programme will be in place to manage worker safety during works.
AM22-3	**Vehicle Identification** ▪ To be implemented by all parties. ▪ All parties will assign and mark all of their vehicles and mobile equipment that come on the site with a unique letter-number identifier on front, rear, and both sides. This will allow identification of offending vehicles, which can then be traced to the owner and the driver for further action. Vehicles without such markings, such as delivery vehicles or visitors, will be assigned identifiers before entering the site.
AM22-4	**Development and Implementation of a Worker Transport Plan to establish a regular bus service for worker transportation at construction site** ▪ The ER/PMC and Contractors will collectively develop and implement a Worker Transport Plan for all workers and contractors to provide adequate transportation of workers between accommodations, the main gate, and workplaces, and between the gate and nearby worker residences. ▪ This Plan, and Contractors' individual sub-plans, will identify optimum stop locations, frequency of services, with consideration of shift start and end times per contractors. Formal bus stops will be established at key locations, such as: • Site entrance gate • Rogun City • Accommodation blocks • Construction area 1 • Construction area 2 • Permanent offices ▪ The Plan will include a regular route schedule, with A capacity to accommodate peak demand during shift changes.
AM22-6	**Construction of parking facilities at the Rogun Construction Site Entrance** ▪ Rogun JSC has announced a plan to develop one or more areas to accommodate short-term parking near the main gate to accommodation shift-change traffic and reduce the need for roadside parking and pedestrian traffic.

22.7 SUMMARY

Table 22-5 – Summary of Traffic and Transport Effects (Construction)

Impact	Driver Delay		Community Safety	Road Conditions	Road Safety		Hazardous / Large Loads
	M41 Dushanbe-Obigarm	Рц001 Local Road Obigarm-Rogun City		M41 Dushanbe-Obigarm	M41 Dushanbe-Obigarm-Nurobod	Rogun HPP Construction Site	
Receptor Sensitivity	Low	Medium	High	Low	Low	High	Medium
Frequency	Constant	Constant	Constant	Constant	Constant	Constant	Infrequent
Likelihood	Certain	Certain	Certain	Certain	Certain	Certain	Unlikely
Extent	Regional	Regional	Local	Regional	National	Local	Local
Duration	Medium-term	Medium-term	Medium-term	Medium-term	Permanent	Medium-term	Medium-term
Magnitude	Medium	Medium	Large	Small	Beneficial	Large	Small
Effect	Adverse	Adverse	Adverse	Adverse	Beneficial	Adverse	Adverse
Direct / Indirect	Direct	Direct	Direct	Direct	Direct	Direct	Direct
Significance of Effect	**Minor**	**Moderate**	**Major**	**Negligible**	**Positive**	**Major**	**Minor**
Mitigation (Y/N)	**No**	**Yes** AM22-4 AM22-6	**Yes** AM22-1 AM22-2 AM22-3	**No**	**No**	**Yes**	**No**
Residual Significance	**Minor**	**Minor**	**Moderate**	**Negligible**	**Positive**	**Moderate**	**Minor**

Table 22-6 – Summary of Traffic and Transport Effects (Operation)

Impact	Road Conditions	Driver Delay
Receptor Sensitivity	Low	Low
Frequency	Medium-term	Periodic
Likelihood	Unlikely	Unlikely
Extent	Regional	Local
Duration	Medium-term	Medium-term
Magnitude	Small	Very Small
Effect	Adverse	Adverse
Direct / Indirect	Direct	Direct
Significance of Effect	**Negligible**	**Negligible**
Mitigation (Y/N)	No	No
Residual Significance	**Negligible**	**Negligible**

PUBLIC

JSC “Rogun HPP”

State Enterprise “Directorate for Flooding Zone of Rogun HPP”

Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan

ROGUN HYDROPOWER PROJECT – UPDATED ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

- Volume 1, Chapter 23: Transboundary Cumulative Impact Assessment



PUBLIC

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LIST OF ACRONYMS AND ABBREVIATIONS

ADB	Asian Development Bank
AIIB	Asian Infrastructure Investment Bank
AoI	Area of Influence
BVO	Basin Water Organisation
CASA	Central Asia-South Asia project
CEDMP	Contactor's Environmental and Social Management Plan
CIA	Cumulative Impact Assessment
d/s	Downstream
DFZ	Directorate of Flooding Zone of Rogun HPP
DSPOE	Dam Safety Panel of Experts
E&S	Environmental and Social
EAAA	Ecologically Appropriate Area of Analysis
ECS	Environmental, Climate and Social
EFlow	Environmental Flows
EIB	European Investment Bank
EPAP	Emergency Preparedness and Action Plan
EPP	Emergency Preparedness Plan
ESF	Environmental and Social Framework
ESIA	Environmental and Social Impact Assessment
ESMMP	Environmental and Social Management and Monitoring Plan
ESMP	Environmental and Social Management Plan
ESP	Environmental and Social Policy
ESPOE	Environmental and Social Panel of Experts
ESS	Environmental and Social Standards
FSL	Full Supply Level
GBAO	Gorno Badakhshan Autonomous Oblast
GHG	Greenhouse gas
GLOF	Glacier Lake Outburst Flood
GRM	Grievance Redress Mechanism
HH	Household
HPP	Hydropower Project
ICWC	Interstate Commission for Water Coordination of Central Asia
IFC	International Finance Corporation
IUCN	International Union of Conservation of Nature
LRP	Livelihood Restoration Plan
m asl	meters above sea level
MoEWR	Ministry of Energy and Water Resources
MOL	Minimum Operation Level

MoM	Minutes of Meeting
MWh	Megawatt-hours
n.a.	not applicable
NTS	Non-Technical Summary
PAP	Project Affected Person
PMF	Probable Maximum Flood
PMG	Project Management Group
POE	Panel of Experts
PR	Performance Requirements
PS	Performance Standards
RAP	Resettlement Action Plan
RCIA	Rapid Cumulative Impact Assessment
ROR	Run-of-river
SEP	Stakeholder Engagement Plan
TBIA	Transboundary Impact Assessment
TCIA	Transboundary Cumulative Impact Assessment
TEAS	Techno-Economic Assessment Study
TJK	Tajikistan
TKM	Turkmenistan
TL	Transmission Line
TOR	Terms of Reference
u/s	upstream
USAID	United States Agency for International Development
UZB	Uzbekistan
VC	Valued Component
VEC	Valued Environmental Component
WB	World Bank

EXECUTIVE SUMMARY

This is the **Transboundary Cumulative Impact Assessment for Rogun HPP ESIA** prepared on behalf of the Project Management Group for Energy Facilities Construction under the President of the Republic of Tajikistan (PMG). Its aim is to discuss and evaluate cumulative impacts that may arise from interactions of Rogun HPP with any other project in the wider project area, and, where required and possible, propose appropriate mitigation measures. It is a part of the updated ESIA for Rogun HPP. Rogun HPP (the Project) is a major hydropower project presently under construction on Vakhsh River, upstream of the already existing Nurek HPP. Once finalised, Rogun HPP will consist of a 335 m high rockfill dam forming a reservoir with a surface of 159 km² and a total volume of 13.3 km³, and a power house with an installed capacity of 3,780 MW.

This TCIA was prepared according to the applicable standards as defined in the TOR, mainly those of the international agencies involved in funding Rogun HPP or projects closely related to it. Chapter 2 provides an overview of applicable standards. The main applicable guideline is the Good Practice Handbook on Cumulative Impact Assessment and Management (IFC 2013).

According to IFC (2013), "CIA is the process of (a) analysing the potential impacts and risks of proposed developments in the context of the potential effects of other human activities and natural environmental and social external drivers on the chosen VECs (Valued Environmental Components) over time, and (b) proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risk to the extent possible." Chapter 3 shortly outlines the approach chosen for this CIA. It is of importance to note that it does not only focus on issues where the ESIA has shown that Rogun HPPP will actually have impacts and where therefore cumulative impacts with other projects are expected or likely to materialize, but has to include aspects where there is a potential for such cumulative impacts, and/or where relevant stakeholders have concerns that this may happen. This means that the definition of the potential area of influence (AoI) as well as the selection of potential receptors (also called VECs, Valued Environmental Components, or VCs, Valued Components) must not be too narrow, potentially reaching beyond the AoI which was chosen for the ESIA for the project. This is discussed in Chapter 3. The VC of main importance is water, and, more precisely, water availability, use and distribution in the Amu Darya basin, this mainly since any project related to water resources in this vast area can potentially have impacts on water availability in its downstream area. Other VCs which had to be included mainly because of concerns of certain stakeholders are issues more or less directly related to biodiversity, namely, the situation in the Aral Sea, fish migrations in the Amu Darya area, and a protected area called Tigrovaya Balka.

It is a usual practice, according to the relevant standards and guidelines, to prepare, usually as part of the ESIA (Environmental and Social Impact Assessment), a CIA (Cumulative Impact Assessment) for the project in question. Since in the case of Rogun HPP the main potential (cumulative) impacts would concern questions of water availability and seasonal distribution in the downstream area of the project, and would therefore have its main impacts on the downstream countries in the Amu Darya basin, in this case the CIA is necessarily also a TCIA (Transboundary Cumulative Impact Assessment).

Per the definitions provided in several of the relevant guidelines and standards, a CIA has to include, in addition to the main project for which it is being prepared, "impacts from other relevant past, present and reasonably foreseeable developments as well as unplanned but predictable activities enabled by the project that may occur later or at a different location." Chapter 4 provides a list and a short description of these developments, which can be existing structures, projects under construction, in the planning or conceptual stage, here usually called "other projects". These are:

- Nurek HPP (existing)
- Vakhsh HPP cascade d/s of Nurek (existing)
- Shurob HPP (early planning stage)
- HPP cascades u/s of Rogun HPP on Obihingou and Surkhob rivers (early planning stage)
- HPP cascade on Pyanj River (early planning stage)
- Irrigation in Tajikistan (planning stage)
- Qosh Tepa Canal, Afghanistan (under construction)
- International Highway (Vakhdat – Jirgital, M41) (under construction)
- 500 kV TLs for Rogun (existing / under construction)
- Central Asia – China gas pipeline (early planning stage)

The first seven in this list are projects directly related to water, while the remaining three are projects of different types with potential cumulative impacts with Rogun HPP. One main environmental driver in addition to impacts caused by any of these projects is climate change, which in relation to future developments concerning water availability and distribution plays a major role.

Following the identification of these projects and the main VCs, Chapter 5 defines the AoI for the CIA. Conclusions here:

- **The Area of Influence for the CIA is the entire Amu Darya basin, with the Vakhsh catchment and the area downstream of the Pyanj-Vakhsh confluence, i.e. the Amu Darya, as the central parts.**
- **The Cumulative Impact Assessment (CIA) is necessarily also a Transboundary Impact Assessment (TBIA), called here Transboundary Cumulative Impact Assessment (TCIA)**

The main part of the TCIA is the assessment as such of the cumulative impacts. This is done in Chapter 6, whereby for each of the other projects listed above a description is provided, followed by identification and discussion of the cumulative impacts, or an explanation why there will be no such impacts. The main conclusions from the detailed discussions of potential cumulative impacts are summarised shortly in Chapter 7, which is reproduced here:

Pipeline

Definition: The Central Asia-China Gas Pipeline is planned to pass north of Rogun reservoir. No detailed information on this project, which is presently on hold, is available.

Interactions and Cumulative Impacts: cumulative impacts with Rogun can be excluded. One information received is that there would be a possibility for the pipeline to follow more or less the alignment of the replacement road. Should this be the case, then this latter might provide access to some construction sites of the pipeline, in this way reducing the overall impact of these structures to some extent.

Conclusions: No relevant cumulative effects, no mitigation measures required.

Transmission Lines and Road Projects

Definition: This includes a number of linear structured of two different types, namely, 500 kV transmission lines built for Rogun and/or as part of the CASA 1000 Project, and two road projects not related to Rogun HPP; see Section 6.9; for details.

Interactions and Cumulative Impacts: There was a concern about a potential conflict between resettlement villages (resettlement triggered by Rogun HPP and therefore part of the Project) and the land requirements for these linear structures. The main concern was that in an extreme case this could mean that households that had been resettled because of Rogun HPP would have to be relocated again because of one of these TL or road projects. As explained in Section 6.9, the two roads in question have been built, and the alignment of the TLs, as far as they have not yet been built as well, is known. There is no conflict with any of the Rogun-related resettlement areas.

Conclusions: No cumulative impacts, no mitigation measures required.

New Main Road

Definition: The existing road along Vakhsh River in the area of the Rogun reservoir will be submerged during the process of reservoir impoundment. Impoundment has started already and is planned to continue till approximately 2037, when the reservoir will reach its FSL. The road needs to be replaced, and this replacement consists of the following main parts: (i) new main road which provides access to the Garm region, to GBAO and to the border with Kirgizstan, (ii) new main bridge crossing the river (or, finally, the reservoir), and (iii) local access roads to villages on both banks of the river/future reservoir, which lose their present access. The new main road as well as the new bridge are being developed as separate projects with separate financing and are therefore considered as separate projects, to be included in the CIA.

Interactions and Cumulative Impacts: Construction of the new main road in the very rugged terrain along the Northern (right) bank presents a risk of causing additional sediment input into the reservoir. However, since road construction does not take place in the immediate vicinity of the reservoir, this risk is considered as real, but minor and manageable. Another issue is accessibility: the existing road has already been affected by the increasing reservoir water level, and in three places temporary roads had to be built for allowing access to the upper parts of the valley. The ongoing resettlement process for Rogun depends on this access. Should the reservoir interrupt the existing road before the new one is available, the resettlement process could not go on.

On the other hand, reservoir filling would not be possible to continue if resettlement had not been done. A delay in reservoir filling could be a problem for the Project since the amount of water that can be retained annually is strictly limited by the relevant water allocation agreements. This means that there is a clear interdependence between reservoir impoundment, resettlement and road construction.

Conclusions: Construction of the new main road is finalised, the road is open for traffic since early 2025; the construction of the main bridge will follow later, reservoir impoundment has not reached that level yet. There is no risk of blocked access to resettlement sites due to submersion of the old road.

Qosh Tepa Canal

Definition: The Qosh Tepa Canal is a project of a large irrigation canal which will derive water from Amu Darya with the aim of irrigating up to 600,000 ha in Afghanistan. Only limited information on this project is available. 100 out of the planed 285 km are built. The canal is expected to derive about 5 km³ of water per year, but depending on source it has the capacity to derive as much as 10 to 20 km³ annually; see Section 6.7 for details.

Interactions and Cumulative Impacts: The canal, located downstream of Rogun HPP, has no impact on this latter, and Rogun HPP, which will be operated under the accepted water allocation rules, will not have any impact on the canal. However, the canal will interfere with water availability in the downstream area (Turkmenistan and Uzbekistan). Rogun HPP has the potential to make additional water available in exceptionally dry years, and the Qosh Tepa canal and the irrigation schemes alimented by it would benefit from this.

Conclusions: Qosh Tepa canal is developed without any relation with Rogun HPP, this latter Is not connected in any way with the canal, and no cumulative impacts are to be expected between Rogun HPP and the Qosh Tepa Canal. However, since both projects are related to the very relevant question of water availability and water allocation in the Amu Darya basin, the canal needs to be included in the discussions on water distribution. In this context it also has to be pointed out that Afghanistan is not a member of the organisations regulating water allocation in the basin.

Irrigation in Tajikistan

Definition: So far, Tajikistan does not make complete use of the water allocated to it by the relevant international agreement, mainly Protocol 566; in an average year, about 1.2 km³ (corresponding to about 6% of the average annual flow of Vakhsh River or 2% of average annual flow of the Amu Darya) are not used so far and are therefore available further downstream. Tajikistan plans to use this water for filling Rogun reservoir, a process which has started already. Once the reservoir is full, expected for 2037, Tajikistan will use this surplus water for expanding its irrigation activities located downstream of Nurek.

Interactions and Cumulative Impacts: In any case, Tajikistan intends to make use of the full share of water allocated to it under Protocol 566, and it is committed to remain within the limitations of the protocol also for filling and operating Rogun HPP.

Conclusions: There will be no change in water availability in the downstream area which would not be within the limitations defined by Protocol 566.

Pyanj HPP Cascade

Definition: There is a plan for developing a cascade of HPPs on the Pyanj River, which, if implemented completely, would consist in 15 HPPs with a total capacity of 17,900 MW and a cumulative storage volume of 32.5 km³. None of these potential HPPs is in an advanced planning stage as yet, and it is very unlikely that any one of these would be developed before the finalisation of Rogun HPP. Pyanj forms the border with Afghanistan, which means that these projects would have to be developed as bi-national endeavours.

Interactions and Cumulative Impacts: Since Rogun HPP and the Pyanj cascade are on different rivers, there would not be any direct interactions between the two. However, since they are both located in the headwaters of the Amu Darya, adding this cascade (or relevant parts of it) to the system would increase the potential for influencing water availability in the downstream area.

Conclusions: A potential cumulative impact of Rogun HPP with the Pyanj cascade could be an influence on water availability in the downstream area, mainly in Turkmenistan and Uzbekistan, but also in Afghanistan, once Qosh Tepa Canal built. This, however, would become manifest only at some not yet definable point in the future. Still, the fact that such a situation might actually develop just points out the importance of basin-wide agreements on water use.

HPP Cascade Upstream of Rogun

Definition: As for Pyanj, there is a plan for developing two additional HPP cascades on Surkhob and Obihingou, the two rivers which at their confluence form Vakhsh River; combined they would comprise 9 HPPs with a total installed capacity of 5,800 MW and a total storage volume of 3.0 km³. As for the Pyanj cascade, none of these is in an advanced planning stage, and it is not envisaged to go ahead with this development before Rogun HPP will be commissioned and in operation.

Interactions and Cumulative Impacts: Adding these two cascades to the same river system (Vakhsh) would clearly result in a number of cumulative impacts. Since the planned cascades are upstream of Rogun, this latter would not influence them in any way. However, a few points have to be mentioned:

- Hydrology: Surkhob and Obihingou cascades would add additional storage volume to the Vakhsh cascade. It has to be assumed that they would be developed and operated following the same conditions as for Rogun HPP, i.e. without any additional seasonal shift of water and by filling them using the available water volume according to Protocol 566; therefore, they would not in any way negatively impact water availability along the Amu Darya. On the other hand, the additional storage once filled this would increase the potential for releasing water in extremely dry summers, which would definitely be a positive effect on water use along the Amu Darya.
- River habitat fragmentation: The lower reaches of Vakhsh River were already fragmented by Nurek dam and the HPPs downstream of Nurek, and Rogun HPP adds to this by creating an additional barrier and by fundamentally changing habitat conditions on the entire length of its reservoir. Presently, there is no information available on the value of Surkhob and Obihingou as aquatic habitat, but building these additional dams would add to river fragmentation.
- Floodplain submersion: The filling of Rogun reservoir will submerge two floodplains considered as natural habitats. Adding the Surkhob cascade would have a negative impact on the numerous floodplains along this river, a cumulative impact with Rogun HPP.
- Sedimentation: Additional dams upstream of Rogun would mean additional storage room for sediments. This would have the positive effect of reducing the amount of sediment reaching Rogun reservoir, thereby increasing the potential life span of Rogun HPP, and indirectly also the potential life span of Nurek HPP. The overall cumulative effect on the entire Vakhsh cascade would be positive.

Conclusions: There would certainly be cumulative impacts of Rogun and the two upstream cascades, neutral (or slightly positive) concerning hydrology, negative concerning biodiversity and aquatic habitats, and positive concerning sedimentation and overall life span of the Vakhsh cascade.

Shurob HPP

Definition: Shurob HPP is planned to be built once Rogun has reached the operation stage, with a dam and power house with 850 MW installed capacity at the upper end of Nurek reservoir and a reservoir reaching the toe of Rogun dam. It would use the water released from Rogun and the remaining head between the two large HPPs; see Section 6.3 for details.

Interactions and Cumulative Impacts: Shurob cannot be built without Rogun, as otherwise its small reservoir would be filled with sediment very quickly. Once Rogun in place, the water released from the dam will be almost free of sediments. Shurob reservoir will impound the remaining 17 river km between Rogun HPP and Nurek reservoir. However, this impact is considered as very minor, since this is a short and completely isolated river stretch which in addition to that will be exposed to the regime dictated by the operation pattern of Rogun HPP, which will at least to some extent be a peaking pattern. One additional at least marginally positive effect would be that it will offer job occasions during construction, where at least some of the workers who will lose their job at the end of construction activities for Rogun could find a new source of income. There would be no competition for workers between the two, since there will be no overlap of the two construction phases.

Conclusions: Shurob, in all likelihood, will be a low-impact addition to the Vakhsh cascade, and it will contribute substantially to electricity supply. No negative cumulative impacts are expected.

Vakhsh Cascade Downstream of Rogun

Definition: Rogun HPP will be a major addition to the cascade on Vakhsh River, which as of now consists of one large storage scheme, Nurek HPP, and a cascade of smaller, basically ROR schemes downstream of it; see Section 6.2 for details.

Interactions and Cumulative Impacts: Given the proximity of Rogun to the downstream cascade (same valley, same river, short distance), potential cumulative impacts have to be analysed carefully. Main facts and conclusions are the following:

- Hydrology, yearly flow pattern: as all large storage dams, Rogun has the potential to retain water during the high-flow season for using it for electricity generation in the low-flow, high-demand season. This would be to the detriment of downstream water users who have to rely on water for irrigation, with a high demand in the growing season. Tajikistan has committed itself to build and operate Rogun HPP respecting the agreed-upon rules for water allocation and water use among the riparian states in the Amu Darya basin, and especially Turkmenistan and Uzbekistan. This means that Tajikistan will not use more water than allocated to it under Protocol 566, and it will not shift water from summer to winter in addition to the 4.2 km³ already shifted by Nurek; this quantity corresponds to the live storage volume of Nurek and can be retained only after a winter reservoir drawdown to the Minimum Operation Level (MOL) of Nurek reservoir. The change in the cascade with Rogun HPP will be that yearly regulation will be done largely by Rogun, while Nurek reservoir will be kept at a more or less stable level throughout the year. Overall, this clearly means that for downstream water users the situation with Rogun HPP in place will not change; see also ESIA Vol. 1,. Ch. 13, Water.
- Hydrology, short-term fluctuations: in addition to seasonal storage, hydropower plants also have the potential for changing production very quickly (peaking regime). This allows the utility to very closely follow demand, which as a rule is not constant during the day, but usually follows a distinct pattern with times of high demand and times of low demand. This plasticity in production can be a problem for the river and its surroundings, including people living along and close to the river, since it can mean very marked short-term variations in river discharge and flow velocity, which has a potentially very negative impact on aquatic habitats and can be a safety risk for people. In the case of Rogun, however, it has to be pointed out that the area between Rogun dam and Nurek reservoir is not inhabited or used by people in any way and that therefore there is no safety risk for people, and that the value of this part of the river as habitat for aquatic organisms is very low (see ESIA Vol. 1, Ch. 15, Biodiversity). Presently, seasonal as well as daily peaking is done by Nurek. Once Rogun operational, this will be assumed by Rogun at least to some extent. Nurek will still have to do some daily peaking, following the operation pattern of Rogun. The smaller schemes downstream of Nurek, which have only small (hourly or at most daily) regulating capacities, will in turn follow this pattern, smoothing out the short-term fluctuations in the process. At the downstream end of the cascade, river flow is constant with small if any daily fluctuations. The situation with Rogun in place will be the same as today.
- Riverine and aquatic habitats: Construction of Nurek dam and HPP changed the situation in Vakhsh River considerably, mainly in three respects:
    - As mentioned, Nurek shifted 4.2 out of the 20 km³ flowing on average annually in Vakhsh River from summer to winter, in this way reducing the seasonal difference between the high- and the low-flow seasons, reducing the former and increasing the latter.
    - Nurek reservoir retains all the sediments transported by the river. The water downstream of Nurek is largely devoid of sediments.
    - Like all storage reservoirs, Nurek reservoir also has a capacity for flood regulation. This means that flood events are smoothed out a least to some extent, especially by reducing peak flows during floods.

  These changes had a considerable negative impact on one important semi-aquatic habitat, namely the floodplain and Tugai vegetation in Tigrovaya Balka, since this habitat type largely depends on seasonal changes in water discharge and therefore water level, on sediment dynamics, and on occasional flood events. One additional negative impact of Nurek and the downstream cascade on biodiversity was the fact that any long fish migrations between the Amu Darya and the upper reaches of Vakhsh River, which under natural conditions may have been quite important, were completely interrupted.

  Rogun may have added to a small extent to a further reduction in short-range fish migrations from Nurek reservoir upstream. Other than that, the situation in the downstream area, especially concerning Tigrovaya Balka and fish migrations, will not be changed due to Rogun.
- Floods, PMF: Nurek is not able to safely manage PMF (Probable Maximum Flood), however, Rogun HPP was designed in a way as to be able to do so. This is a considerable improvement in risk management for the downstream area, reducing the risk of a dam break and its potentially disastrous

consequences in this whole area. This is a very relevant positive cumulative impact of Rogun HPP with the downstream Vakhsh cascade, which may become even more important in the future, since under the conditions of climate change there is a risk of more marked and important short-time changes in river flow which may result in floods. Details for this still need to be evaluated and described in an Emergency Preparedness Plan (EPP). The draft EPP for the dam with crest elevation at 1110 m asl was submitted on February 29, 2024. The EPP for the full dam is in preparation, and it will need to be in line with the current EPP study for the Vakhsh cascade (DSPOE presentation, Almaty Riparian Meeting of Nov. 8-9, 2023).

- Sedimentation: Rogun will retain sediments, in this way avoiding accumulation of additional sediment in Nurek reservoir. This will increase the total life span of Nurek HPP, a positive effect on the entire Vakhsh cascade.
- Joint operation of Rogun and Nurek HPPs will also increase electricity generation in Nurek to some extent; this is mainly due to the fact that there will no longer be a marked drawdown of Nurek reservoir in winter, thus allowing to benefit from the additional head.
- The addition of Rogun HPP to the Vakhsh cascade offers the potential to deliver additional water to the downstream area in the case of exceptionally dry years; this would be a considerable positive effect.

Conclusions: As main conclusions, the following can be said:

- Operating Rogun and the entire Vakhsh cascade while respecting the conditions defined in Protocol 566 concerning water allocation, and especially by not shifting additional water from summer to winter will prevent any negative cumulative impacts on water users in the downstream area.
- The overall joint operation of the cascade will not lead to additional negative impacts on aquatic habitats and related biodiversity in the downstream area (especially: Tigrovaya Balka and fish migrations).
- The fact that Rogun will be able to handle the PMF is a positive effect for the downstream area by reducing the risk of a dam break event.
- Adding Rogun to the cascade will have a number of additional benefits, namely (i) increasing the life span or Nurek by retaining sediments, (ii) increasing to some extent energy production in Nurek HPP, and (iii) giving the possibility of releasing additional water to the downstream area in the case of dry summers. Obviously, the main effect of Rogun HPP will be to add a very considerable amount of electricity to the grid, without using additional water. This will be a benefit for all consumers of electricity in the country, and potentially beyond, by contributing to the Central Asian grid.

Overall, it can be concluded that there will be no negative impacts, but some improvements in the downstream area, due to the cumulative effects of Rogun HPP with the Vakhsh cascade.

Concerning the three aspects related to biodiversity it can clearly be stated that Rogun HPP will not change the situation as compared to what it is now. This is shortly discussed in Chapter 8. The main point here is that Rogun HPP will be operated within the conditions defined in agreement with riparian countries, i.e. without shifting additional water from summer to winter. It also will not change the short-term flow regime in Vakhsh River downstream of the existing cascade.

The final part of the report, Chapter 9, discusses the issue that was identified as the main area of concern in relation to all projects in the water sector in the Amu Darya Basin: availability, use and distribution of water in this area.

In order to take into account and discuss main concerns pronounced by downstream water users, a number of scenarios were developed which show potential outcomes of alternative patterns of water use. These are the following:

- **Scenario 1: present situation.** This is the baseline scenario which assumes that all countries in the Amu Darya basin would continue to use their share of Amu Darya water as they have done so far.
- **Scenario 2: Tajikistan using its full share.** The scenario assumes that Tajikistan will use the full share allocated to it by ICWC/BVO agreements, with the consequence that the 1.2 km³ of water not used so far on average would no longer be available for downstream users. In the scenario it is assumed that Turkmenistan and Uzbekistan would continue to use their share as done so far. Tajikistan has clearly announced, and is entitled, to use its full share. It intends to do so first for filling Rogun reservoir and then for increasing its own irrigated area. This means that this is the situation that will materialise in the

future, in accordance with BVO regulations, and independently of whether Rogun HPP will be built or not.

- **Scenario 3: rapid reservoir filling.** This scenario assumes that Rogun reservoir would not be filled with the water not used so far over a period of up to 16 years, but would be rapidly filled within three years, retaining 3.3, 5 and 5 km³ of water in three consecutive years, afterwards returning to a normal operation pattern as per scenario 2. This would cause severe water shortage in the downstream areas during the three years of filling.
- **Scenario 4: additional shift of water.** Same assumptions as for scenario 3, but in addition to that assuming that, once the reservoir filled, Rogun HPP would shift an additional 5 km³ of water per year from summer to winter, with the aim of maximising winter electricity generation. In addition to the negative effects of the filling period mentioned above, this would result in a situation where summer flow conditions in Turkmenistan and Uzbekistan would change to permanently dry to very dry summers, while winter flow would be increased, largely without any benefit for the two countries.
- **Scenario 5: Qosh Tepa.** Like scenario 4, but assuming that in addition to that Afghanistan would divert a yearly volume of 10 km³ of water through this canal. The result for Turkmenistan and Uzbekistan would be that they would have to face a situation of permanently extremely dry summers like never experienced before. This is the worst case scenario.

Two main aspects have to be pointed out as a result of this scenario analysis:

1. The situation as described in scenario 2 is the one which will materialise as soon as Tajikistan will use its full share of water. This will happen in any case, with or without Rogun. This situation is clearly accepted by and within the ICWC/BVO regulations.
2. Scenarios 3 to 5 describe situations with a degree of impact on downstream water users (Turkmenistan and Uzbekistan) that would clearly not be acceptable. It has to be pointed out that the assumed role of Tajikistan within these scenarios, namely, rapid filling of the reservoir and additional seasonal shift of water, would cause inacceptable negative environmental and socio-economic impacts on the downstream area, with no possibility for mitigation, and that for these reasons none of these scenarios had ever been considered for implementation. In addition, **these would be clear violations of ICWC/BVO agreements**, **while Tajikistan has clearly committed itself to respecting these agreements.** The contribution of Afghanistan to the situation as outlined in scenario 5 however cannot be influenced by ICWC/BVO regulations, since Afghanistan is not a member of these institutions.

The main conclusions therefore are the following:

- Under changing climatic conditions, storage of water for being able to make use of excess water in extremely wet years and to face droughts in exceptionally dry year, both of them situations expected to become more severe in the future, may get increasingly important.
- It may also be required to add additional storage capacity to the system for increasing its flexibility and potential to react.
- Such increased storage and water regulation capacity would also require agreements for refilling storage after an exceptional drawdown.
- International regulating bodies, in this case ICWC/BVO, and their agreements will play an increasingly important role.
- It will certainly get increasingly important to have all interested parties, i.e. all riparian states, included in any agreements concerning the use of wate resources.

This last point is of special importance. Presently, ICWC/BVO for the Amu Darya basin includes Kirgizstan, Tajikistan, Turkmenistan and Uzbekistan. Afghanistan should be included in future agreements on the use of this important common resource.

1 INTRODUCTION

1.1 Purpose of the Report

The 2014 TEAS and ESIA (Pöyry, 2014) had shown that it is possible to operate Rogun HPP in a way as not to change flow characteristics in Vakhsh River downstream of Nurek HPP and the existing Vakhsh cascade, and mainly without shifting additional water from summer to winter. The operation of Nurek HPP had led to a shift of 4.2 km³ of water from the high flow season (summer) to the low flow season (winter). An additional shift would not have been in the interest of the downstream riparian countries, since they need the water in summer for irrigation, and the possibility for retaining additional water in summer in Rogun reservoir was a main concern of the countries who would have been affected in that case. However, the studies mentioned had shown that with Rogun HPP in place there would be no such change, and therefore no (negative) impact on downstream conditions and water users. Tajikistan committed itself to operate Rogun HPP according to these conditions, keeping its water use within the agreement with the riparian states, namely the Protocol 566, which defines the annual amount of Amu Darya water available to each country. Therefore, the conclusion was that there will be no impact downstream of Nurek due to Rogun, and therefore no risk of a cumulative impact. The updated ESIA prepared by WSP is based on this commitment by Tajikistan.

However, it then turned out, especially in the meetings with downstream riparian countries in which several CSOs and NGOs participated, that this was not considered as satisfactory, since concerns were voiced about potential cumulative impacts that might materialise in spite of this situation. For this reason it was decided to extend the scope of the CIA to be prepared as part of the updated ESIA.

It is therefore important for the CIA to focus not only on given or verified project impacts and their possible cumulative effects with other projects, but also to look at relevant topics where, under changing conditions, there might be a potential for cumulative impacts, and/or there are concerns uttered by stakeholders that this might be the case.

1.2 Rationale for Carrying Out a CIA

This Section just provides a short description of the reasons why a CIA has to be prepared; for a list and discussion of the guidelines and standards to be followed refer to Chapter 2.

IFC (2013) describes and defines the CIA as follows:

- CIA is the process of (a) analyzing the potential impacts and risks of proposed developments in the context of the potential effects of other human activities and natural environmental and social external drivers on the chosen VECs (Valued Environmental Components) over time, and (b) proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risk to the extent possible (IFC 2013:21).
- The key analytical task is to discern how the potential impacts of a proposed development might combine, cumulatively, with the potential impacts of the other human activities and other natural stressors such as droughts or extreme climatic events (IFC 2013:21).
- Cumulative impact assessment and management is appropriate whenever there is concern that a project or activity under review may contribute to cumulative impacts on one or more VECs (IFC 2013:23).

The World Bank definition is slightly different, since it says the following:

- The cumulative impact of the project is the incremental impact of the project when added to impacts from other relevant past, present and reasonably foreseeable developments as well as unplanned but predictable activities enabled by the project that may occur later or at a different location . Cumulative impacts can result from individually minor but collectively significant activities taking place over a period of time . The environmental and social assessment will consider cumulative impacts that are recognized as important on the basis of scientific concerns and/or reflect the concerns of project-affected parties . The potential cumulative impacts will be determined as early as possible, ideally as part of project scoping (WB 2017:18).

Both definitions emphasise the fact that cumulative impacts can arise when the development or project in question has impacts which in turn might interact in any way with impacts caused by other developments or projects, and that the CIA has to focus on these cumulated effects or, as the WB puts it, on the incremental

impacts resulting from these interactions. The 2014 ESIA has shown that there is a possibility for operating Rogun HPP in a way as not to change water availability and seasonal distribution in the downstream area. This operating pattern was adopted by Tajikistan, since it means that the international agreements of water use and allocation in the Amu Darya basin will be respected. The conclusion of this is that Rogun HPP will not have any negative impact on the regionally most important of all VECs which could be affected, namely, water availability in the Amu Dary basin. It could therefore be argued that no CIA is required for Rogun HPP.

However, both definitions given above include one additional relevant condition for carrying out a CIA, namely "concern that a project or activity under review may contribute to cumulative impacts" (IFC) and "cumulative impacts that are recognized as important … and/or reflect the concerns of project-affected parties" (WB). The riparian consultations organised by WB in the context of the further development of Rogun HPP have shown clearly that, in spite of the results of the ESIA, there are concerns about water availability in the downstream area, since Rogun HPP could potentially also be operated in a different way, meaning that there are potential impacts which have to be considered. Therefore, a CIA is required for Rogun, and the focus has to be on water. Since the vast majority of water users downstream of Rogun and the entire Vakhsh cascade are other countries, namely, Afghanistan, Turkmenistan and Uzbekistan, this CIA necessarily is also a Transboundary CIA.

2 RELEVANT STANDARDS AND GUIDELINES

2.1 Applicable Standards

The applicable international standards for the CIA according to the Terms of Reference, namely the CIA Handbook of the International Finance Corporation (IFC, 2013) and the Environmental and Social Standards (ESS) of the World Bank are described shortly in Table 2-1.

Table 2-1: Relevant standards and guidelines

Editor	Title	Date	Comments
IFC	Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets	2013	Provides guidance for the preparation of a CIA; asks for CIA to be done according to IFC's Performance Standards (PS), which makes these PS relevant even though IFC is not involved in the project. To be used as the main guidance document according to the TOR.
IFC	PS1: Assessment and Management of Environmental and Social Risks and Impacts	2012	Applicable. "Affected communities, reduction of water flows in watershed due to multiple withdrawals," have to be considered in the CIA covering the Amu Darya basin.
IFC	PS5: Land Acquisition and Involuntary Resettlement	2012	Applicable. Potential land acquisition and land use conflicts between the resettlement program for Rogun HPP and other projects.
IFC	PS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	2012	Applicable. Ecosystems services, protection and conservation of biodiversity can be disturbed by the river flow fluctuations downstream of Rogun HPP and affect the whole Amu Darya basin. Those effects are cumulative in case of hydropower developments in the Amu Darya basin.
IFC	PS7: Indigenous Peoples	2012	Not applicable. No populations that have to be considered or consider themselves as indigenous or ethnic minorities identified in the wider project area.
IFC	PS8: Cultural Heritage	2012	Applicable. Risk to cultural heritage due to floods in case of dam failure.
WB	ESS1: Assessment and Management of Environmental and Social Risks and Impacts	2017	Applicable. The Rogun HPP project potentially affects a broader area than the hydropower installations of the project. Focus required on the Amu Darya Basin.
WB	ESS2: Labor and Working Conditions	2017	Not applicable. Workers' condition and health and safety need to be dealt with as part of the ESIA and ESMP for Rogun HPP project.
WB	ESS3: Resource Efficiency and Pollution Prevention and Management	2017	Applicable. Efficient use of one key resource in Central Asia, water for energy generation, irrigation, drinking and other uses is a major concern.
WB	ESS4: Community Health and Safety	2017	Applicable. Potential cumulative impacts on water quality and their indirect effects have to be considered.
WB	ESS5 : Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	2017	Applicable. TL development for Rogun HPP could create conflicts with resettlement (same as PS5).
WB	ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	2017	Applicable: same as PS6.
WB	ESS7: Indigenous Peoples	2017	Not applicable: same as PS7 .
WB	ESS8: Cultural Heritage	2017	Applicable: same as PS8..
WB	ESS9: Financial Intermediaries	2017	Not applicable. Bank funding is not being provided to financial institutions for further on-lending within the Rogun HPP project.
WB	ESS10: Stakeholder Engagement and Information Disclosure	2017	Applicable. Stakeholder engagement on the national and international level (riparian meetings as initiated by WB and PMG; ICWC/BVO for water allocation in the Amu Darya basin) need to continue.
AIIB	ESF	2022	The ESF asks for assessments including "direct, indirect, and cumulative Project-related impacts". p. 19: "On a case-by-case basis and in consultation with the Client, the Bank may require the Client to undertake a

			strategic, sectoral or regional assessment, a cumulative impact assessment or other specialized assessment, for the Project."
ADB	Safeguard Policy Statement	2009	General requirement to include "potential direct, indirect, cumulative and induced environmental impacts and risks". p. 16: "Conduct an environmental assessment for each proposed project to identify potential direct, indirect, cumulative, and induced impacts and risks to physical, biological, socioeconomic (including impacts on livelihood through environmental media, health and safety, vulnerable groups, and gender issues), and physical cultural resources in the context of the project's area of influence. Assess potential transboundary and global impacts, including climate change. Use strategic environmental assessment where appropriate." p. 31: "Impacts and risks will be analysed in the context of the project's area of influence. This area of influence encompasses (i) the primary project site(s) and related facilities … (ii) associated facilities that are not funded as part of the project (funding may be provided separately by the borrower/client or by third parties), and whose viability and existence depend exclusively on the project and whose goods or services are essential for successful operation of the project; (iii) areas and communities potentially affected by cumulative impacts from further planned development of the project, other sources of similar impacts in the geographical area, any existing project or condition, and other project-related developments that are realistically defined at the time the assessment is undertaken; and (iv) areas and communities potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location".
EIB	The EIB Group Environmental and Social Policy	2022	This EIB document stresses the need for addressing issues related to environmental and social impacts resulting from project and the requirement for carrying out ESIAs for such projects, without however providing detailed guidelines or standards to be observed for such studies. It does not specifically mentions cumulative impacts.

Taking into account that in addition to World Bank a number of other bi- and multilateral financing institutions are involved in the financing of Rogun HPP or projects closely related to it (e.g. transmission lines, replacement road) the SEP lists the following guidelines and standards as relevant for Rogun HPP:

- World Bank: Environmental and Social Framework (2018) and World Bank Group General Environmental, Health, and Safety Guidelines (2007);
- Asian Development Bank: Safeguard Policy Statement (2009) and associated safeguard documents;
- Asian Infrastructure Investment Bank: Environmental and Social Framework (2019, 2021 and 2022);
- The European Investment Bank (EIB) Environmental and Social Framework (ESSF), consisting of the E&S policy (2022) and revised E&S standards (2022); and the EIB Environmental, Climate, and Social (ECS) Guidelines on Hydropower Development (2019);
- Islamic Development Bank: Sustainable Development Goals;
- Eurasian Development Bank and Eurasian Fund for Stabilization and Development: Environmental and Social Responsibility Policy;
- Saudi Fund for Development; and
- Kuwait Fund for Arab Economic Development.

Even if these institutions do not have specific CIA guidelines, they mention the necessity to include cumulative impacts in a comprehensive environmental assessment, although not necessarily as a separate process.

2.2 CIA: Definitions

Definitions of CIA:

- IFC (2013:21), "CIA is the process of (a) analysing the potential impacts and risks of proposed developments in the context of the potential effects of other human activities and natural environmental and social external drivers on the chosen VECs over time, and (b) proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risk to the extent possible."
- WB (2016: 23),p. 23: "Cumulative Impact Assessment is an instrument to consider cumulative impacts of the project in combination with impacts from other relevant past, present and reasonably foreseeable developments as well as unplanned but predictable activities enabled by the project that may occur later or at a different location." p. 18: "The cumulative impact of the project is the incremental impact of the project when added to impacts from other relevant past, present and reasonably foreseeable developments as well as unplanned but predictable activities enabled by the project that may occur later or at a different location. Cumulative impacts can result from individually minor but collectively significant activities taking place over a period of time. The environmental and social assessment will consider cumulative impacts that are recognized as important on the basis of scientific concerns and/or reflect the concerns of project-affected parties. The potential cumulative impacts will be determined as early as possible, ideally as part of project scoping".
- AIIB, 2022 ESF, p. 82: "Cumulative impact assessment is the assessment of the impact on the environmental or social conditions, which results from the incremental impact of an action when added to other past, present or reasonably foreseeable actions, regardless of what agency or person undertakes such actions. Cumulative impact can result from individually minor but collectively significant actions taking place over a period of time".
- ADB: guidelines do not give a definition of cumulative impact assessment, but in 2022, p. 122, under the heading "Cumulative Effects and the Environmental Assessment Process" point out the importance of "identifying relevant past, present, and future actions. By evaluating resource impact zones and the life cycle of effects, rather than projects, the boundaries of cumulative impact assessment can be properly defined."

2.3 CIA Procedure According to IFC

The IFC CIA Handbook (IFC 2013) lists the following steps as essential for the preparation of a CIA:

Step 1: Scoping Phase I – Identify VCs, Spatial and Temporal Boundaries

The identification of VCs was based on primary and secondary data gathered during the ESIA process, whereby it has to be noted that both the 2014 (Pöyry 2014) and the updated (WSP 2025) ESIA Reports were considered. In the Central Asian context, water (water quantity, availability and seasonal distribution; see Section 4.1.1 for a more detailed discussion) is the one VC of overarching importance. Spatial boundaries for the CIA are not necessarily limited to the AoI defined for the ESIA; if in a combination with other projects there is a potential for cumulative effects becoming manifest outside of the ESIA AoI, or if relevant stakeholders utter concerns that this may happen, it is required for the CIA to expand the area of (potential) influence accordingly. The temporal boundaries of the CIA were defined by the expected life span of the Project.

Step 2: Scoping Phase II – Other Activities and Environmental Drivers

As defined by WB (2016:23), the CIA, in addition to impacts caused by the Project has to include "relevant past, present and reasonably foreseeable developments as well as unplanned but predictable activities enabled by the project that may occur later or at a different location". It was therefore necessary to extend the scoping for other such developments (in this report usually referred to as "other projects" independently of their actual stage of development) or other environmental drivers. The most important of these latter is climate change, including potential relevant secondary effects this may have in the wider project area, mainly on water quantity and seasonal distribution as well as on erosion and therefore on sedimentation.

Step 3: Establish Information on the Baseline Status of VCs

Baseline Status of the VCs was based on the baseline data that was collected during the ESIAs, supplemented with additional information, where required and available, that was collected specifically for the CIA.

Step 4: Assess Cumulative Impacts on VCs

Impact assessment focuses on interactions between different projects, or more specifically, between, Rogun HPP and any of the other projects and their respective impacts. Additional explanations on this point are provided in Section 3.1.1.

Step 5: Assess Significance of Predicted Cumulative Impacts

The significance of a cumulative impact will be evaluated in a descriptive and qualitative way. It has to be stated clearly that for the other projects information availability is often restricted, (very) preliminary or at a general level, and precise (quantitative) information is often lacking; this is the case especially for projects which presently are in an early planning stage. This does not make them any less relevant for getting a picture for potential future developments, but there are too many uncertainties as to allow a reasonably precise prediction of a future situation.

Step 6: Management of Cumulative Impacts – Design and Implementation

Where significant – or, in this case more likely – potentially significant impacts are identified, mitigation measures will have to be developed. Sinc the CIA is at a different level as the project-specific ESIA, these mitigation measures will usually not reach the degree of detail that would be expected in a project-specific ESMMP, they will mostly be at a much more general level. One important difference can be pointed out here already: while in the case of an ESMMP the responsibility for implementing the mitigation measures will mostly be the Project Proponent's, may it be directly or indirectly, e.g. by obliging the contractor to take measures and respect standards, in all likelihood in the case of mitigation measures for cumulative impacts, implementation will not be within the capability and authority of the Project Proponent.

3 BOUNDARY CONDITIONS FOR THE CIA

3.1 Stepwise Approach Chosen

The list of steps to be taken in a CIA according to IFC as described shortly above is a useful guideline inasmuch as none of these points can be ignored. In practice, however, it may not always be possible or advisable to take these steps as a rigid rule which needs to be followed point by point. It is therefore necessary to give some additional explanations on the approach specifically chosen in the present case.

3.1.1 Basic Considerations

A few basic considerations concerning scope and limitations of a CIA are shortly presented hereunder:

- The central part of a CIA is the project which is the subject of the ESIA, in this case Rogun HPP (the Project).
- The focus of the CIA is on potential mutual interactions of this Project with other projects, activities or developments; these interactions can be mainly of the following forms:
    - the Project has an impact on any of these other developments;
    - other developments have an impact on the Project, or
    - impacts stemming from the Project interact with impacts stemming from other developments, mutually reinforcing the effect, reducing it or leading to additional indirect impacts (whereby it should be kept in mind that “impact” can mean negative, undesirable, as well as positive, beneficial effects).
- Projects, activities or developments to be included in the CIA (in this report usually referred to as “other projects”) cannot be defined too narrowly; in fact, this should include existing structures and projects under construction as well as plans, development intentions (in the sense of “projects in the pipeline”) etc., i.e. “relevant past, present and reasonably foreseeable developments” as per the WB definition given above.
- The time span to be considered also needs to be rather long-term. According to IFC (2013: p. 35, Box 7), the complete life cycle of the proposed development (in this case Rogun HPP) needs to be covered. This means that projects which might be developed in the future, i.e. reasonably foreseeable, will have to be included, even if there is not much detailed information on them available as yet, and even if it is uncertain when, if ever, some of them will potentially be implemented.
- This means that some of these other projects may not (or not yet) be well defined, their implementation potentially at some as yet unknown point in the future. For such types of developments, there might not yet be more than a general idea of what their potential impacts would be. This also limits the assessment of magnitude and exact importance of cumulative impacts resulting from them.
- Impacts to be considered are those which have been identified and assessed as relevant in the ESIA for the Project, as long as there can possibly be any cumulative impacts, but should include, according to the WB definition, “concerns of project-affected parties”, even if it seems clear from the start that such impacts might be minimal.
- Given the scope of projects included, it will often not be possible to propose very well-defined mitigation measures, especially if such measures may be required, if ever, only at some point in the future.
- It has also to be pointed out very clearly that the proponent of the Project, in many if not in most cases of cumulative impacts, will have limited or no possibilities to implement mitigation measures, since responsibilities will be shared, or will be on an entirely different level.

3.1.2 Specific Approach

Some general comments on the requirements and limitations for a CIA were made above. Here, specific conditions for the CIA for Rogun HPP are outlined.

While an ESIA focuses on one specific project and aims at identifying all impacts to be expected and to assess them in detail, the focus of the CIA is on receptors (also called Valued Components, VCs) which can be affected by different projects and where the combined impacts from these different projects could have a cumulative

effect; such a cumulative effect can potentially be of different types, like mutually increasing, mitigating or resulting in indirect impacts which would not become manifest without the interaction of different projects.

However, in most cases, as certainly in this one, the central point of attention is still the project in question, i.e. Rogun HPP (the Project). This clearly means that there can only be cumulative impacts on receptors where the Project itself has impacts, or has the potential to have impacts. The starting point for assessing cumulative impacts therefore has to be an analysis and evaluation of the impacts caused by Rogun HPP. The selection of receptors or VCs to be included, however, should not be too narrow. Specifically, it seems appropriate to include VCs or impacts which reflect the concerns of project-affected parties, as expressed in WB guidelines, even if the ESIA demonstrates that such impacts will be minimal or non-existent. At the same time, the focus of the CIA will usually have to be on categories of VCs which are defined rather broadly and not too specific, mainly since in most cases there will be no specific impact assessment available for the other projects included in the CIA.

The broad categories of impacts – and therefore of potential cumulative impacts – are shortly discussed here:

- Water: an HPP, and especially one with a large storage capacity, will necessarily have an impact on water (hydrology), and can influence river discharge pattern downstream of the power plant and seasonal distribution of flow. Water availability is a major concern in Central Asia, demonstrated by the importance of agreements between riparian states in the Amu Dary basin. For this reason, water availability is a VC to be considered.
- Biodiversity: every dam project will directly affect a river by creating a barrier, and plants with large storage reservoirs will change living conditions in a number of aquatic as well as terrestrial habitats.
- Socio-economic impacts: mainly two (potential) impacts of HPPs on local and regional socio-economic conditions have to be considered and are often of very high relevance, namely, (i) the effect of improving local economic conditions by providing a large number of income-generating jobs, mainly during the construction period and to a lesser extent during operation, and (ii) resettlement, i.e. the fact that people will suffer physical and/or economic displacement due to the project (ESIA Vol. 1, Ch. 17, Socio-Economy). In this context it also needs to be noted that the main socio-economic effect of an HPP – and the reason for its development – is to ensure a stable and adequate electricity supply (mainly to the population outside of the AOI considered in the ESIA) and, in the case of Rogun, to allow exports to neighbouring countries. This is usually not a direct concern or subject of an ESIA or a CIA, although the ESIA will have to take that into account, e.g. for discussing (potential) effects on GHG emissions.
- Construction-related impacts: a large number of impacts are usually related – and mostly limited – to construction activities, as e.g. noise and air contamination, temporary land use and influx of people from outside.
- Climate change: HPPs can be affected by climate change, usually in the long term, due to changes in precipitation and other conditions affecting water availability (glacier melt). On the other hand, they can contribute considerably to mitigating climate change by replacing fossil fuels for generating electricity; when addressing this, the potential risk of methane production in the reservoir will have to be considered, since in an extreme case this could even outweigh the benefit from fossil fuel replacement.

3.2 Definition of VCs

3.2.1 Relevant Receptors

While it may be useful to think about VCs as a starting point of a CIA, such an early selection should in no case be considered as final and exhaustive. Once the other projects to be included in the considerations have been identified, it is still possible that an issue – which might have to be considered as an additional, not previously identified VC – might appear and will have to be dealt with.

As mentioned above, the most important issue in the wider context of environmental and social impacts in the project area is water. A combined effect of Rogun HPP and other projects related to and influencing water resources might have an impact on water availability in the downstream area, or it may be required to operate them jointly in a way as to mitigate such an impact. The VC or the direct receptor, in this case, would be water (quantity, availability, accessibility), which in turn would affect water uses, mainly irrigation systems in the downstream area, and the population depending on irrigation and therefore on water resources (indirect receptors or VCs).

This means that the VCs should not be too narrowly defined right from the start, since an open mind must be kept for cumulative impacts (and “their” VCs) that may be identified during the process of baseline analysis, project identification and impact assessment.

The following general approach was therefore used for identifying, defining and characterising VCs that might be exposed to cumulative impacts:

- The sensitive receptors (also termed VCs) were identified based on impacts described in the ESIAs, but also depending on types of projects included in the evaluation, on area of (potential) influence for the specific effects identified, and on the situation to be expected there.
- These receptors were not narrowly defined, and they were described to the extent required and possible.
- Impacts are described with sufficient detail, making it clear that e.g. “effects on water availability” could be negative, if volume would be reduced or seasonal distribution changed in an unfavourable way, or could be positive, e.g. by making additional water available for irrigation from storage reservoirs in dry years.

As a conclusion of this it can be stated that the main VC is **Water Availability in the Downstream Area**.

3.2.2 Additional VCs

In the context of developments in the water sector in general, but perhaps regarding the situation in the Amu Darya basin even more so, three issues related more or less directly with biodiversity are often discussed and give rise to concerns, namely:

- the Aral Sea,
- fish migrations, and
- floodplain habitats, especially Tigrovaya Balka.

All three depend on water availability, distribution and use and are directly or indirectly influenced by structures affecting aquatic habitats. For this reason they have to be included among the topics discussed in the CIA.

4 PROJECTS INCLUDED

This Chapter provides the list of projects or other developments that are included in the CIA.

4.1 Projects Related to Water

4.1.1 Importance of Water

Water availability, scarcity and distribution are main concerns in the Central Asia Region. An interstate organisation (ICWC/BVO), including the former Soviet Republics and now independent states Kirgizstan, Tajikistan, Turkmenistan and Uzbekistan regulates water allocation among the states in the Amu Darya basin. One issue of increasing importance is the fact that Afghanistan is not part of these organisations. In addition to hydropower development in Tajikistan, potential increase in water use in the future by Afghanistan could develop into an issue of very relevant proportions. The situation will also be influenced – and may change to a considerable extent – due to the mid- and long-term effects of climate change.

As a short summary of the situation, the following points can be mentioned:

- As extensively discussed in the 2014 ESIA, one main concern of riparian countries related to the development of Rogun HPP was the potential of an additional storage power plant in the upper reaches of the Amu Darya basin to shift water from summer to winter in addition to the volume already shifted by Nurek HPP. This concern is explained by the fact that storage plants retain water in the high-flow season (in this case spring and early summer) for producing electricity in the low-flow season (winter) when the demand for electricity is highest. Such a shift would present a problem for the downstream riparians, who need water mainly for irrigation, i.e. in summer.
- Tajikistan made it very clear that with Rogun HPP in operation the country will continue to respect the international agreements, meaning that it will not use water above the quota allocated to it, and that it will not shift additional water from summer to winter. This was analysed and described in detail in the 2014 studies (TEAS as well as ESIA).
- The updated ESIA compares the present flow situation downstream of Nurek (without Rogun in place) with the situation as it will be with Rogun operating (ESIA, Vol. 1, Ch. 13) and concludes that there will be no significant changes.

While for the ESIA this latter position may be justified, for the CIA it is not sufficient. Even if under the present conditions it is safe to say that Rogun HPP will not have any negative impacts downstream of Nurek HPP, it is still required to carefully analyse the situation, since concerns still remain and since it cannot be excluded that under changing conditions, be it with additional projects to be included in the CIA and/or with changing environmental drivers as e.g. climate change, the situation for Rogun HPP will also change. Therefore it is necessary for the CIA to put the focus on water, i.e. water quantity, availability and seasonal distribution in the downstream area.

4.1.2 Relevance for CIA

Hydrology was an important issue in the ESIAs, and this is also true for the CIA, for the following main reasons:

- Construction and operation of Rogun will have an effect on Nurek, and therefore on the downstream area, by retaining water for reservoir filling and by changing the inflow pattern to Nurk reservoir. What the impact will be depends mainly on the combined operating scheme of the Vakhsh cascade, which needs to be looked at.
- Influence on Amu Darya (d/s of Pyanj/Vakhsh confluence, and to the Aral Sea) is the most important issue in the Central Asian/Amu Darya basin context, and a major concern of relevant stakeholders.
- To be taken into consideration:
    - Entire Vakhsh cascade (knowing that the HPPs downstream or Nurek are comparatively small and basically ROR schemes, without much effect on river flow pattern).
    - Shurob HPP (between Rogun and Nurek, in planning), is a ROR scheme without any influence on flow pattern except in the 17 river km between the two major schemes.
    - Potential for further HPP development u/s of Rogun reservoir, on Rivers Obihingou and Surkhob.

- Projects in the Pyanj catchment, i.e. upstream of its confluence with Vakhsh. Several small projects (Pamir 1, and Sebzor, both operating) are pure ROR and/or too small for having a noticeable influence, but there are at least ideas for additional storage schemes in this area which would have an effect.
- Irrigation in Tajikistan d/s of Nurek: Tajikistan does not (yet) use all the water that in principle is allocated to it, but intends to do so, with effects further d/s.
- The Qosh Tepa Canal, a new irrigation channel in Afghanistan, will take water that will no longer be available for Turkmenistan and Uzbekistan; the role of Rogun might change in the light of that. This 285 km canal project is located in northern provinces of Afghanistan. It proposes to divert water from the Amu Darya River to allow up to 600,000 hectares to be used for agriculture. The proposed location of intake from the river is near Khoshtepa (Afghan/Tajik border).

4.2 Other Projects

A number of other projects, not related to the water sector, may also have, to a degree to be determined, mutual effects with Rogun HPP. The most relevant of these is certainly the replacement road (and related developments), i.e. the International Highway (Vakhdat – Jirgital, M41) Project. This project can be seen – and certainly is – a mitigation measure for Rogun HPP, since the existing main road M41 between Obi Garm (near Rogun dam site) and Nurobod (in the upper part of the reservoir, including the only bridge crossing Vakhsh River) will be submerged by the reservoir and therefore needs to be replaced. However, this is developed as a separate project, with separate financing and under a different organisation (PGM under the Ministry of Transport), and therefore is treated as an additional project for the CIA.

4.3 List of Projects to Be Included in the CIA

Table 4-1 provides the list of projects which are included in the CIA, along with a brief description mentioning potential cumulative effects.

Table 4-1: Projects with a potential for cumulative impacts

No.	Project	Comments
A	**Projects related to water**	
1	Nurek HPP	The Nurek rehabilitation project as such will not have cumulative impacts with Rogun HPP. However, Nurek and Rogun HPPs are mutually interdependent, operation of one having effects on the other one. Any change in operation pattern has a potential for impacts on the downstream area. Nurek HPP will be included in the CIA, not limited to the Rehabilitation Project, but as major part of the Vakhsh HPP cascade d/s of Rogun HPP
2	Vakhsh HPP cascade d/s of Nurek	This part of the cascade consists of several ROR HPPs. None of them has the capacity to influence river discharge, since their storage is daily at most, they depend entirely on water released at Nurek. Still, they form an integral part of the Vakhsh cascade.
3	Shurob HPP	Shurob HPP is intended to be built, once Rogun fully operating, at the upper end of Nurek reservoir, forming a reservoir that will reach the water outlet of Rogun HPP, with the aim of making use once more of the water released from Rogun as well as using the remaining head between Rogun and Nurek. This will completely change the 17 km stretch of Vakhsh River between Rogun dam and Nurek reservoir. However, it has to be taken into account that this part of the river can no longer be considered as being a natural riverine habitat, since it will be or potentially already is an evacuation channel for water turbined at Rogun HPP under at least a part-time peaking regime. Construction of Shurob will certainly create jobs, but there is no temporal overlap with Rogun construction.

No.	Project	Comments
4	HPP cascades u/s of Rogun HPP on Obihingou and Surkhob rivers.	Plan in the conceptual stage for the development of two HPP cascades u/s of Rogun reservoir, with 5 potential dam sites on Obihingou River and 4 on Surkhob River. Anticipated storage volume is rather small (1.55 km³ for Obihingou and 1.45 km³ for Surkhob cascade), meaning a moderate effect on Rogun. However, they would add to the fragmentation of river habitat in the region, possibly add to disappearance of floodplain habitats from Vakhsh valley, and they would provide a certain capacity for sediment retention, thus potentially prolonging the useful life span of Rogun HPP.
5	HPP cascade on Pyanj River.	There is a plan in the conceptual stage (i.e. no project developed any further as yet) for a possible cascade on Pyanj River with sites identified as potential sites for HPPs, some of which with a considerable storage volume. Since Pyanj forms the border with Afghanistan, they would have to be developed as binational projects. There is no intention from the Tajik side to proceed with any of these projects before the construction of Rogun HPP is finished. However, if implemented in the future, this cascade could have relevant implications for the Amu Darya regime, whence a potential cumulative effect with Rogun HPP.
6	Irrigation in Tajikistan	Tajikistan is not yet using its full share of the water allocated to the country. The plan is to use this water now for filling Rogun reservoir and, once the reservoir filled and operating normally, to use it for expanding irrigation d/s of Nurek. In any case, this will have – or already has – an effect in the downstream area. This needs to be verified.
7	Qosh Tepa Canal, Afghanistan	The canal might abduct as much as 10 billion m³/y; this would change the situation in its d/s area (Turkmenistan and Uzbekistan). Such a change might also have repercussions on water allocation agreements in the Amu Darya basin, and might require a reconsideration of the operation pattern of Rogun HPP.
B	**Other projects**	
8	International Highway (Vakhdat – Jirgital, M41)	This road is the replacement road for the one that will be – and partially already is – submerged by reservoir impoundment. This means that it is a compensation measure for Rogun HPP. However, it is being developed as an independent project. Access to the villages in the upper part of the reservoir area is possible only via the existing or the new road. For the reservoir level 1075 m asl (present level) three temporary roads had to be built to replace road sections already submerged, or going to be submerged when the reservoir level will reach 1110 m asl. Resettlement cannot go on without road access, and further impoundment cannot be done without prior resettlement. There is a clear interdependence. Other new roads (continuation of international road after main bridge, where a section will have to be replaced, access road on right bank along upper part of reservoir, access road on left bank of reservoir from main bridge to dam site, individual access roads to villages on the right bank connecting them to the new main road) will also have to be discussed.
9	500 kV TLs for Rogun and CASA 1000	Rogun HPP cannot operate without the TLs in place. In this sense they form an integral part of the Project (corresponding to WB policy). The CIA will have to check whether there could be a conflict of TL alignment with resettlement sites.
10	Central Asia – China gas pipeline	According to DFZ, this pipeline would roughly follow the alignment of the new road. This means that it would be close to the reservoir (with a potential e.g. of additional sediment input into the reservoir). On the other hand, the new road could provide access to construction sites of the pipeline, in this way reducing the overall impact.

5 AREA OF INTEREST FOR THE CIA

5.1 Vakhsh River Catchment

5.1.1 Basic Information

As explained above, the river downstream of Nurek is not considered as an area potentially impacted by Rogun HPP. The ESIA concludes that Tajikistan's commitment to keep their water usage within the annual allocations by ICWC/BVO Rogun HPP will avoid any impacts downstream of Nurek HPP. However, this is the area that has to be of foremost interest for the CIA for the following reasons:

- The river (Vakhsh) between Rogun HPP tailrace and Nurek reservoir will change completely (change in river discharge from natural regime to entirely project-related, with flow changing – in potentially short cycles – between minimum flow and full turbine output; water almost devoid of sediments). Not an impact of relevance, as described in both ESIAs.
- Nurek reservoir: operation mode will change from basically seasonal (strong drawdown in winter) to a type of ROR scheme, with a more or less stable reservoir level, serving to some degree as re-regulation reservoir for Rogun. This can have a positive effect in the downstream area (less fluctuations). TEAS and ESIA (2014) showed that it is possible to operate Vakhsh cascade with Rogun added in a way as not to change downstream flow conditions, and mainly seasonal water distribution. Still, the fact remains that Rogun HPP adds a considerable storage volume to the cascade, which in theory offers the potential to increase water retention in summer. This can explain why there are concerns in the downstream area on this relevant issue, and why therefore this needs to be discussed in detail in the CIA.
- Nurek cannot withstand the PMF; Rogun is able to manage the PMF, in this way protecting Nurek dam. This has to be considered as a major positive effect in the downstream area, especially since a dam break of Nurek would certainly have dramatic impacts beyond the Tajk border.
- Filling Rogun Reservoir (planned for the period of 2019 to approximately 2037) inevitably retains water. Even if this is water allocated to Tajikistan, it is water that before 2019 was not retained by Tajikistan and was therefore available downstream. There is no reason to assume that Tajikistan would not respect international agreements on water allocation, but it is still a change in comparison to the no-Rogun situation.
- During operation, Rogun HPP will seasonally retain the same amount of water as now already retained by Nurek, i.e. 4.2 km^3; no additional water will be shifted from summer to winter. In parallel to that, the operation of Nurek will be changed from a reservoir with seasonal storage and drawdown to one which will be operated as an almost ROR scheme, with very little fluctuations in reservoir volume (see Figure 6-2).
- There is a plan showing the potential further development of hydropower in the part of the Vakhsh catchment upstream of the Rogun reservoir, on the rivers Surkhob and Obihingou. While none of these HPPs is in a planning stage as to be realised soon, they have to be included since there is a potential for their implementation "in the reasonably foreseeable future".
- Water to be used by Tajikistan for filling and operating Rogun HPP: "The Government of Tajikistan's commitments to i) use only the Tajik allocation of water, as fixed by the ICWC in accordance with the existing agreements and ii) to maintain summer water transfer at the same level as is currently being transferred at Nurek." (ESIA, Vol. I, Ch. 6, Table 6-2: Summary of Topics Raised in the Fifth Riparian Information-Sharing and Consultation Session (July 2014)).

5.1.2 Projects Included

In addition to Rogun HPP the following of the projects mentioned above with potential cumulative effects are included in this part of the Area of Influence:

- Existing Vakhsh cascade downstream of Rogun HPP.
- Shurob HPP.
- Cascade upstream of Rogun HPP.
- Irrigation in Tajikistan downstream of Nurek.

5.2 Amu Darya Basin

As discussed in detail in the 2014 ESIA, water is a very important resource in Central Asia. Large storage dams have the potential to influence seasonal flow distribution, which could lead to conflicts between different water users because of different requirements for water (mainly in winter for electricity generation, mainly in spring and summer for agricultural purposes). For this reason, the CIA must put a clear focus on this resource and potential cumulative effects of different projects in the Amu Darya basin.

5.2.1 Situation in the Amu Darya Basin

The Amu Darya is the largest river of Central Asia, and one of the two main tributaries of the Aral Sea. The river is formed by the confluence of its two most important tributaries, the Pyanj and Vakhsh rivers. The Vakhsh contributes an average of about 26 % to the annual Amu Darya flow, and the Pyanj about 40 %. In the Amu Darya, as in both its main tributaries, the flow pattern is highly seasonal, with high flows in summer due to snow and glacier melt in the mountains, and low flow in winter since most of the precipitation in the catchment area falls as snow.

Water abstraction from the Amu Darya, mainly for irrigation, has led to the demise of the Aral Sea during the second half of the 20th century. By far the largest part of total annual flow in the Amu Darya basin stems from the high mountains in Tajikistan, while water requirements for irrigation are highest in Uzbekistan and Turkmenistan (see key figures in Table 5-1). International agreements on water allocation among the countries in the catchment area are therefore essential. Water use is regulated by the Amu Darya basin organisation (ICWC/BVO). The main agreement is the so-called Protocol 566, which defines the percentage each country is entitled to use. Based on this and a forecast of the probable water amount in the next growing season the specific quota are determined yearly. Afghanistan is not a party to these organisations and agreements.

Table 5-1: Origin and use of water in the Amu Darya basin

Country	Contribution to total flow of Amu Darya	Water allocation according to Nukus Protocol 566	
	%	%	km³**
Kirgizstan	2.42	0.6	0.4
Tajikistan	80.15	15.4	9.5
Turkmenistan	3.58	35.8	22.0
Uzbekistan	5.97	48.2	29.6
Total 1	*92.12*	*100*	*61.5*
Afghanistan*	7.88		2.1
Total 2	**100**		**63.6**

* Afghanistan is not an ICWC member. The quantity of water used by Afghanistan included in the Table is based on empirical values.
** The values in km³ per year reflect the situation in an avarage year. The actual amount to be used by each country is determined by an annual forecast of expected water quantities based mainly on assessments of the snow cover in the catchment area.
Source: Mr. Daler Abdurazoqzoda, Head of Energy and Water Policy Department (pers. comm. 2024-03-05).

Nurek HPP, the first large storage hydropower project in the Amu Darya basin, caused a considerable change in the downstream flow pattern mainly by shifting 4.2 km³ of water from summer to winter, in this way reducing the difference between the summer high flow and the winter low flow conditions. Rogun HPP was first conceived in the Soviet Union in the 1950s and 1960s as part of the regional Central Asian development, mainly for providing irrigation water for the cotton producing region in the lower Amu Darya basin, and in addition, like the already existing Nurek HPP just downstream of Rogun, for generating peaking power for the Central Asian grid. The political situation has changed since the independence of the former Central Asian Soviet Republics.

Like every large storage reservoir, Rogun HPP will have the capacity to influence seasonal distribution of river flows in the downstream area. As the 2014 ESIA has shown, it is possible to operate Rogun in a way that will

not negatively affect the downstream riparian countries, and Tajikistan has confirmed that it will continue to respect water distribution according to Protocol 566. A more detailed analysis of this topic is presented in Section 9.7. In addition to that, Rogun improves flood protection in the downstream area, since it is capable to handle the PMF, while Nurek is not designed to handle such a flood and would be at risk. Rogun HPP has also the potential to provide additional water in dry years.

5.2.2 Projects Included

In addition to Rogun HPP the following of the projects with potential cumulative effects are included in this part of the Area of Influence:

- Nurek and Vakhsh cascade downstream of Nurek (existing).
- Shurob HPP (in planning stage).
- HPP cascade upstream of Rogun (in the conceptual stage).
- HPP cascade on Pyanj River (in the conceptual stage).
- Qosh Tepa Canal in Afghanistan (under construction).

5.3 Rogun Reservoir and Surroundings

Here, in addition to Rogun reservoir and the cascade upstream of Rogun already mentioned above, resettlement sites within the upper part of Vakhsh valley, construction of the new main road and the pipeline have to be included.

5.4 Resettlement Sites

According to the ESIA, there is a risk of conflicts of the resettlement program with other projects. Vol. I, Chapter 3 describes this in the following way:

“3.10.9. People in some villages that will be affected by resettlement for the Project, may also be impacted by other projects, including:

- Elements of the CASA-1000 rural electrification project, which required land to be acquired in, among other things, Tursunzoda and Rudaki;
- Obi Garm-Nurobod road project – (ADB & EBRD) required land acquisition in Rogun city and Nurobod district;
- Dushanbe-Tursunzoda-Uzbekistan border road project (ADB) required land acquisition, in particular, in Tursunzoda City; and
- Dushanbe-Bokhtar road project (ADB & JICA) required land acquisition in Rudaki district. “

This has to be verified as part of the CIA. The transmission lines associated with and required for Rogun HPP are considered as separate projects. This means that resettlement, be it physical or economic displacement, caused by a TL would be considered as part of that project, and not as a cumulative impact with Rogun HPP. However, if a conflict should arise with one of the resettlement villages, in a worst case the need to relocate once more households which have already been relocated due to Rogun HPP, this would clearly be a cumulative impact to be looked at in the CIA.

5.5 Overall AoI

From the description of sectoral AoIs above it is clear that in some cases there is an overlap between some of them, and/or the projects to be considered within them.

As a consequence it can be said that:

- **The Area of Influence for the CIA is the entire Amu Darya basin, with the Vakhsh catchment and the area downstream of the Pyanj-Vakhsh confluence, i.e. the Amu Darya, as the central parts.**

- **The Cumulative Impact Assessment (CIA) is necessarily also a Transboundary Impact Assessment (TBIA).**

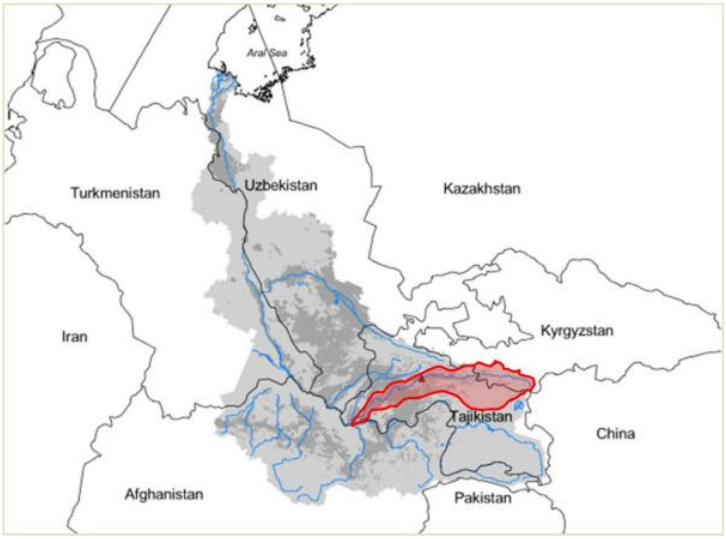


Figure 5-1: Amu Darya basin as AoI for the CIA

Grey: Amu Darya Basin; red area: Vakhsh catchment. Red triangle: Rogun dam site.

In addition to the Amu Darya basin as such, the area along the Karakum Canal in Turkmenistan, which was built between 1954 and 1988 and deviates 13 km³ of water from the Amu Darya to supply irrigated areas and major settlements, including the capital, would also have to be included in the AoI, since changes in water availability in the river would also have consequences there.

6 CUMULATIVE IMPACT ASSESSMENT

6.1 Rogun HPP

As stated above, this is a CIA specifically prepared for Rogun HPP (also mentioned as Rogun or the Project). The focus will be on interactions between Rogun HPP and the other projects included in the CIA, interactions meaning effects of Rogun on any of the other projects, effects of any of the other projects on Rogun, and impacts of Rogun HPP and one or more of the other project on the same receptor (i.e. cumulative impacts in the strict sense of the term). Here, a short description of Rogun HPP is provided. For the selection and description of the other projects see Chapter 4.

6.1.1 Main Characteristics of Rogun HPP

Table 6-1: Main characteristics of Rogun HPP

Main part	Item	Unit	Dimension
1. Dam	Height	m	335
	Crest elevation	m asl	1300
2. Reservoir	Overall length	km	70
	Area at FSL	km²	159
	Elevation at FSL	m asl	1290
	Total volume	km³	13.3
	Drawdown 1: Minimum operation level (MOL 1) Maximum drawdown Live storage 1 Area at MOL 1	 m asl m km³ km²	 1185 105 10.3 51
	Drawdown 2: Minimum operation level (MOL 2) Maximum drawdown Live storage 2 Area at MOL 2	 m asl m km³ km²	 1260 30 4.2 (Nurek: 4.2) 125*
3. Hydrology	Catchment area (Komsomolobod)	km²	29,500
	Average inflow yearly monthly maximum (July) monthly minimum (February)	 m³/s m³/s m³/s	 631 1,600 73
	Total annual inflow	km³	20.1
	Floods: 2 years 10 years 100 years PMF	 m³/s m³/s m³/s m³/s	 2,360 3,070 4,030 7,800
4. Power Plant	Total installed capacity	MW	3780
	Number of units (630 MW each)	N	6
	Discharge from turbines maximum per unit maximum (all 6 units)	 m³/s m³/s	 271 1,626
	Yearly power production	GWh	14,400 (17,000)

* Estimated value, determined by interpolation.

Dam type: rockfill with central impervious core.

Construction stage situation (May 2025):

- dam crest 1,110 m asl, height 143 m (upstream cofferdam)
- reservoir level 1,075 m asl
- Reservoir area 12 km², volume 0.5 km³
- 2 units @ 200 MW each under operation.

Some additional relevant information on Rogun HPP:

- Rogun dam is the second large dam constructed on Vakhsh River, about 70 km upstream of the existing Nurek dam.
- Its main purpose is the production of electricity, a large part of which shall be exported, mainly to Pakistan and Afghanistan, via the 500 kV transmission lines built under the CASA 1000 project (see Section 6.9).
- Filling of the reservoir (13.3 km²) will be done under strict observation of the water allocation rules, which means that on average annually not more than 1.2 km² of water will be retained, which corresponds to the quantity allocated to Tajikistan under Protocol 566 but so far not used by Tajikistan. The plan is to gradually fill the reservoir over the period from 2019 to approximately 2037.
- The expected life span of Rogun HPP is 115 to 130 years; the main limiting factor is sedimentation of the reservoir.

6.2 Interaction with Existing Vakhsh Cascade

In this Section, interactions of Rogun HPP with the existing Vakhsh cascade are described. The Section starts with a short description of the HPPs forming this cascade, for then discussing cumulative impacts. The two entities, namely, Rogun HPP on the one hand and the downstream cascade on the other hand are closely related with each other since they use the same water. Interactions of these two entities therefore determine the future flow pattern in the river downstream of the entire cascade. It is important to look closely at this situation, since changes as compared to present conditions would necessarily have effects in the downstream area.

6.2.1 Cascade Description

The existing HPP cascade downstream of Rogun consists of one large storage dam, Nurek, and 6 ROR HPPs as listed in Table 6-2.

Table 6-2: Vakhsh Cascade

HPP	Regulation capacity	Reservoir			Installed capacity, (MW(	Head, (m)
		Total volume (km³)	Active storage (km³)	Surface (km²)		
Nurek	annual	10.500	4.2	98	3'000	265
Baipaza	weekly/daily	0.097	0.080	8.04	600	60
Sangtuda-1	daily	0.258	0.012	9,75	670	64.4
Sangtuda-2	daily	0.066	0.003	-	220	22
Golovnaya	daily	0.095	0.018	7.5	210	23.3
Perepadnaya	daily	-	-	-	29.9	-
Centralnaya	daily	-	-	-	15.1	-

Source: Pöyry (2014)

Golovnaya HPP, in addition to producing electricity, also diverts water from Vakhsh River to an irrigation channel, and the two HPPs downstream of Golovnaya are located on this channel (see Figure 6-1).

Nurek has a large storage volume, which enabled it to influence river discharge in the downstream area, shifting water from the high-flow season (summer) to the low-flow season (winter). The other dams in the cascade have little or no storage and are operated as ROR schemes. They have no capacity for changing the river regime.

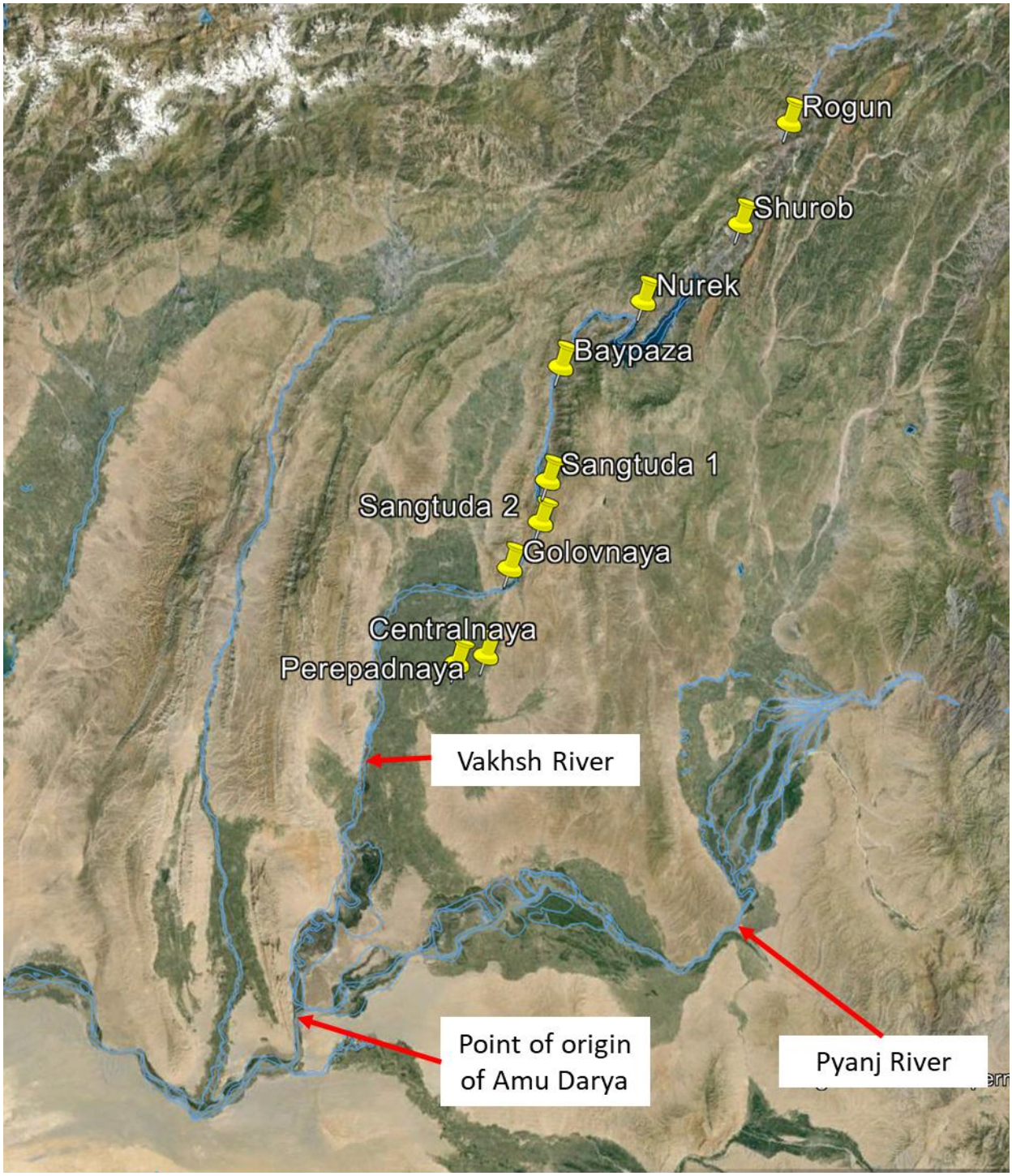


Figure 6-1: Vakhsh cascade indicating location of dams

Rogun is under construction, Shurob is in an earyl planning stage, the other HPPs indicated are under operation.

6.2.2 Potential Impacts

6.2.2.1 Impacts on Rogun HPP

Since this cascade is downstream of Rogun HPP, there is no impact on this latter.

6.2.2.2 Impacts Stemming from Rogun HPP

There are clear impacts of Rogun HPP on Nurek:

- During the filling phase of Rogun reservoir, estimated to last from 2019 to approximately 2037, a total of 13.3 km³ of water which would otherwise have reached Nurek reservoir directly is retained there. With an average yearly flow of Vakhsh of 20 km³, retaining about 1.2 km³ per year would mean a reduction of water available for Nurek and the downstream cascade by 6%, and in Amu Darya by 2%. It can be assumed that generation of electricity would be reduced by roughly the same percentage.
- Presently, two units with a reduced capacity (200 MW each) are installed and operational at Rogun HPP; these can compensate at least to some extent the reduction experienced at Nurek. The runners on these two turbines will be replaced at a later stage (foreseen to take place end of 2025), for them to reach the final capacity of 630 MW, and the 4 remaining turbines will gradually be installed.
- Tajikistan has committed itself to keep the flow pattern of Vakhsh downstream of Nurek, meaning that with the operation of Rogun HPP no additional water will be shifted from summer to winter. This is mainly done for avoiding negative impacts, i.e. water shortage during the vegetation period, in the downstream area, the irrigation perimeters in Turkmenistan and Uzbekistan. Rogun HPP will at least partially be operated as a peaking plant, meaning that net regulation will largely be managed by the operation pattern of Rogun; this necessarily means that the operation of Nurek HPP will be changed to a ROR-type pattern scheme, by keeping the reservoir level more or less constant throughout (see Figure 6-2).
- Nurek HPP is not capable of withstanding the PMF. Rogun HPP was designed in a way as to be able to store and safely convey the PMF. This is a very relevant reduction of the risk of dam break and catastrophic flooding in the downstream area.
- Rogun reservoir will retain most if not all the sediment reaching it from its catchment area, and with this it will increase the useful life span of Nurek. Rogun is also designed to safely pass flows once the reservoir is full with sediments. Nurek is not, which means some solution has to be found before its reservoir fills. Rogun gives an extra 100+ years to come up with solutions.
- Operation of the Vakhsh cascade with Rogun HPP in place will also increase electricity production in the other HPPs of the cascade (see Table 6-3).
- Once fully operational, Rogun HPP will add, on average, 14.4 TWh of electricity to the Tajik grid, increasing the production of the entire Vakhsh cascade from 19.9 TWh (before Rogun) to 35.3 TWh per year (TEAS 2014: Phase II Report, Vol. 1, p. 243). As mentioned, this will be done without changing flow conditions in Vakhsh River downstream of Nurek.

Most of the effects of Rogun on Nurek are directly related to the operation pattern of Rogun HPP. There will be no direct impacts of Rogun HPP on the other power plants further downstream, since these will just continue to use the water released from Nurek HPP.

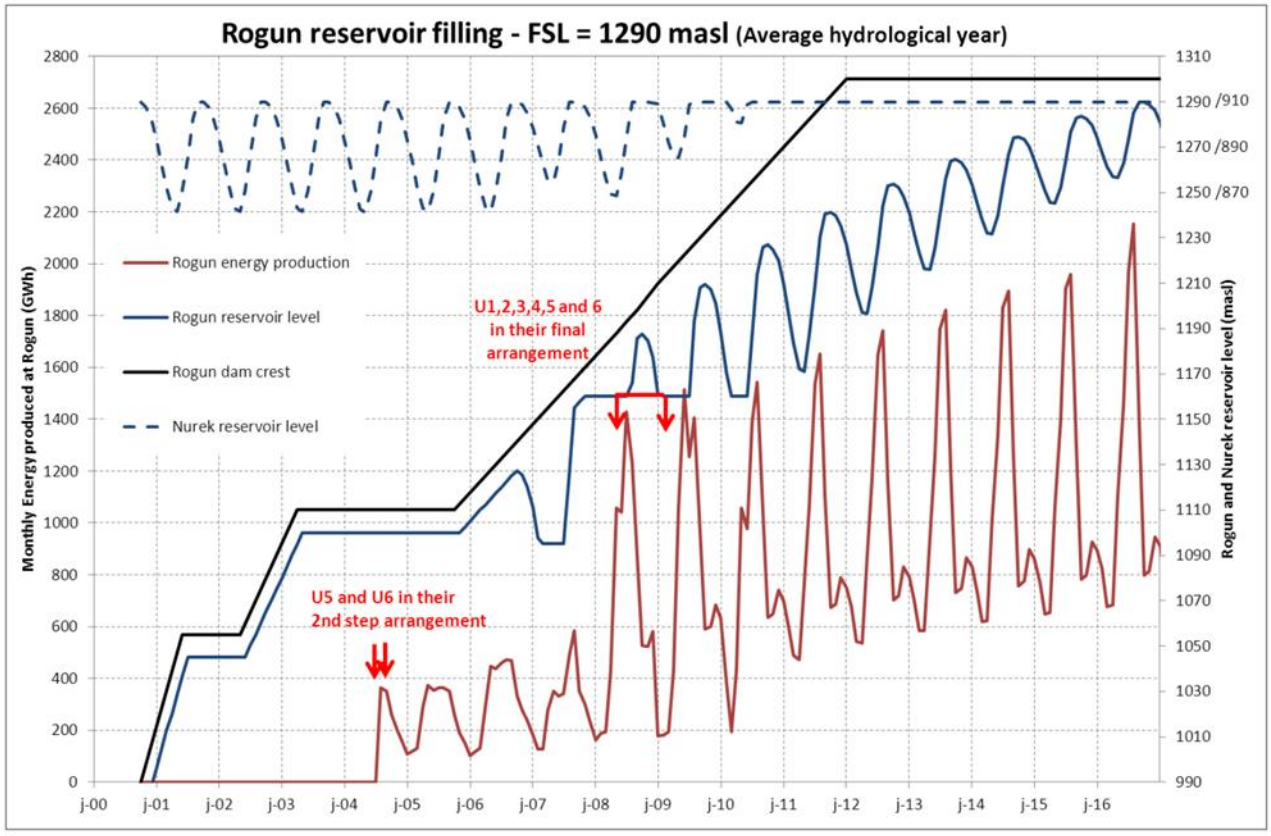


Figure 6-2: Simulation of Rogun reservoir filling

Source: TEAS 2014: Phase 2 Summary Report, Figure 50
U1 to U6: units (turbines and generators); U5 and U6 are the ones already installed with reduced capacity.

The Figure illustrates the development over the 16 years filling period. The water regime in Nurek reservoir (dashed blue line) will change from a seasonal pattern with a marked drawdown in winter to a regime with near constant water level, i.e. close to a ROR scheme, while Roun will be operated under seasonal storage regime; note that in the graph, seasonal variation in reservoir level is illustrated, but there will also be short-term (daily) peaking. Under this system, Rogun HPP will not use its total live storage of 10.3 km³, since operation will be limited to the volume of 4.2 km³ per year as presently regulated by Nurek; this means that a considerable amount of water will be stored in Rogun reservoir, part of which could be used for making available additional water for irrigation in dry years.

Table 6-3: Effect of Rogun HPP on d/s cascade

Power plant	Without Rogun (GWh/y)	With Rogun (GWh/y)
Nurek	11,376	12,373
Baypaza	2,657	2,636
Sangtuda 1	2,908	2,955
Sangtuda 2	1,064	1,054
Golovnaya	1,157	1,150
Perepadnaya and Centralnaya	203	200
Total	**19,365**	**20,368**

Source: TEAS 2014: Economic Analysis, Table 14

6.2.2.3 Potential Cumulative Impacts

TEAS and ESIA of 2014 have analysed the hydrological situation in detail. The main conclusion from this analysis were:

- As all large storage reservoirs, Nurek and Rogun reservoirs have the potential to change the seasonal flow regime in the downstream area by retaining water in the high flow season and using it for electricity generation in the low-flow season. The construction of Nurek HPP led to such a shift of 4.2 km³ from summer to winter, corresponding to the live storage of Nurek reservoir.
- Rogun HPP would have the capacity to make an additional such shift if it were operated in a way as to maximise winter electricity generation. However, Tajikistan is committed not to change the yearly flow pattern from the present one, i.e. with Nurek. This limitation to a live storage volume of 4.2 km³ is an operational design constraint which had to be respected in the development of the project. This takes into account the fact that water allocation is regulated in the ICWC/BVO agreements, and that the downstream users need water for irrigation in summer.
- In this situation it can be said that Rogun HPP and the Vakhsh cascade downstream of it will not have a cumulative impact on water availability in the area along the Amu Darya.

This latter point is illustrated in the following Figure, which is a result of the new water resources modelling (ESIA Vol. 2, Annex 13-3, Water Resource Modelling), which compares present inflow to and outflow from Nurek reservoir with the future situation with Rogun HPP in place.

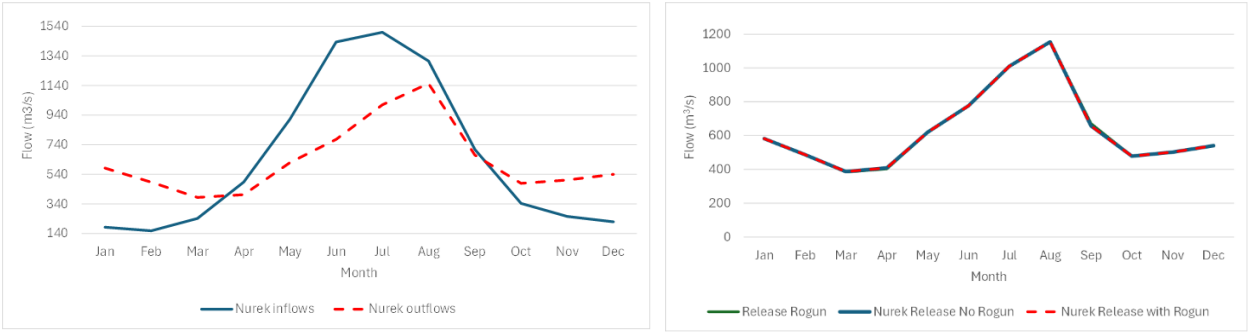


Figure 6-3: Flow situation downstream of Nurek without and with Rogun

Nurek in- and outflow situation without Rogun (left) and with Rogun (right)
Source: 2025 ESIA, Vol. 2, Annex 13-3, Water Resource Modelling; Vol. 1, Ch. 13, Water

The inflow to Nurek, which corresponds to the inflow to Rogun, will be changed by the fact that Rogun, as shown in Figure 6-2, will take over the function as regulator in the cascade. Release from Rogun, the new inflow to Nurek, will follow the same pattern as was applied in Nurek before, Nurek now operating as a near-ROR scheme, and as a result the seasonal flow pattern downstream of Nurek will not change.

Due to the marked seasonal fluctuation, Rogun reservoir is not expected to develop into a good habitat for fish species; on the other hand, since Nurek will not show such fluctuations any longer, it can be expected that there conditions for fish species which are adapted to lake conditions will find a better situation (see 2025 ESIA, Vol. 1, Ch. 15, Biodiversity).

6.2.3 Cascade Operation with Rogun HPP

6.2.3.1 Electricity Demand

In Tajikistan, electricity demand is highest in winter. Therefore seasonal water storage in reservoirs is essential for meeting this demand pattern, and this causes the reservoir drawdown illustrated in Figure 6-2. However, there is also a distinct daily pattern, as shown in Figure 6-4.

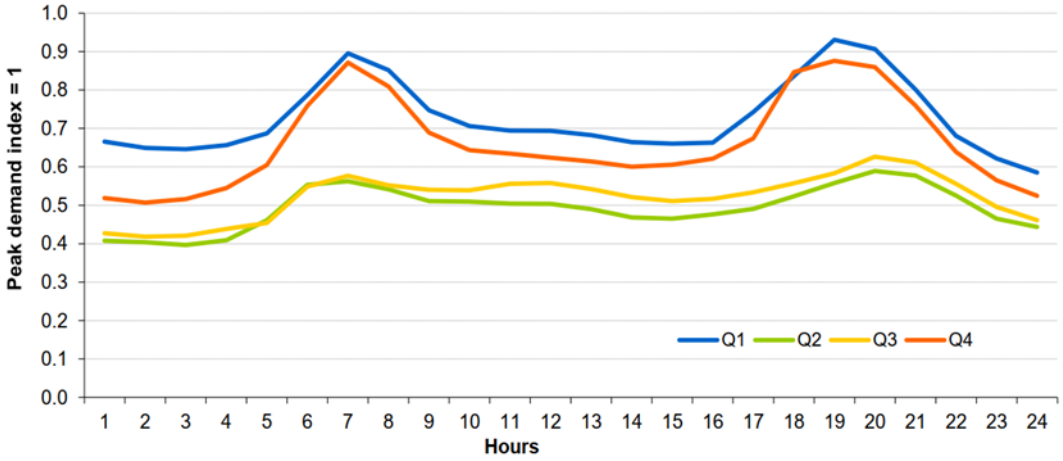


Figure 6-4: Average daily electricity demand pattern

TEAS 2014: Economic Analysis, Fig. 18, p. 33

In addition to the fact that electricity demand in winter (Q1, January to March, and Q4, October to December) is higher than in summer, the Figure also clearly shows that there are two daily peaks, one in the morning and one in the evening.

Hydropower is a very suitable source of electricity for covering differences in demand, since turbines can be turned on and off rather quickly. As already explained, the seasonal river flow pattern will not be changed, no additional water will be shifted from summer to winter. Remains the question of daily peaking, i.e. whether there will be a change in the short-term flow pattern in Vakhsh river downstream of the cascade.

6.2.3.2 Rogun Reservoir Filling

Figure 6-2 illustrates the principal pattern that will be followed for filling Rogun reservoir and for gradually starting its operation. Here, the water retention process as presently under way is described.

Presently (May 2025) the dam has reached an elevation of 1100 m asl and the water level is at 1075 m asl. Reservoir capacity, i.e. the volume available for storage, increases as the construction of the dam progresses. However, Tajikistan has committed itself to respect BVO water allocation rules also for the filling of Rogun reservoir. This means that the water available for this corresponds to the yearly water volume allocated to the country, but so far not used. According to TEAS, this amounts to 1.211 km³ in an average year (with yearly fluctuations due to precipitation and resulting overall water availability. Due to this restriction in water retention, the increase in actual water volume retained is slower as the increase in reservoir volume, as shown in Table 6-4: the reservoir will reach its full capacity in 2033, when the dam crest will have reached its final level of 1300 m asl, while the filling of the reservoir will not be finalised before 2037. As mentioned, the figures presented in the Table are based on the assumption that the average volume of 1.211 km³ will be available every year. In case a series of dryer than average years should occur during this period, filling of the reservoir could even take longer.

Table 6-4: Increase of reservoir capacity and water volume stored

Date	Reservoir capacity (km³)	Water Volume (km³)
1 Jan 2025	0.86	0.440
1 Jan 2026	1.317	1.317
1 Jan 2027	2.053	2.053
1 Jan 2028	3.240	3.240
1 Jan 2029	4.713	4.450
1 Jan 2030	6.883	5.660

1 Jan 2031	9.402	6.870
1 Jan 2032	13.300	8.080
1 Jan 2033	13.300	9.290
1 Jan 2034	13.300	10.500
1 Jan 2035	13.300	11.710
1 Jan 2036	13.300	12.920
1 Jan 2037	13.300	13.300

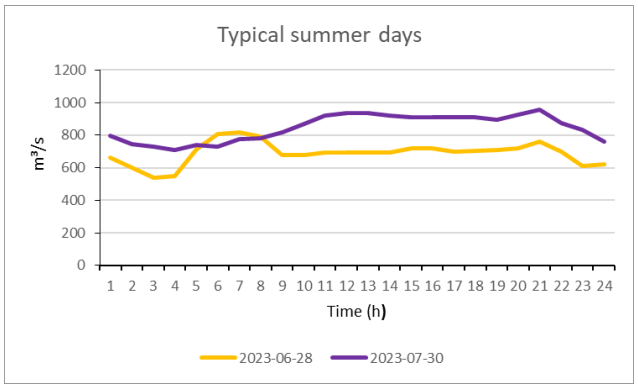
6.2.3.3 Nurek HPP Operation

Presently, an upgrade program is under way for Nurek HPP. The first phase of this project includes replacement of 3 hydraulic units, replacement and repair of mechanical and electrical equipment and maintenance of main power plant equipment, and the delivery and installation of 6 units of single-phase 500/220/10 kV autotransformers. It also includes the implementation of works related to dam safety. The implementation of the 1st phase of the project began on June 2, 2017, and is expected to be completed on December 31, 2026. As of September 2024, the status of the program is as follows: construction of the first hydroelectric unit (power unit A) was completed on August 15, 2022, and was officially commissioned on October 24, 2022. Currently, this hydro unit is operating with a capacity of 375 MW. Renovation and electrification works in all parts of the main hydroelectric unit No. 4 (power unit D) have been completed and the necessary tests have been carried out. Currently, the 30-day technical testing program related to the reliability of the use of this unit has started and is ongoing. Delivery of the materials/parts of the third hydro unit (power unit C) is currently continuing as planned, and up to now 95% of the main construction materials have been delivered and stored at the power plant. This hydraulic unit will be commissioned in October 2025. Performance of works within the scope of other tasks of the project (R2.1 "Dam Safety - monitoring", R2 "Dam Safety - hydromechanical" and R4 "Open-type installation of autotransformers" continues as per plans.

Nurek provides a large part of the total electricity presently produced and used in Tajikistan. It is operated in three ways, whereby these three modes are overlapping:

- Baseload: 2 to 3 out of the 9 units are always in operation (not including maintenance or emergency shutdowns), and water output of each of the units, when working at full capacity, is between 150 to 163 m³/s.
- Seasonal storage: during the high-flow season the reservoir is filled to its FSL of 910 m asl, and during winter, when inflow into the reservoir is lowest and electricity demand is highest, it is drawn down to its MOL of 857 m asl, in this way using its live storage of 4.2 km³ (2014 ESIA, p. A).
- Daily peaking: daily variation in electricity demand has to be met by corresponding short-term changes in production. Such a peaking regime means that turbines are turned on and off frequently, which in turn leads to important variations of water output from the power plant. Presently, peaking demand is met by Nurek and the cascade downstream of it.

Typical daily patterns are shown in Figure 6-5.



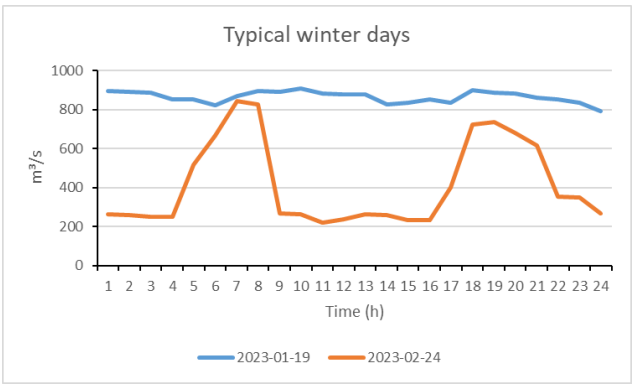


Figure 6-5: Turbining pattern in Nurek HPP

Source; Barki Tojik Dispatch Center, data received 2024-05-08

The theoretical water output from Nurek, with all 9 units operating at full capacity, would be between 1,350 m³/s (with the reservoir at FSL) and 1,467 m³/s (with the reservoir at MOL). The Figure shows that during the days illustrated this maximum was never reached. This can be due to the demand level at that time, but also, especially in winter, due to limited water availability. It also shows that production (and with it use of water) is not constant during the day. In summer, the hourly differences are rather small, a small peak in the morning is visible in one curve and one in the evening in both of them. In winter, the situation can be very different. While one of the curves shows a day with almost constant 24 h output, the other one illustrates a day with a marked peaking pattern. In the morning, water use raises within 3 h from 250 to 842 m³/s, to drop then from 827 to 266 m³/s within one hour; it should be noted that the available data are average hourly discharges, the actual change may be within a much shorter time. The values of roughly 250 m³/s during the day and in the night would mean that at this time probably only two units were operating at reduced capacity.

This clearly illustrates the fact that in a peaking power plant, the daily pattern can vary greatly from one day to the next, and that during the day very marked short-term variations are possible.

6.2.3.4 Peaking Pattern in Rogun and Nurek

The 2014 technical studies concluded that the best way for operating the Rogun-Nurek cascade would be to mainly use Rogun reservoir for seasonal regulation, i.e. for operating the power plant in a way as to draw down the reservoir in winter and fill it again in summer; this led to the pattern for reservoir operation shown in Figure 6-2. The study did not explicitly plan daily peaking in Rogun HPP: “It is noteworthy that the daily peaking possibility is not assessed in this report here because the simulation time step is the month. All variables presented are monthly data. It is to be noted that operating Rogun in peaking mode could be possible within the monthly operation studied here but it will not change the average monthly energy production. The peaking operation can be assessed thanks to the economic analysis by dispatching the total energy within a day to fit the demand.” (TEAS 2014: Phase II: Project Definition Options . Volume 3: Engineering and design. Chapter 5: Reservoir operation study., p. 30).

Once Rogun HPP will be fully operational, the two large power plants will be operated together. The following principles will be applied:

- Operation will be made in a way as to optimise the use of the available water.
- Rogun will assume the part of seasonal storage, with an FSL at 1290 m asl and an MOL of 1260 m asl; this corresponds to a live storage of 4.2 km³ (live storage 2 in Table 6-1; MOL 1, 1185 m asl, and live storage 1, 10.3 km³, in that Table will not be applied in operation, this is a project configuration for being able to react to increasing reservoir sedimentation in the future).
- Nurek will be operated as a “close to ROR” HPP. Its reservoir will be kept at more or less the same level throughout, at usually about 5 to 10 m below FSL in order to have sufficient regulating capacity. This is required since the maximum water output of Rogun HPP is 1626 m³/s (all 6 units at full capacity), as compared to the 1467 m³/s of Nurek.
- Both of the large storage plants, Rogun as well as Nurek, can be used for peaking, i.e. for short-term variations in energy output. In the case of Rogun, time required for turbines to reach full capacity is a few minutes. The 9 turbines of Nurek are presently being replaced by new ones, as part of the Nurek Rehabilitation Project. This will increase capacity from now 300 to new 375 MW per unit, due to higher efficiency of the new turbines. They will also have a very short reaction time (0 to full capacity in 2 seconds), and are therefore highly efficient for reacting to short-term variations. A part of the peaking now done by Nurek will be taken over by Rogun. This means that peaking will be done by operating the entire cascade, including the smaller HPP downstream of Nurek, in an optimal way. A detailed plan for operating the entire cascade is not – or not yet – available. In any case, the cascade will be operated as a unit, with the aim of optimising water use and electricity output.
- In periods where Rogun will be operated as a peaking plant with large short-term differences, Nurek will also act in a way as at least dampening the fluctuations in flow volume caused by Rogun.

6.2.3.5 Cascade Downstream of Nurek

As mentioned above, the six smaller HPPs downstream of Nurek are operated in very close coordination with Nurek (and with Rogun in the future). In this way, they can also contribute to covering peak demand. As they have only small (hourly to daily) storage capacity, they cannot be used for seasonal storage. However, their small storage allows them to act as re-regulation ponds for Nurek.

Short-term flow variations caused by large peaking HPPs, causing abrupt massive flow changes in the river downstream of the water outlet, often have very negative effects on biodiversity of the river and its immediate surroundings. These impacts are mainly the following:

- Surge wave: a very rapid (within seconds) massive increase in water volume will cause a surge wave which will flush out the river, destroying sensitive habitats (or not allowing their development) and negatively affecting most if not all of the species living there. It is also a risk for people who stay near, in or on the river.
- Sharp increase and important daily changes of flow velocity may make it difficult for many species to live there.
- Marked changes in water depth will mainly affect slow moving or immobile water organisms, by leaving large areas of the river bed suddenly dry for several hours. Fish spawning grounds can be completely destroyed by this effect (in addition to the impact caused by the surge wave).

HPPs designed for peaking therefore are often equipped with a re-regulation pond, which will be able to smoothen these abrupt changes at least to some degree. In the case of the Vakhsh cascade, the downstream HPPs also have this role to play.

Baipaza HPP, the first one in the cascade downstream of Nurek, has a storage capacity of 0.08 km³. This would be enough for receiving the volume of water released from Nurek during about 15 h production at full capacity. This is more than sufficient for attenuating short-term fluctuations. The other HPPs further downstream act in the same way, with the result that the Vakhsh River downstream of the cascade does not show any of the short-term fluctuations caused by Nurek HPP.

With Rogun HPP in place, the cascade will be operated in the same way, the situation downstream of the cascade will not change.

6.2.4 Conclusions

This leads to two important conclusions for the future situation with Rogun HPP:

1. The yearly water distribution will not change, as no additional water will be shifted from summer to winter. This means no negative impact caused by Rogun on downstream water users.
2. The daily/short term regime in Vakhsh river downstream of the cascade will not change. This means that there will be no additional negative impacts on aquatic and riparian habitats in the downstream area of Vakhsh River, and mainly on the floodplain habitats in Tigrovaya Balka and the aquatic habitats in Amu Darya.

6.2.5 Flood Management

The Emergency Preparedness and Action Plan (EPAP, Grunder 2024) describes the outcome of a dam break for the situation with the Rogun main dam at la level of 1110 m asl. In this case, a flood wave with a height of 90 m would develop at the foot of the dam, which would be reduced to 60 m at the upper end of Nurek reservoir and would then be further attenuated in the Nurek reservoir. Nurek dam would not be overtopped during such an event. Since the Vakhsh valley between Rogun and Nurek is not inhabited, damage to structures (with the exception of the power house and associated structures just below Rogun dam) and people would not have to be expected.

An EPAP for the final dam crest elevation of 1300 m asl is under preparation.

As already mentioned, Rogun HPP will be able to safely handle PMF. This is a considerable reduction of flood risk in the downstream area, since Nurek is not able to safely convey PMF. This effect may become even more important in the future, since under the conditions of climate change there is a risk of more marked and important short-time changes in river flow which may result in floods.

6.3 Shurob HPP

6.3.1 Project Description

Shurob dam and HPP is planned to be built directly at the upper end of Nurek reservoir; the purpose of this 850 MW HPP is to make use of the remaining approximately 70 m head on the 17 river km of Vakhsh River between Rogun and Nurek. The reservoir will reach almost to the foot of Rogun dam (see Figure 6-6), and it will use the water released from Rogun. It is in an early planning stage, design details are not yet available.

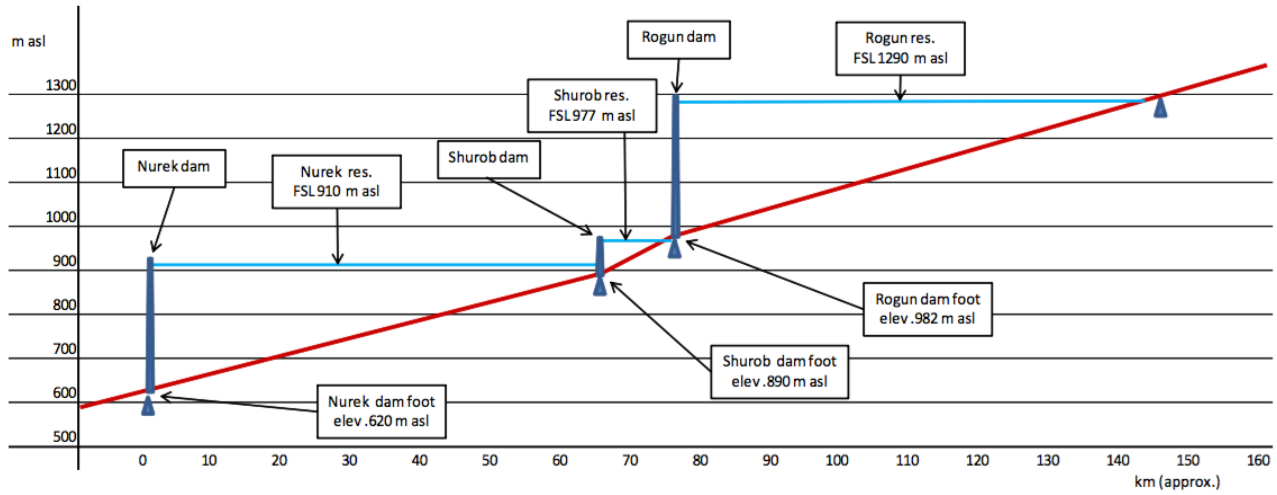


Figure 6-6: Cascade in upper Vakhsh River

Source: Pöyry 2014, Figure 8-35

The river between Rogun tailrace and Nurek reservoir is narrow, with a rather marked gradient, bordered by steep slopes (see Figure 6-7). The entire area is difficult to access and not inhabited or used otherwise (Gruner 2024, EPAP) . Available satellite pictures give a good impression of its character.

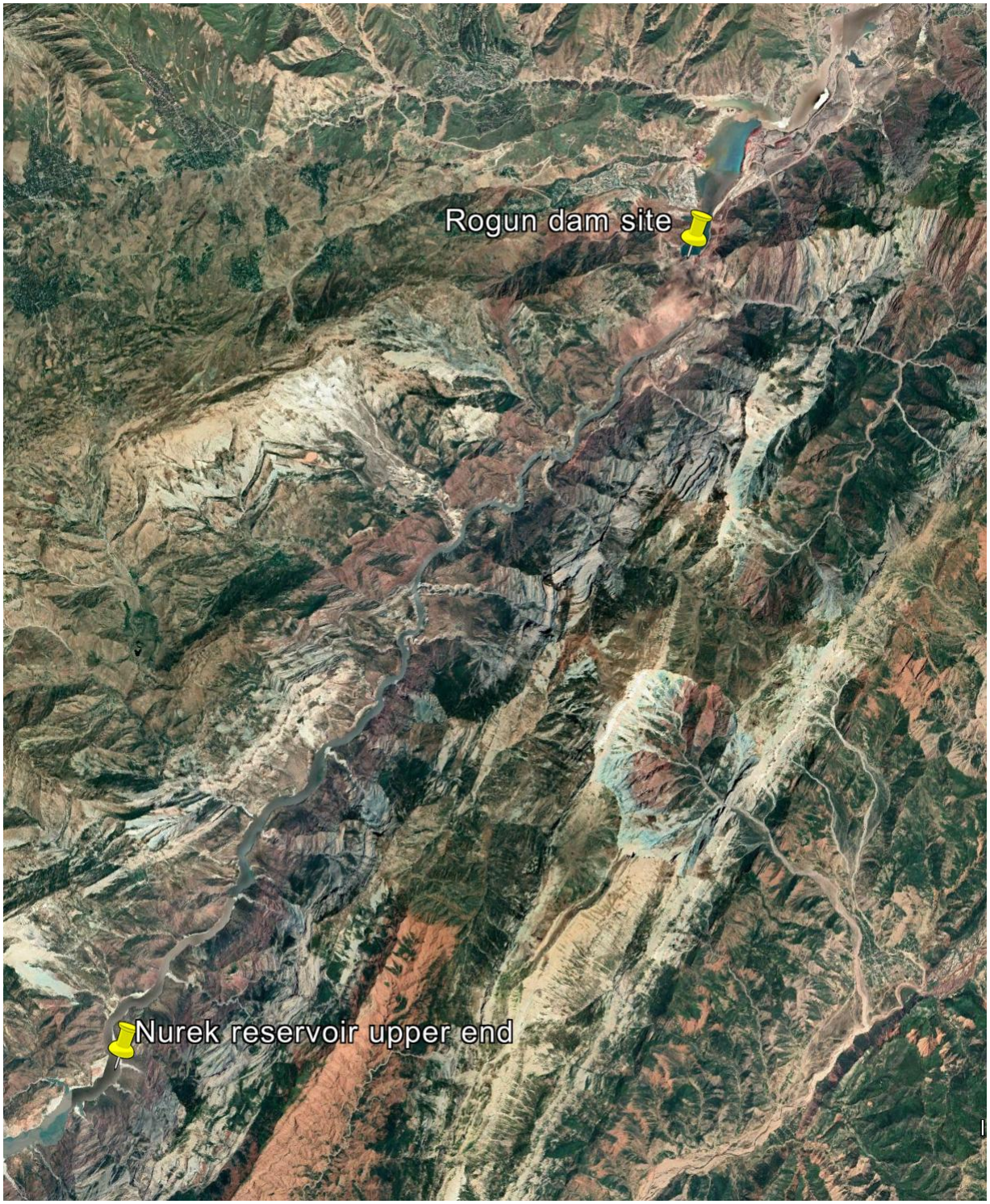


Figure 6-7: Vakhsh River between Rogun and Nurek

Considering the biodiversity value of this part of the river, the following has to be taken into account:

- Its role for fish migration is very limited at best, since fish migrations have been interrupted with the construction of Nurek dam. It cannot be excluded that before the construction of Rogun dam started, there was some limited fish migration towards upstream from Nurek reservoir. Rogun dam will definitely interrupt this, if any remains at all. Any remaining migration in this part of the river is further restricted by the fact that its only tributary of some relevance, the Obishur river which joins Vakhsh on the left bank immediately downstream of Rogun dam is blocked by a dam which was built to retain sediment from Obishur, which otherwise would have threatened to block outlets from Rogun dam and power house.

- During the filling phase, river flow in this part of the river will be reduced by the volume retained in Rogun reservoir; this will be, as mentioned, 1.2 km³ in an average year, i.e. 6% of the average yearly flow volume. The remaining volume will be released from Rogun via the diversion tunnels, spillways or turbines.
- Once fully functioning, Rogun will most probably be operated in a way as to have at least one unit running all the time.
- In addition to that, Rogun HPP will be operated, at least to some extent, as a peaking plant. According to information received, the regime for Rogun HPP would be similar to the one illustrated for Nurek in Figure 6-5: one or two units operating all the time, and, depending on demand and water availability, peaking production when required. This could mean short-terms flow variations between 400 and up to 1600 m³/s. With such a regime, this part of the river will lose most if not all of its remaining value as a habitat for aquatic organisms.

The updated ESIA (Volume 2, Annexes, Annex 13.1) determined a residual or ecological flow (EFlow) that would be required for this part of the river in case flow could or would be stopped completely. This EFlow was determined for the (probably rare) cases where Rogun HPP will be closed down completely; see discussion in Water Chapter (ESIA Vol. 1, Ch. 13: Impacts on Water).

6.3.2 Potential Impacts

6.3.2.1 Impacts on Rogun HPP

Shurob HPP, being located downstream of Rogun, will not have any direct impact on this latter.

6.3.2.2 Impacts Stemming from Rogun HPP

Shurob will depend completely on the turbine operating regime of Rogun. It will be operated as a ROR project which invariably will have to turbine the water released from Rogun HPP, with very little regulating storage. Shurob could not be built without Rogun in place, since its small reservoir would be filled with sediment very quickly.

6.3.2.3 Potential Cumulative Impacts

Basically, there are the following cumulative impacts of Shurob HPP with Rogun HPP:

- Environmental: the cumulative impact on habitat would be to extend the loss of riverine and riparian habitat by an additional 17 km since the 17 km river reach between Rogun dam and the upper end of the Nurek reservoir would be submerged by the Shurob reservoir. However, as already mentioned it is important to note that this reach will have already been affected by the changes in flow pattern, mainly peaking, caused by Rogun operation.
- Social: there is a possibility that after the construction of Rogun HPP some workers would find new jobs on the Shurob construction site.

Considering that the river reach in question will be affected not only by changes in seasonal, but much more so by changes in daily, short term flow patterns as described above, the impact of impounding it is considered as negligible. The river section between Rogun HPP outlet and Nurek reservoir will probably be covered by water all the time, it is not assumed that in a case of complete shutdown of Rogun HPP the Shurob reservoir would be emptied completely. However, in spite of that, due to high variation of inflow into the comparatively small Shurob reservoir, this will not have any value as an aquatic habitat. The overall impact can be considered as neutral. If Shurob is built, there will certainly be job opportunities there; still, it will be a much smaller construction site, and there will be no time overlap with Rogun HPP.

One additional, and definitely positive cumulative impact seems to be much more important: Shurob will make use of the head between Rogun and Nurek, and it will use the water released by Rogun once more for producing electricity. This will increase overall productivity of the Vakhsh cascade. Since it will definitely not affect a habitat that could be called a natural river, it can be considered as a minimum impact addition to the cascade (see Zwahlen et al., 2019). The ESIA to be done for Shurob will have to check this.

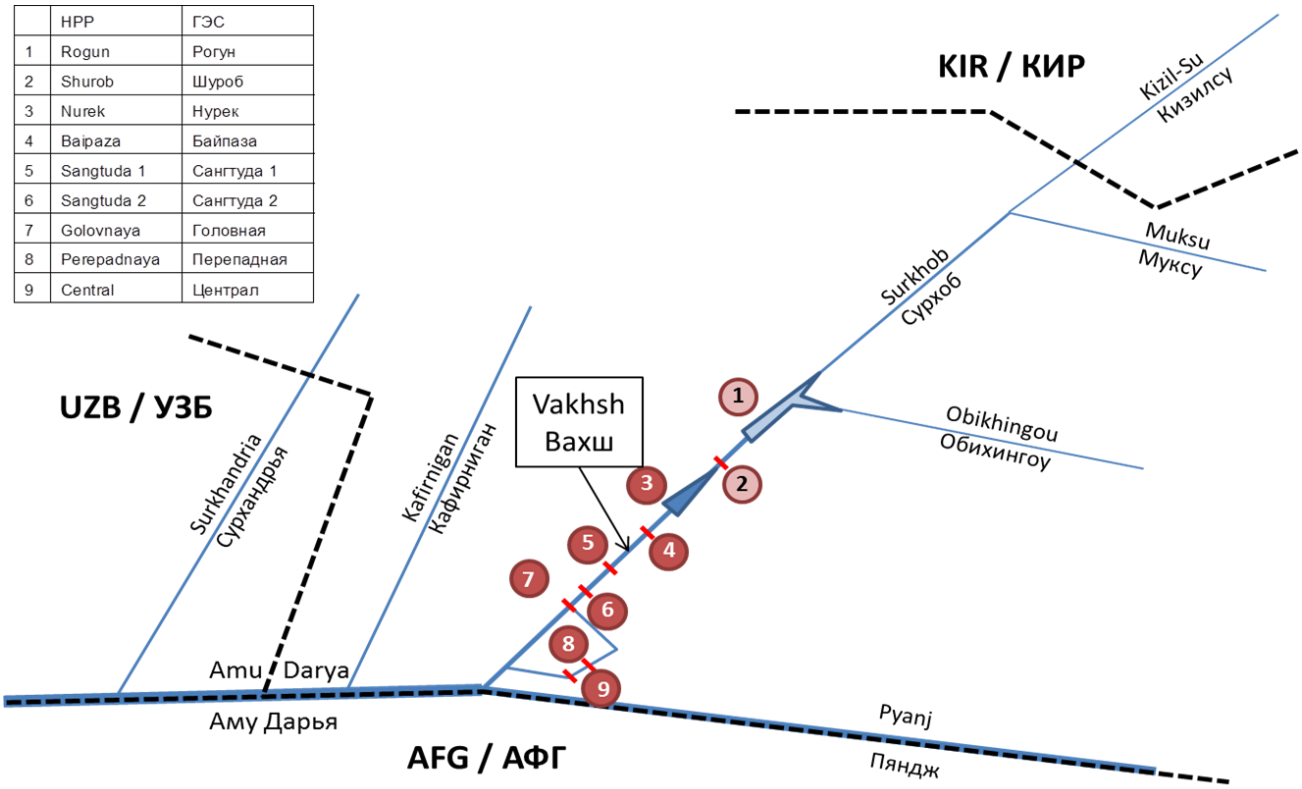
6.3.3 Mitigation

No mitigation required.

6.4 HPPs in the Pipeline Upstream of Rogun

6.4.1 Project Description

As described in Section 6.1, Rogun HPP is the uppermost part of a cascade of hydropower plants on Vakhsh river. However, there is a plan for further developing hydropower upstream of Rogun, using the two rivers, Surkhob and Obihingou (see Figure 6-8) which, at their point of confluence, form Vakhsh River. Figure 6-9 illustrates the two additional cascades, and Table 6-5 lists the planned HPPs. None of these is in an advanced stage of planning, and none of them will be built before the construction of Rogun (and most probably also Shurob) will be finished. Still, this is at least an outline of a possible further development in the future.



	HPP	ГЭС
1	Rogun	Рогун
2	Shurob	Шуроб
3	Nurek	Нурек
4	Baipaza	Байпаза
5	Sangtuda 1	Сангтуда 1
6	Sangtuda 2	Сангтуда 2
7	Golovnaya	Головная
8	Perepadnaya	Перепадная
9	Central	Централ

Figure 6-8: Diagrammatic view of river system in the study area

Black dotted lines: international borders. Graph not drawn to scale.
Source: Pöyry 2014, Fig. 4-2

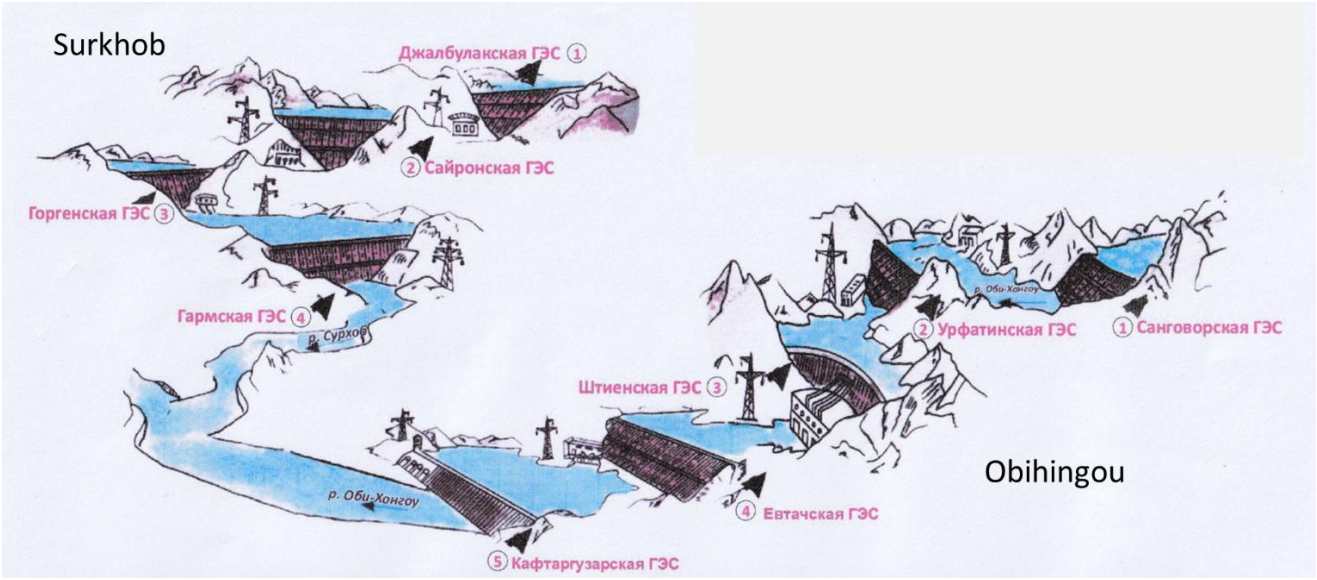


Figure 6-9: Surkhob and Obihingou cascades

Source: PMG, Planning Department

Table 6-5: Planned HPPs upstream of Rogun

No.	Name	Storage (km³)	Capacity (MW)	Output (TWh/y)
A	**Surkhob River (total)**	**1.45**	**2,100**	**8.7**
1	Dzalbulak	1.4	600	2.0
2	Sairon	0.001	500	2.2
3	Gorgen	0.002	600	2.7
4	Garm	0.002	400	1.8
B	**Obihingou River (total)**	**1.55**	**3,700**	**9.3**
1	Sangvor	1.5	800	2.0
2	Urfatin	0.01	850	2.1
3	Shten	0.01	600	1.5
4	Evtach	0.02	800	2.0
5	Kaftaruzar	0.01	650	1.7
	Total both cascades	**3.0**	**5,800**	**18.0**

Source: PMG, Planning Department

6.4.2 Potential Impacts

Building these two cascades of HPPs, or parts thereof, would certainly cause impacts which would, during detailed planning, have to be assessed in project-specific ESIAs. Even without any detailed information on any of these projects it can already be said that two major mitigation measures would be required, namely:

- Resettlement: both valleys are populated, and it can be assumed that a number of villages would be affected.

- Road replacement: the international road to Kyrgyzstan runs along Surkhob River, and in the Obihingou valley there is a road leading to GBAO area; both would have to be replaced.

However, these would be project-specific impacts, to be dealt with in the framework of the respective projects, and cannot be considered as cumulative impacts with Rogun HPP. Potential cumulative impacts are discussed in the following sections.

6.4.2.1 Impacts on Rogun HPP

As Table 6-5 shows, none of the planned HPPs has a very large storage, but even so they would add a total of 3 km³ of additional storage volume to the cascade. Since they will be built later than Rogun, their filling would not interfere with the filling of Rogun reservoir, and it can be assumed that this would be done under similar conditions as presently for Rogun, namely, by respecting the water allocation to Tajikistan according to Protocol 566; this especially means that in spite of the increased total storage volume no water would be shifted from summer to winter in addition to the 4.2 km³ already shifted by Nurek. The impact on Rogun would be negligible, and an impact on water availability in the downstream area, if any, would be minor (and definitely within agreements).

One other impact on Rogun, however, would be more important: all the additional dams would retain sediments, and with this they would have the potential to increase the life span of Rogun HPP. The effect that could actually be expected would have to be analysed in detail, but a very simple calculation would at least give an Impression of what it could be. According to the TEAS (2014) calculations, it will take 115 years for filling the 13.3 km³ of Rogun reservoir with sediment. Adding to this the 3 km³ of the two additional cascades would bring the total storage volume up to 16.5 km³; with the assumed rate of sediment input, this would mean that total filling would be reached after about 140 years, a potential additional 25 years of useful life of Rogun HPP. The fact that Rogun reservoir will retain sediments also increases the life span of Nurek HPP, and an increased life span of Rogun therefore could also be a benefit for Nurek.

Climate change will certainly affect Rogun HPP, and with it, although less directly, the entire Vakhsh cascade. As described in the 2014 and 2023 ESIAs, the main effects of climate change on Rogun HPP will be the following:

- Temperature and rainfall have already increased regionally during the last century. Temperature in the Vakhsh River basin are likely to increase by approximately 1.7°C between 2010 and 2050.
- Increasing temperatures also mean that more precipitation will fall as rain instead of snow.
- Glaciers already lost 2.5% of volume of ice during the 20th century. It is predicted that glaciers will lose another 20% of their volume during the next 30 to 40 years, which will increase water availability, but is also likely to cause mudflows and floods, bringing large amounts of sediments into the reservoir.
- Increasing temperature and retreat of glaciers leads to an upward shift of permafrost, which in turn will mobilise material and increase erosion.
- Retreating glaciers also increase the risk of GLOFs (Glacier Lake Outburst Floods).
- Under changing climatic conditions, storage of water for being able to make use of excess water in extremely wet years and to face droughts in exceptionally dry years, both of them situations expected to become more severe in the future, may get increasingly important.
- It may also be required to add additional storage capacity to the system for increasing its flexibility and potential to react.
- Such increased storage and water regulation capacity would also require agreements for refilling storage after an exceptional drawdown.
- International regulating bodies, in this case ICWC/BVO, and their agreements will play an increasingly important role.
- It will certainly get increasingly important to have all interested parties, i.e. all riparian states, included in any agreements concerning the use of wate resources. This last point is of special importance. Presently, ICWC/BVO for the Amu Darya basin includes Kirgizstan, Tajikistan, Turkmenistan and Uzbekistan. Afghanistan should be included in future agreements on the use of this important common resource.

This shows that under changing climatic conditions water availability may change to some extent, but the main risk for Rogun HPP is an increase in sediment inflow to the reservoir. Additional sediment retention could counteract this development to some extent.

6.4.2.2 Impacts Stemming from Rogun HPP

Since these additional HPPs will be located upstream of Rogun reservoir, there will be no impacts on them stemming from Rogun.

6.4.2.3 Potential Cumulative Impacts

Two cumulative impacts of Rogun HPP and the two additional cascades can be identified:

1. River habitat fragmentation: as described in both ESIAs, Vakhsh River was fragmented by the high dam of Nurek and the cascade downstream of it, and Rogun adds to this effect. Building another 9 dams upstream of Rogun will add to this impact. Presently, there is no specific information about the quality of Surkhob and Obihingou as river habitat, e.g. for fish migration, but it can be assumed that they have to be considered as natural habitat, whose nature would be changed profoundly by the new cascades.
2. Submersion of floodplains: As the 2014 ESIA identified, and the updated ESIA emphasises, a number of floodplains with a total surface of 75 to 77 ha (ESIA, Vol. II, Ann. 15, Section 4.1) will be lost to Rogun reservoir impoundment. While Obihingou seems to be too narrow and too steep for having developed extensive floodplains, this is definitely not the case for Surkhob, as Figure 6-10 shows. Potential dam sites and size of reservoirs of the two cascades are not yet known, but it cannot be excluded that some of these floodplains would be affected due to further hydropower development.
3. The additional storage, even if not very large, would change the possibility for influencing water availability in the downstream area. As mentioned above, under the conditions defined by Protocol 566 there will be no additional shift of water from summer to winter. However, the increased total storage volume could enhance the possibility of providing additional water to the downstream area in dry summers.

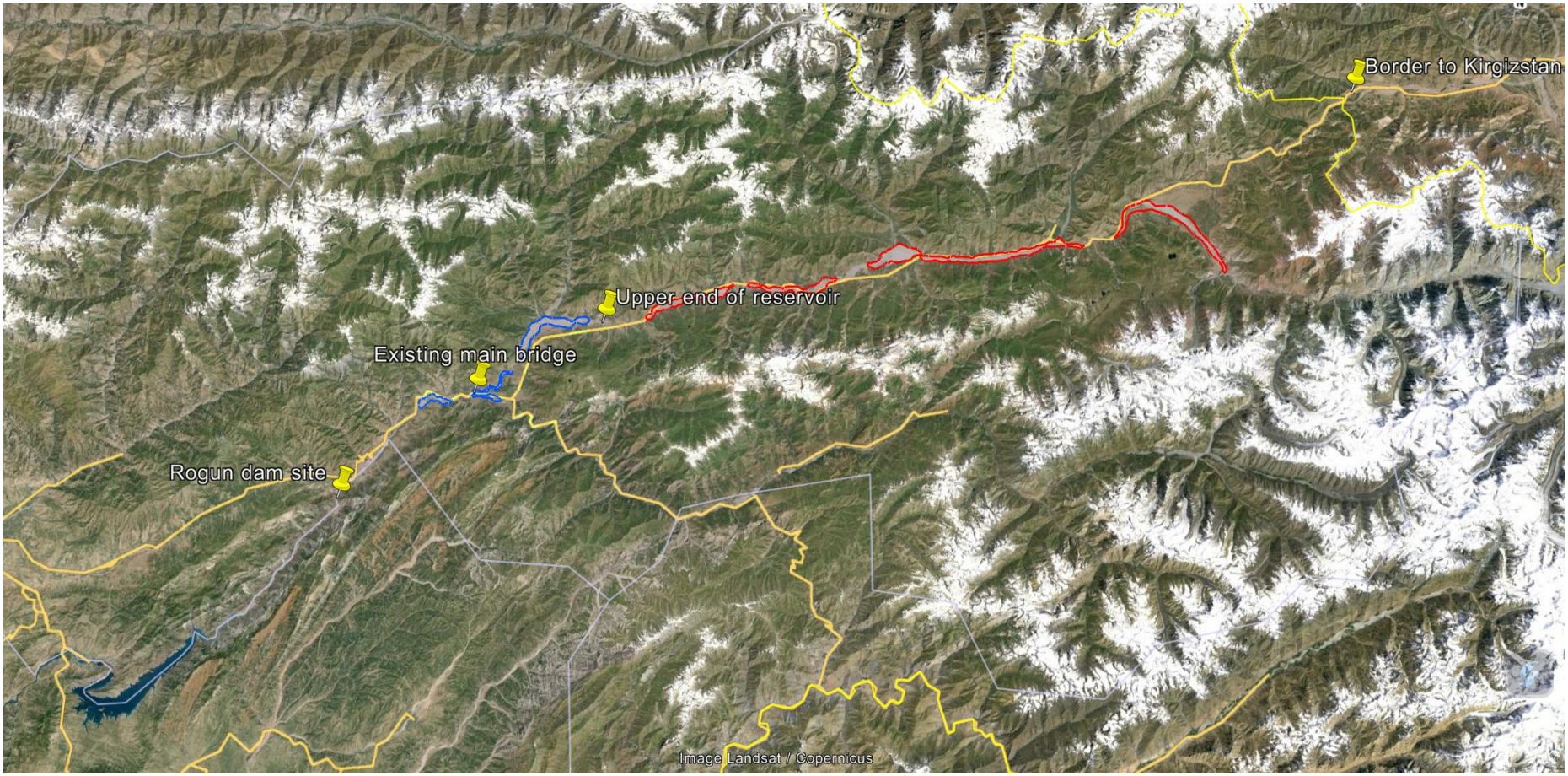


Figure 6-10: Floodplains in Vakhsh and Surkhob Rivers

Outlined in blue: floodplains that will be submerged in Rogun reservoir.
Otulined in red: major floodplains along Surkhob river upstream of Rogun reservoir.
Dark yellow: main roads
Light yellow: internationa borders

6.4.3 Mitigation

Concerning the floodplain habitat, the 2014 EISA (p. 144) made the following statement: “The floodplains (two of which will be affected by the reservoir, a smaller one near Komsomolobod, a larger one further upstream, near Nurobod) have been identified as important habitats for wildlife. This type of habitat has become extremely rare in many parts of the world, and especially in highly developed countries, where river training and other regulation measures, mainly for the purpose of flood protection and for gaining agricultural land, have led to their almost complete destruction. This is not (or not yet) the case in Tajikistan, where this habitat type can be found along all major rivers.” This statement (see also Zwahlen, 2022, p. 146) is certainly still valid today, but as the previous section clearly indicated, there is a growing pressure on this habitat type even in Tajikistan.

The updated ESIA identified the effect of Rogun HPP on floodplain habitats as an impact requiring compensation. In Vol. I, Chapter 15, Biodiversity, the following measures are proposed for reaching NNL (No Net Loss):

- Creation of new floodplain habitat upstream of the reservoir area or within a different catchment; and
- Other, out of kind, projects such as supporting creation of another habitat type that will be demonstrated to compensate for the loss of floodplain through creation of a sufficient area of another sensitive, native habitat type.

Creating new floodplains upstream of Rogun reservoir might be difficult since, as shown in Figure 6-10, floodplains already exist at suitable locations, and as mentioned in Section 6.4, these might be affected if the HPP cascade on Surkhob River will be implemented. Creation of such new floodplains in a different catchment might also be problematic, since natural floodplains (still) exist in considerable numbers along all rivers in Tajikistan.

However, one compensation measure that is certainly worthwhile considering would be an effort for improving the situation of the floodplain habitat in the Tigrovaya Balka Nature Reserve. As clearly stated in the ESIA (Vol. I, Chapter 15, and Vol. II, Annex 15-1), construction and operation of Rogun HPP will not affect this habitat in any way, meaning that there is no need for mitigation measures of Rogun project in this area. However, it is a very valuable habitat, which was affected by the construction of Nurek HPP, and where “out of kind” compensation measures could be implemented as part of a NNL strategy; see Section 8.3 for a discussion of this point.

The updated ESIA identified 185 ha of juniper woodland and 77 ha of floodplain that are naturel habitat that will be lost due to reservoir impoundment and for which compensation is required in order to reach No Net Loss (NNL). The No Net Loss Framework (NNLF; ESIA Vol. 3, A5) prepared as part of the ESIA identified a list of required actions and potential sites for such compensation and carefully evaluated them. In this process, suitable sites for compensation of juniper forest and floodplain loss were selected; both of the potential siles mentioned above, floodplains upstream of Rogun reservoir as well as Tigrovaya Balka, were eliminated as not suitable for the purpose.

6.5 Pyanj HPP Cascade

Pyanj River is the river which drains the Gorno-Badakhshan area of Tajikistan and adjacent areas of Afghanistan. It forms the border between these two countries. At its confluence with Vakhsh River the name of the river changes to Amu Darya. With 36 km³ per year, Pyanj contributes more water to Amu Darya than Vakhsh (20.1 km³). As for Surkhob and Obihingou, there is a plan for developing hydropower along Pyanj.

6.5.1 Project Description

Large storage projects in the Pyanj River basin, whether on Pyanj itself or on a tributary, would have the potential to influence water discharge in the downstream area. For this reason, it is required to include such projects in the CIA.

Presently, there is no project in an advanced stage of development on the Pyanj River; however, there is a list of a cascade of 14 potential HPP schemes at the conceptual stage (see Table 6-6).

Table 6-6: Pyanj hydropower cascade

No.	Name	Storage (km³)	Capacity (MW)	Output (TWh/y)
1	Barhsor	1.25	300	1.6
2	Anderov	0.1	650	3.3
3	Pish	0.03	320	1.7
4	Khorog	0.01	250	1.3
5	Rushansk	4.1	3,000	14.8
6	Yagulemsk	0.02	850	4.2
7	Granitnie Vorota	0.03	2,100	10.5
8	Shigrovat	0.04	1,000	9.7
9	Khostav	0.04	1,200	6.1
10	Dashtidjum	10.2	4,000	15.6
11	Djumar	1.3	2,000	8.2
12	Moskov	0.04	880	3.4
13	Koktshin	0.2	350	1.5
14	Verkhne Amudarin	15.2	1,000	4.4
15	Gidrouzel (no further data)			
	Total	**32.56**	**17,900**	**86.3**
	Rogun HPP (for comparison)	13.3	3,600	14.4

As can be seen from this list, a number of these HPPs would be ROR schemes (presumably all with a storage capacity <1 km³), while two would have very substantial storage. Since these dams would be located on the Pyanj River, i.e. on the border with Afghanistan, they would have to be developed as binational projects. According to information received, about 5 years ago Afghanistan made a request to Tajikistan for a joint development of Dashtijum HPP; this was then rejected by Tajikistan on the grounds that presently no financing would be available, since the entire focus presently is on constructing Rogun HPP. As already mentioned, none of these potential HPPs is at any advanced stage, and in the process of detailed planning, some parameters may still change. The list only serves the purpose of giving a rough idea on what development might be possible in the future. It can also be assumed that none of these projects would be built before the construction of Rogun HPP is finalised, and that Shurob HPP (see Section 6.3) would be prioritised. Assuming institutional conditions concerning water allocation as the ones valid presently and knowing that it takes approximately 16 years for filling Rogun reservoir with its volume of 13.3 km³ and an annually available water volume of 1.2 km³, it can easily be calculated that at least 27 years would be required for retaining the total storage volume of the complete Pyanj cascade.

There might be other HPPs in the Pyanj basin, on tributaries of the main river. In fact, there are the ones developed and operated by Pamir Energy; however, these are rater small ROR schemes, like Khorog HPP on Gunt River (in operation, 9 MW, no storage), Sebzor HPP on Shokhdara River (recently commissioned, daily storage of <0.001 km³, 11 MW, 77.6 GWh/y; Fichtner 2021) and Charsem HPP on Gunt River (0.0006 km³, 15 MW; USAID, n.d.). The largest one is Pamir 1 on Gunt River (28 MW), which uses Lake Yashilkul as storage reservoir. The regulating structure built there around 2006 allows for the shift of about 10 m³/s from summer to winter, which is used in Pamir 1 HPP for generating electricity. This adds up to about 0.015 km³ shifted from summer to winter. Compared to the winter flow of Pyanj river at the confluence with Gunt (180 m²/s, corresponding to a total winter flow of 2.8 km³), this shift is barely noticeable and well within natural fluctuations. The effects of all these HPPs are too small to have any noticeable impact on the Amu Darya regime.

6.5.2 Potential Impacts

The Pyanj cascade, and here especially the two with large storage, if implemented, would have the potential to very markedly influence the downstream river regime. Actual effects would depend not only on storage capacity, but, as for Rogun HPP, also on operation mode.

6.5.2.1 Impacts on Rogun HPP

Since this cascade is in a different catchment area, there would be no impact on Rogun HPP

6.5.2.2 Impacts Stemming from Rogun HPP

Here as well it can clearly be stated that Rogun HPP would have no impact on any dam project in the Pyanj cascade (unless one would count the fact that Rogun construction leads to a delay in implementation of HPPs elsewhere in Tajikistan as an impact).

6.5.2.3 Potential Cumulative Impacts

As Rogun and Nurek HPPs, projects of similar size would have the capacity to influence the flow pattern, and namely seasonal distribution of flows, of the Amu Darya, and therefore water availability in the downstream area of the Pyanj-Vakhsh confluence, which is certainly a cumulative impact. Rogun HPP can – and will – be operated in a way as not to cause problems downstream, i.e. not reducing water availability for downstream riparians in the growing season, and it can be used for providing additional water in dry summers, which is a clear benefit for downstream water users. A detailed assessment of cumulative impacts cannot be made at this point in time, but it can be assumed that for a combination of the two cascades an overall operating regime would have to be and could be found and agreed upon which would be to the benefit for all parties involved.

6.5.3 Mitigation

Since the projects under discussion here – the Pyanj River HPP cascade – are not yet well defined and their possible implementation is still far in the future, precise mitigation measures like specific operating regimes for specific projects cannot be defined as yet. The importance of basin-wide agreements for regulating such questions cannot be overstressed.

6.5.4 Discussion

This points out, once more, the importance of international agreements. It is difficult to see how Tajikistan would, within the Amu Dary Basin organisations, handle binational storage plants on Pyanj River as long as Afghanistan is not included in these organisations.

6.6 Irrigation in Tajikistan

6.6.1 Project Description

As shown in the data on water allocation and water use (see Section 9.2) Tajikistan does not use the full share of Amu Darya water allocated to it, but there is an intention to increase irrigation in the area downstream of Nurek, in this way making use of the difference while still adhering to Protocol 566.

In this respect, the following information was received from Ministry of Energy and Water Resources:

- So far, Tajikistan is not using 15-20% of its yearly water allocation, corresponding on average to 1.2 km³ (with yearly variations ranging from about 0.3 to 2.2 km³, see Table 9-1). This will be used for filling the Rogun reservoir, as shown in Table 6-4.
- There is an intention to increase irrigation once the Rogun reservoir will be filled, which will not be earlier than 2037. There is no detailed plan for this as yet.
- Presently, 767,000 ha are irrigated. The intention is to add 100,000 ha to this.
- Water saving irrigation technology will be used to minimise water consumption.

6.6.2 Potential Impacts

6.6.2.1 Impacts on Rogun HPP

All relevant irrigation schemes are located downstream of Nurek, and water supply to them is regulated from Nurek reservoir as well as in Golovnaya HPP (see Section 6.2).

6.6.2.2 Impacts Stemming from Rogun HPP

Once Rogun reservoir will be filled, the so far unused part of water allocated to Tajikistan will no longer be required there and will therefore be available for irrigation. This means that reservoir filling at Rogun brings about a delay in possible increase of irrigation.

6.6.2.3 Potential Cumulative Impacts

The use of the full amount of water allocated to Tajikistan by Protocol 566, which means that this water is no longer available in the downstream area, can be seen as cumulative impact on the downstream area, since the water is first used for one, and then for the other purpose. However, it has to be pointed out that this is in compliance with the mutually accepted rules.

Even if this is in compliance with the agreements, the question about a potential impact of using the complete share by Tajikistan on the Aral Sea remains. As discussed in detail in the 2014 ESIA and shown in Section 8.1, the southern part of the Aral Sea has almost disappeared, the very small remaining part having a too high salt content as to allow any species of fish to live there. The annual inflow to the "Large Aral Sea", the southern part, was between 0 (in dry years) and about 8 km³ (in wet years), with an average of about 5 km³." (2014 ESIA, p. 71 and 333). The average inflow of 5 km³ per year, however, did not stop the Aral Seas from further shrinking. The use of its full allocation by Tajikistan, with a yearly average of 1.2 km³, could increase frequency of zero inflow to the Aral Sea, but as Figure 8-3 shows, there is no simple direct relationship between flow in Amu Darya and the volume of water actually reaching the Aral Sea. In any case, inflow volumes are too small as to change its overall condition (see a more detailed discussion in Section 8.1 and the results of scenario analyses in Section 9.7.4).

6.6.3 Mitigation

Even if Tajikistan will increase its irrigated area, the corresponding increase in water consumption is not necessarily linear. Much will depend on irrigation technology applied. Modern water saving irrigation technology could lead to a substantial reduction in water consumption, which in turn would have a positive impact on downstream water users. Details of this will have to be carefully analysed during future irrigation development, and this will also have to address the question whether such modern technologies could be applied on already existing irrigation schemes as well.

6.7 Qosh Tepa Canal

6.7.1 Project Description

The Qosh Tepa Canal is a canal under construction in Afghanistan for deviating water from the Amu Darya to be used for irrigation in Afghanistan. Its origin is approximately 285 km downstream from Rogun.

Some information was obtained from the following internet site:

https://thediplomat.com/2023/04/what-afghanistans-Qosh Tepa-canal-means-for-central-asia/

An article published there on April 19, 2023 states the following: “Late last month, an Uzbek delegation visited Kabul in an effort to strengthen ties with the nascent Taliban regime. Among the various infrastructure projects discussed between the two parties was the ongoing construction of Afghanistan’s new Qosh Tepa canal in Balkh province. With a plan to divert up to 10 billion cubic meters from the Amu Darya each year, the canal proposes the utilization of a significant amount of water from a basin that already has a history of intensive use by the downstream states of Uzbekistan and Turkmenistan. As over 100 kilometers of the 285 km-long canal has already been dug, the potential impact of such a project is becoming increasingly palpable each day construction continues.”

The relevant information from this article is that the canal has the potential of diverting 10 km³ of water per year.

Additional information was received from Mr. Daler Abdurazoqzoda, Head of Energy and Water Policy Department, Ministry of Energy and Water Resources. This is summarised below:

- The plan is to finish the canal in 2028.
- The aim is to irrigate 550,000 ha of desert land. The construction of the irrigation system has not yet started.
- 30% of the system would be irrigated by gravity, the remaining 70% require pumping. System envisaged to start operation in 2035.
- The estimated amount of water required would be 5 km³/y; this is calculated based on the following assumptions: cultivated plants will be wheat (with a water requirement of 4,500 m³/ha) and sunflowers (6,000 m³/ha); canal efficiency 65%, i.e. 35% loss due to evaporation and seepage.
- This is a concern for the other countries in the Amu Darya basin, but they acknowledge the right of Afghanistan to use water. The expectation is that Afghanistan will apply modern, water saving irrigation technology. Uzbekistan makes an effort to improve its own irrigation system in order to increase efficiency.
- There is no intention to change the water allocation rules according to Protocol 566.

6.7.2 Potential Impacts

As discussed in detail in the 2014 ESIA, water is a scarce resource in Central Asia. Water use is regulated by the Amu Darya basin organisation (ICWC/BVO). The main agreement is the so-called Protocol 566, which defines the share each country is entitled to use. Based on this and a forecast of the probable water amount in the next season the specific quota are determined twice a year, for the growing season (April to September) and the non-growing season (October to March).

Afghanistan is not part of these organisations. If now it would start deviating a substantially larger quantity than it did so far, this would mean that less water would be available for the other countries, and especially for the two downstream of the new canal, Turkmenistan and Uzbekistan. The following Table shows to what extent the other water users could be affected, taking the two figures (5 or 10 km³/y) mentioned above as scenarios.

Table 6-7: Potential consequences on water availability

Country	**Nukus Protocol 566** (see Table 5-1)		**Situation with Qosh Tepa canal**			
			AFG using 5 km³/y		**AFG using 10 km³/y**	
	%	**km³**	**km³ (1)**	**km³ (2)**	**km³ (1)**	**km³ (2)**
Kirgizstan	0.6	0.4	0.4	0.4	0.3	0.4
Tajikistan	15.4	9.5	9.0	9.5	8.3	9.5
Turkmenistan	35.8	22.0	21.0	20.55	19.2	18.4
Uzbekistan	48.2	29.6	28.2	28.25	25.8	28.0
Total 1	*100*	*61.5*	*58.6*	*58.6*	*53.6*	*56.3*
Afghanistan		2.1	5.0	5.0	10.0	10.0
Total 2		**63.6**	**63.6**	**63.6**	**63.6**	**63.6**

Comments to the Table:

- Situation according to Protocol 566: Water allocation in % and in km³ in an average year (Table 5-1). 61.5 km³/y is the share distributed between the BVO countries with 95% probability (meaning that statistically this value will be reached or surpassed in 95 out of 100 years). In such a year, total Amu Darya discharge would be 78.5 km³; the difference to the amount used is the volume lost to evaporation and infiltration and the volume reaching the Aral Sea.
- It is assumed that Afghanistan, not being a member of BVO, is consuming 2.1 km³/y.

- Situation with Qosh Tepa Canal :
  - (1): assuming distribution among BVO states according to Prot. 566 percentage.
  - (2): assuming u/s countries using the same quantity as before and Turkmenistan and Uzbekistan sharing the loss to equal parts.
- This assumes that Afghanistan would increase its water use from 2.1 to 5 or 10 km³/y; the situation would be further aggravated if the Qosh Tepa deviation were in addition to the 2.1 km³.

It has to be pointed out that none of the two "with Qosh Tepa Canal" scenarios are anything official or agreed upon, these are just hypothetical calculations to show a potential outcome.

A publication by Hydrosolutions (2023: https://www.hydrosolutions.ch/projects/tipping-the-scales-the-future-of-the-amu-darya-river-amidst-agricultural-ambitions) provides additional information, which indicates that the situation may potentially be more serious than outlined above. According to this, Qosh Tepa canal is designed for deviating up to 20 km³ of water per year, aimed at irrigating up to 600,000 ha. The two following Figures illustrate the present situation and the potential outcome.

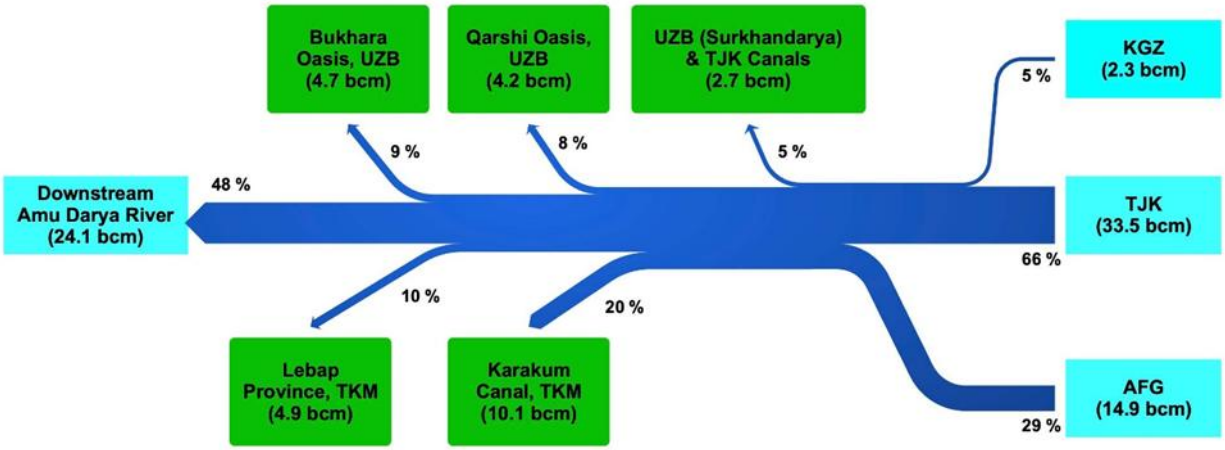


Figure 6-11: Current mean water balance of the up- and midstream river sections.

Source: hydrosolutions GmbH (2023).

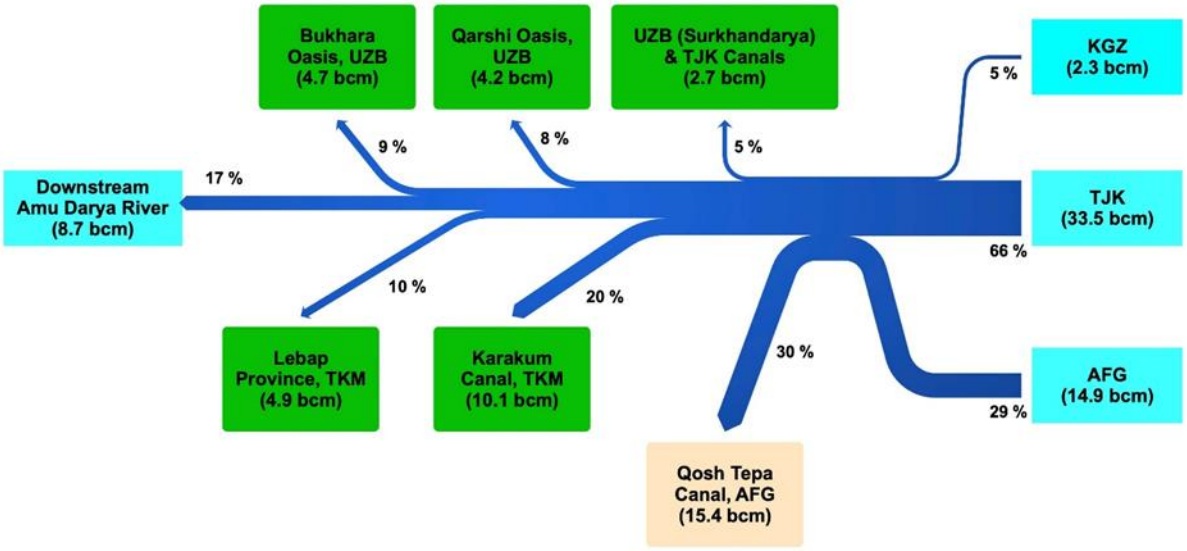


Figure 6-12: Future mean water balance of Amu Darya River with Qosh Tepa

Source: hydrosolutions GmbH (2023).

It is important to understand that the portion labelled “Downstream Amu Darya River” does not mean that this is water that will reach the Aral Sea. Most of it is used by Uzbekistan as part of its allocated share, only a small fraction actually reaches the Aral Sea.

The scenario in Figure 6-12 assumes that, once Qosh Tepa canal operating, pre-existing water abstraction in the upper and central part of Amu Darya would not change, which would mean that the total additional abstraction by Afghanistan would go to the detriment of the lower Amu Darya, with very severe impacts on irrigation in a part of Turkmenistan, but mainly in Uzbekistan.

6.7.2.1 Impacts on Rogun HPP

The Qosh Tepa Canal originates far downstream of Rogun, there will not be any direct impact of it on Rogun HPP. However, the role of Rogun HPP (and potentially other storage schemes to be added in the future), and mainly its capacity to provide additional water in extremely dry years, might become even more important. This however would have to be addressed in the framework of water quota allocation in the entire Amu Darya basin.

6.7.2.2 Impacts Stemming from Rogun HPP

According to agreements, Rogun will not diminish the summer flow to the downstream area. In this way, it will not have any effect on Qosh Tepa. However, since Rogun HPP can be operated to provide additional water in dry years, irrigation in Afghanistan will benefit as well. This would be a positive impact on the Qosh Tepa project.

6.7.2.3 Potential Cumulative Impacts

Both projects, Rogun HPP as well as Qosh Tepa, have the potential to, or actually do, influence water availability in the downstream area. Whether or not such a cumulative impact will arise, e.g. Rogun compensating, to the extent possible, the lack of water due to Qosh Tepa, will depend on specific agreements on operation of the two schemes. A hypothetical scenario of a “worst case” cumulative impact of Rogun HPP in combination with Qosh Tepa canal is described and discussed in Section 9.7.

6.7.3 Mitigation

The most important mitigation measure in this situation would be to improve efficiency of existing and new irrigation schemes, as already mentioned above. No information is available on whether the application of modern, water saving irrigation technology will be applied in the Afghanistan irrigation scheme. According to information available in the internet there is concern about the technology applied for building the new main channel, which does not seem to prevent major losses to infiltration.

Whether Rogun HPP could play any additional role for mitigating negative impacts will depend on the situation and on future agreements for water use in the Amu Darya basin.

6.7.4 Discussion

It is not possible, at this point in time and based on the available information, to make any more firm statement on potential outcomes in this situation. The new situation will not materialise before 2037, when according to plans both projects will be in operation. Still, it could be that the future role of Rogun reservoir for storing water to be used in dry years would become even more important. The situation will also depend on additional hydropower projects which eventually will or will not be developed in the Vakhsh and Pyanj catchments – or potentially elsewhere in the Amu Darya basin.

It has to be pointed out very clearly that the Qosh Tepa Canal is a project developed and built by Afghanistan, with no relation whatsoever to Rogun HPP, and without the possibility of any party involved in the development of Rogun HPP to influence it in any way.

In the 2014 ESIA, the necessity of including Afghanistan in the water management agreements in the Amu Darya basin was mentioned. This has become even more important now.

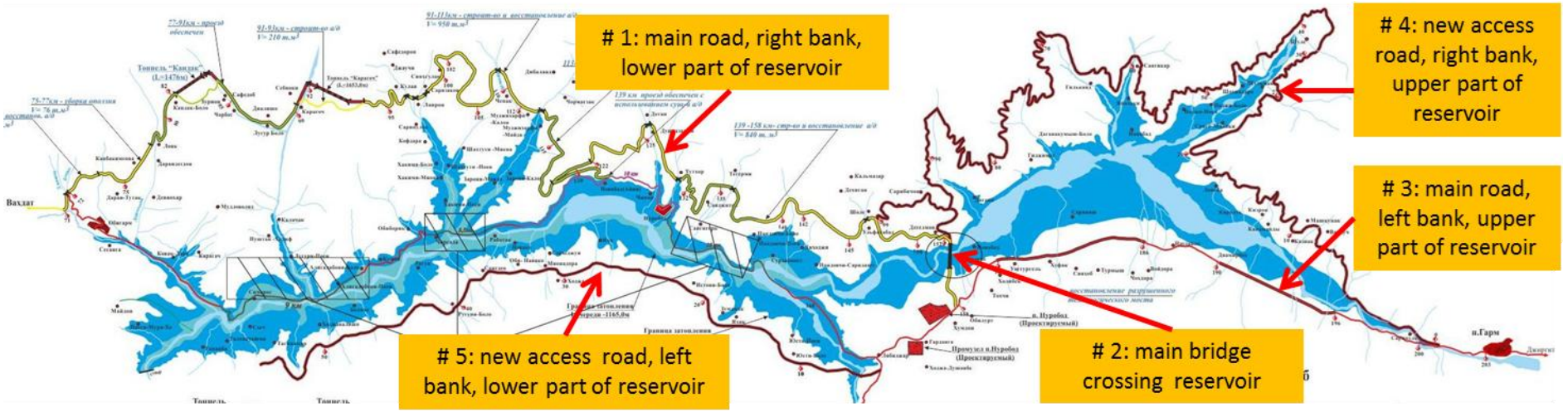
The importance of including Afghanistan is stressed by the Hydrosolutions (2023) publication in the following way: “The potential consequences extend beyond regional economic impacts. By fundamentally altering the water balance in the Amu Darya River Basin, the Qosh Tepa Canal could stir geopolitical instability and strain the delicate diplomatic fabric of Central Asia. The absence of Afghanistan in the existing water-sharing agreements is a key complication, leaving a critical gap in regional water governance.”

6.8 New Road

6.8.1 Project Description

During the filling process of Rogun reservoir, the existing main road between Obi Garm and Nurobod will be gradually submerged. Since this road, located in the Vakhsh valley between the two settlements, is the only access to the upper part of Vakhsh valley, is one of two possible roads for reaching GBAO Oblast in the South-East of Tajikistan, is the international road to Kirgizstan, and is also the only access to the villages to be resettled in Stages 2 and 3 of the resettlement process, it needs to be replaced before being submerged. The replacement road network (see Figure 6-13) consists of 6 different parts as follows:

1. The road Obi Garm – Nurobod, main (part of main/international road).
2. Main bridge crossing the reservoir (part of main/international road).
3. Main road on left bank of upper part of reservoir (where a section of the existing road needs to be replaced; part of main/international road).
4. The new road continuing on the right bank further East, to the North and along the upper part of the reservoir (local road).
5. The new road on the left bank of the reservoir, between main bridge and Rogun dam site, providing access to the villages there (local road).
6. The access roads to villages on the right bank of the reservoir which will lose access due to reservoir filling, connecting them to the new main road (local roads).



Source: 2014 ESIA, Figure 3-5

Figure 6-13: Replacement roads

The existing M41 road connecting Tajikistan to the Kyrgyz Republic will be replaced by the new Obi Garm – Nurobod road (No. 1, main road); construction of this part is nearing finalisation. It is located in the mountain range on the right bank of the lower part of the reservoir at an elevation between 1'305 m and 1'890 m asl. For construction, the 75 km connecting Obi Garm to Nurobod are divided into two sections: 30 km between Obi Garm and Tagikamar (including 2 tunnels of 1.6 km and 1.7 km), and 44 km between Tagikamar and Nurobod. The plan for these two sections was to have them ready and opened for traffic in December 2024 (information received from PMG 2024-09-18), and they were commissioned in early 2025 (PMG, 2025-06-09). A 760 m long bridge (main bridge, No. 2) will cross the reservoir, from where the main road will continue on the left bank (No. 3). It is expected that the contractor for this bridge will be selected early in 2025.

The construction of these roads is definitely an inevitable replacement measure for Rogun HPP and could therefore be considered as part of the mitigation measures for the hydropower project. However, for practical reasons construction of the main road (No. 1) and the main bridge (No. 2) are handled as independent projects, managed by a PMG which is part of the Ministry of Transport. Its financing is also not part of the financing arrangements for Rogun dam and HPP. For these reasons, this is included in the CIA as New Road Project, an independent project and one of the projects with potential cumulative impact with Rogun HPP. The other roads, No. 4 to 6, are local access roads which are required as mitigation/compensation measures for Rogun HPP, since the villages lose their present access due to the impoundment of Rogun reservoir. These facilities will be funded by the AIIB and constructed by the Ministry of Transport and local contractors. (updated ESIA, Vol. 1, Chapter 3, Project Description: Table 3-9).

For the CIA, the new main road (i.e. points 1-3 listed above) is of importance, while the other three parts of the road replacement project are local access roads, whose impacts (and relevance) are dealt with in the ESIA studies (2014 ESIA, 2019 Road ESIA, 2025 ESIA). Road section No. 1 (from Obi Garm to the existing main bridge) is the part which is on the critical path, since it will be gradually affected in the early stages of reservoir filling. The other section, including the existing main bridge, are located at higher elevations and will be affected only at a later stage.

6.8.2 Potential Impacts

Additional sediment input into Rogun reservoir, mainly during construction, could be a potential impact of the road project on Rogun HPP; in any case, this would be an impact of minor importance, due to the distance of the road alignment.

A completely different type of effect, being an interaction between road and hydropower project, is of more relevance:

- The reservoir has by now (May 2025) reached a level of 1075 m asl. At this level, it has already affected three sections of the existing road M 41: (i) shortly after Obi Garm, (ii) near Sicharog, and (ii) near Chorsada (see Figure 6-15 to Figure 6-17). Temporary access roads had to be built at these three locations, the section near Chorsada including two bridges, for allowing access to the upper part of the valley (Nurobod and Garm area and beyond). Of importance for the CIA: without access to the Nurobod area, it would not be possible to carry out stages 2 and 3 of the resettlement program. The temporary roads were built for being used until the reservoir reaches a level of 1110 m asl.
- When the level of the reservoir rises above 1110 m asl (see Table 6-8 for an intended schedule), parts of these temporary road sections will be submerged. The most critical one is the section near Obi Garm where, mainly due to the difficult topography at this precise place, the replacement road runs only slightly above the original road and above the water level indicated, and where yet another temporary solution would be difficult to implement.
- According to information received from DFZ, the replacement of the main road (without main bridge, which will be built at a later stage) is scheduled to be finalised by end of 2024.
- A delay in road construction would lead to submersion of parts of the existing road before the new road provides access. This could mean the following:
    - If in this situation reservoir filling would go on, access to the Nurobod area would be interrupted, and this would mean a delay in the resettlement program; this in turn could lead to a delay in further reservoir filling.
    - If priority would be given to resettlement, this could mean that reservoir impoundment would have to be temporarily interrupted; this in turn could lead to a delay in hydropower project

implementation, since with the water resources allocated to the project it might not be possible to recover such a delay in a following year.

This means that there is a clear interdependence between the two projects. Coordination between Rogun HPP and road construction is provided by regular coordination meetings between the two PMGs. Still, the schedule for road construction is important to be observed.

Table 6-8: Schedule for filling Rogun Reservoir

Year	Res. level m asl	Res. volume km³	Annual retention km³	Res. surface km²	Surface increase km²
2025	1075	0.440		7	7
2026	1110	1.317	0.877	15	8
2027	1150	2.053	0.736	30	15
2028	1170	3.240	1.187	40	10
2029	1200	4.450	1.21	55	15
2030	1220	5.660	1.21	76	21
2031	1230	6.870	1.21	85	9
2032	1240	8.080	1.21	90	5
2033	1250	9.290	1.21	100	10
2034	1260	10.500	1.21	110	10
2035	1270	11.710	1.21	132	22
2036	1280	12.920	1.21	145	13
2037	1290	13.300	0.38	159	14

The following Figures illustrate the situation. Figure 6-14 shows the alignment of the new main road (under construction, first part recently finalised) and indicates locations of the details shown in Figure 6-15 to Figure 6-17.

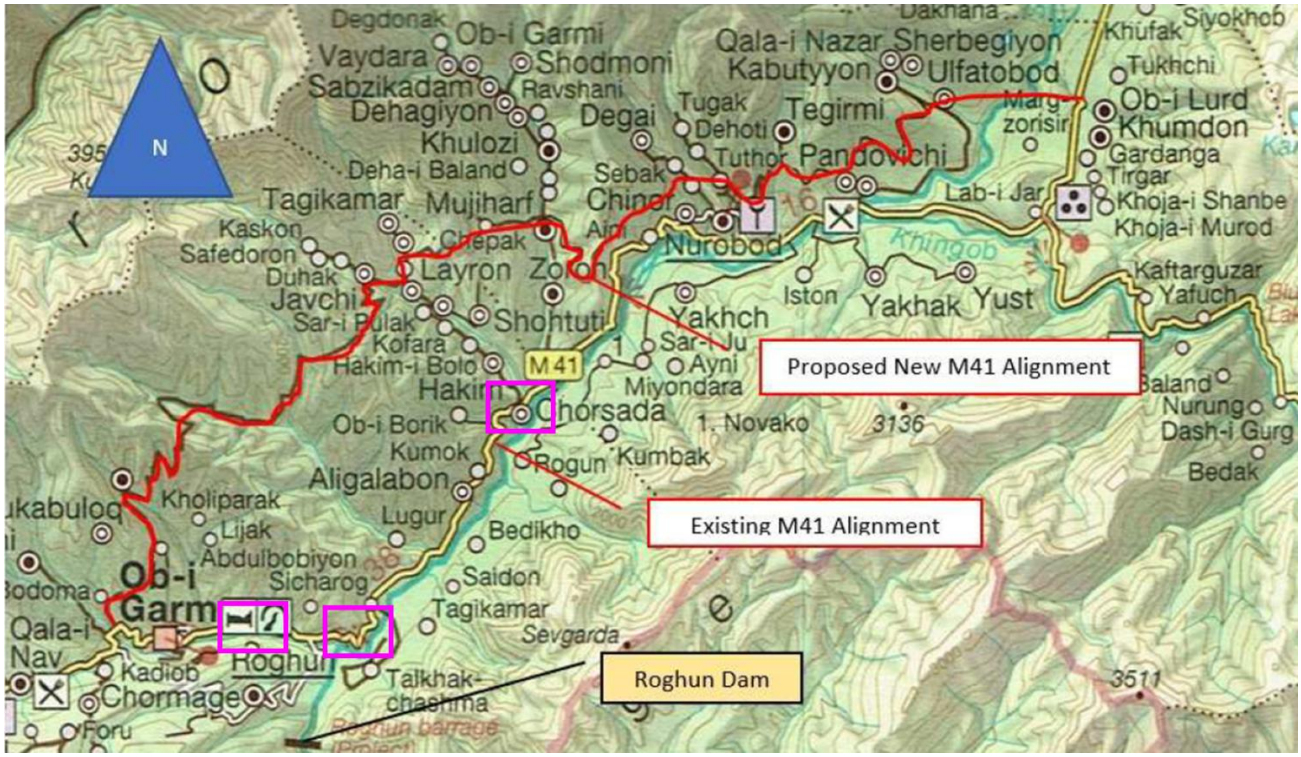


Figure 6-14: Existing and new road alignment

Source: Road ESIA 2019; see also Figure 6-13.
Purple squares: sections shown in folloing three Figures.



Figure 6-15: Temporary road near Obi Garm

Here, the existing road was damaged by a landslide and had to be repalced between the points marked as O.G.1 and O.G.2

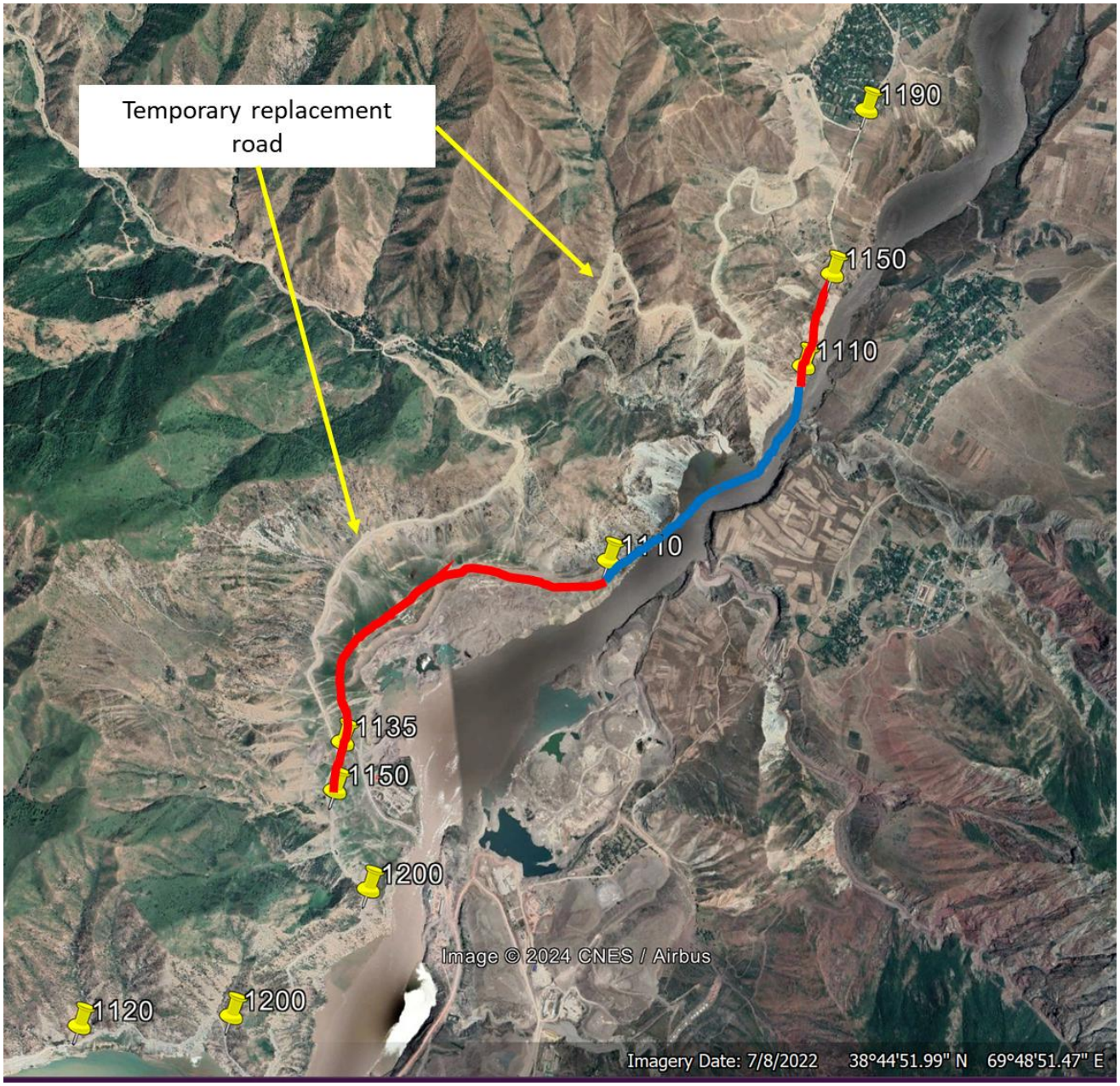


Figure 6-16: Existing road near Sicharog

Google image: 2022; yellow pins indicating road elevation
Blue line: road section that will be submerged at reservoir level 1110 m asl; part of it is presently already submerged.
Red lines: road sections below elevation 1150, to be submerged by November 2025
One section of the temporary replacement road will already be submerged at that time.

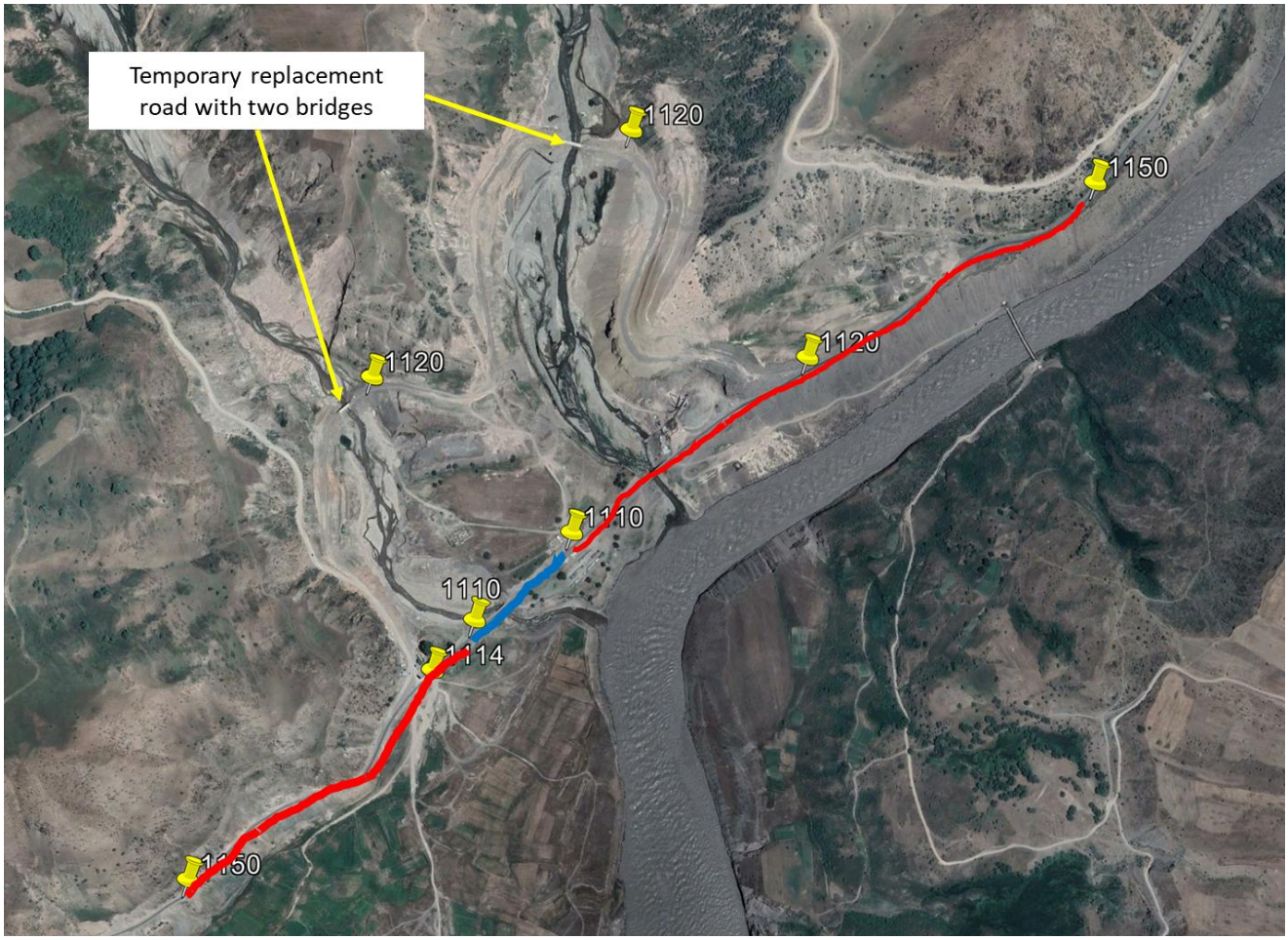


Figure 6-17: Existing road near Chorsada

Google image: 2022; yellow pins indicating road elevation
Blue line: road section that will be submerged at reservoir level 1110 m asl
Red lines: road sections below elevation 1150, to be submerged till November 2025
The temporary replacement road, which includes two bridges, will already be submerged at that time.

The elevations shown in the Figures above are taken from the google earth satellite pictures and may therefore not be very precise. Even so, they clearly illustrate the interdependence of reservoir filling and access to the upper part of Vakhsh valley.

6.8.3 Other Potential Cumulative Impacts

According to information received from DFZ, the planned gas pipeline from Turkmenistan to China will, to the extent possible, follow the alignment of the new road. In this way, the new road could provide access to some of the construction sites to be installed along the pipeline alignment. This could be considered as a positive interaction between these two projects (and an indirect positive impact of Rogun HPP on the pipeline project). Since at present no detailed information is available on the pipeline project, no more precise statement on this can be made at this point in time (see Section 6.10, pipeline project).

6.8.4 Mitigation

The need for minimising the erosion risk related to road construction is discussed in the 2019 Road ESIA; this can be summarised in the following way.

- Erosion is recognised as a major problem in Tajikistan.
- The risk of local increase in erosion due to road construction is addressed.

- Mitigation: preparation and implementation of a Soil, Erosion and Topsoil Management Plan as part of the ESMP (2019 Road ESIA paragr. 415).
- The ESMP in the ESIA report outlines the Soil, Erosion and Topsoil Management Plan (Point 6 in Table 53), listing general measures to be applied for minimising erosion related to construction activities. This it understood as a basis for the preparation of the CESMP (Contactor's Environmental and Social Management Plan).
- Post-mitigation impact considered as of low risk and insignificant.

Road construction along the reservoir in difficult terrain certainly presents the risk of increased erosion, which in turn could lead to an increased sediment load to the Rogun reservoir. The specific risk of additional sediment reaching the Rogun reservoir due to the construction of the new road is not addressed in the 2019 Road ESIA. However, as stated in the 2025 ESIA, it can be considered as minor.

6.8.5 Conclusion

The potentially more serious risk of a conflict between resettlement, i.e. access to the Nurobod area and beyond, and reservoir filling requires a close coordination of the three activities involved, namely road construction, resettlement and reservoir filling. This is given by the interactions between the two PMGs.

The construction of the new road along the right bank of the reservoir was finalised by end of 2024 and it was opened for traffic in early 2025, which means that the risk of cutting the access to the resettlement sites no longer exists.

6.9 Transmission Lines and Road Projects

6.9.1 Potential Conflicts

According to DFZ, concerns were raised in public hearings about potential conflicts between resettlement villages and a number of projects for linear structures, i.e. transmission lines and roads. In a worst case, this could potentially mean that households which had been relocated as part of the Rogun resettlement program could be affected by such structures and would have to move again.

Projects potentially causing such impacts could be the following:

- CASA 1000 and TL projects related to Rogun HPP;
- Dushanbe-Tursunzoda-Uzbekistan border road project; and
- Dushanbe-Bokhtar road project.

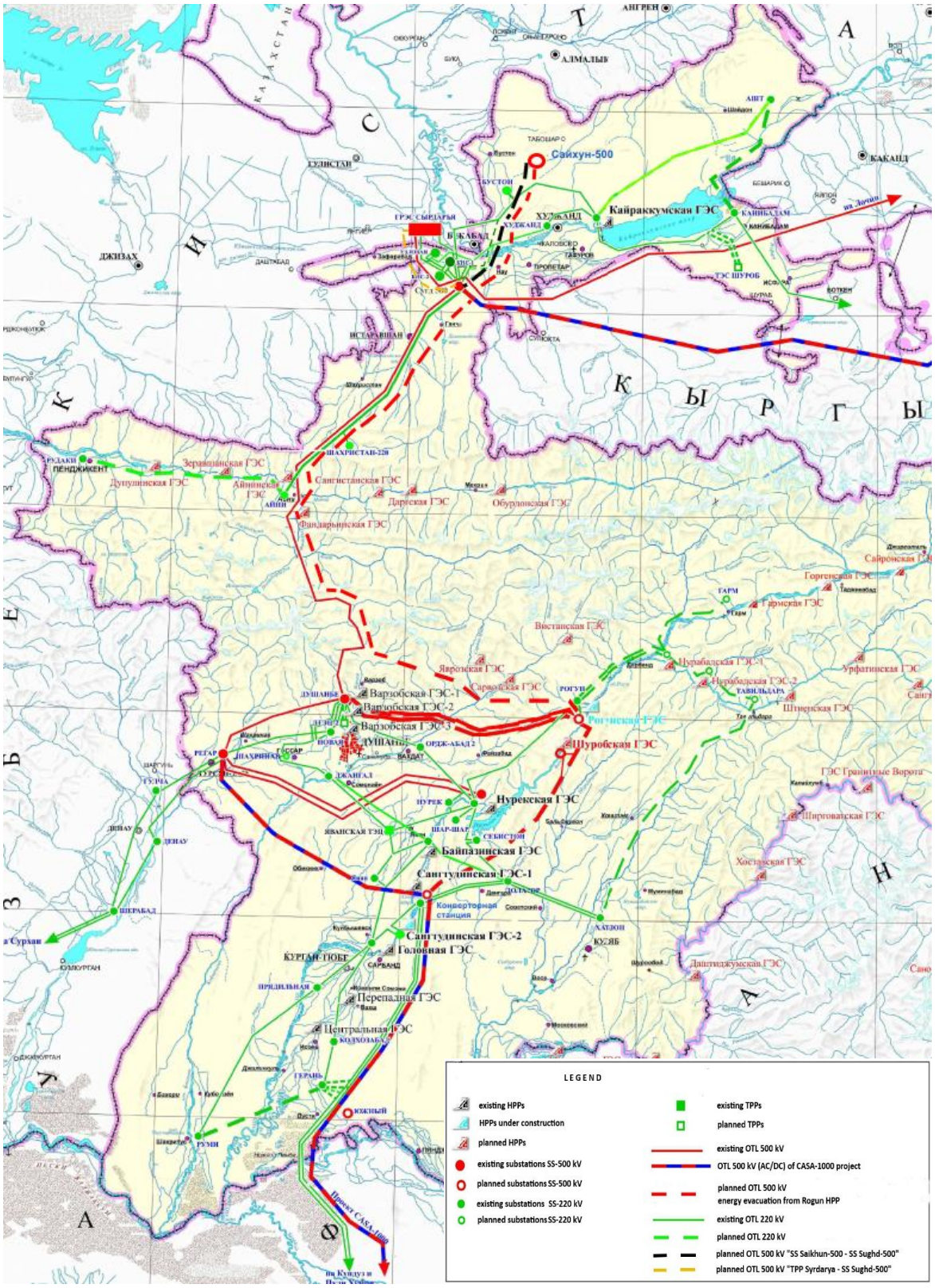
Such cases of multiple resettlement would certainly have to be identified as conflicts between and cumulative impacts of Rogun HPP and these other projects and therefore have to be included in the CIA. It has to be noted that, although TLs to be constructed as part of the CASA 1000 program will be used for exporting electricity from Rogun HPP to neighbouring countries, this latter is not directly related to and not dependent on Rogun HPP (WB 2014)

6.9.2 Transmission Lines

The following transmission lines (see map in Figure 6-18) might create conflicts with resettlement areas of Rogun HPP:

- 500 kV TLs specifically built for connecting Rogun HPP to the national grid.
- CASA 1000, section in Tajikistan. The Central Asia-South Asia Electricity Transmission and Trade Project (CASA 1000) is a project of a TL connecting Kyrgyzstan, Tajikistan, Afghanistan and Pakistan with the aim of exporting electricity from Kyrgyzstan and Tajikistan to Afghanistan and Pakistan. A Regional Environmental Assessment (REA) was made for this project in 2014 (WB 2014). According to this study, this TL is not directly related to or depending on Rogun HPP, and therefore also not a project than can be seen as required for Rogun HPP. While construction of the parts of the line in three countries are largely finalised, construction in Afghanistan was interrupted in 2021. In February 2024 World Bank announced that an agreement was reached which allows to finalise this project (https://www.worldbank.org/en/news/statement/2024/02/23/casa1000resumptionafghanistan). This

was also confirmed in a meeting with Mr. Jamshed Shoimzod, First Deputy Minister, Ministry of Energy and Water Resources, on 2024-05-06.


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6.9.3 Conclusions

A discussion of the issues with the DFZ held on 2024-05-01 provided the following information:

- Transmission lines: there is no case of a conflict between resettlement areas and CASA 1000 or any other TL project. The issue was raised by a participant in a consultation meeting with resettled persons where one of the participants asked whether a new transmission line to be built in the area would present a risk for himself, his family and his house. This was clarified with the TL project proponents and it was confirmed that the distance between new TL and inhabited areas was sufficient and not creating any risk (information confirmed by PMG). In the case of any new TLs that might still have to be built, there would be enough flexibility in defining the alignment for avoiding conflicts with resettlement sites.
- Dushanbe-Tursunzoda-Uzbekistan border road project: this road was built in 2018. It passes at a distance of at least 10 km from the nearest resettlement village.
- Dushanbe-Bokhtar road project: road built in 2022. It does not pass near any of the resettlement villages.

DFZ was/is aware of these projects and would have brought up the issues, would there have been any risk of impact on resettlement sites.

As a conclusion, it can be stated that there is no conflict between the resettlement progress for Rogun HPP and any of these other projects. No mitigation measures are required.

6.10 Pipeline

There is a project for a gas pipeline from Turkmenistan to China (Central Asia – China gas pipeline) which would pass near the Rogun HPP area. The project is presently on hold, no information on it is available. Two statements were received on a potential alignment of this pipeline:

- The first information was that the pipeline would pass approximately parallel to the Rogun reservoir in a distance of about 30 km North of it. In this case, no cumulative impacts would have to be expected.
- According to information received from the DFZ, in the proximity of the project the pipeline would roughly follow the alignment of the new road (replacement road, see Section 6.8). In this case, it might be possible that the new road, at least in places, could serve as access road to some of the construction sites of the pipeline. Since this latter in any case will have to pass through rugged mountain territory, access to such construction sites might often be difficult, and having a road providing access would likely decrease the impact on landscape and habitats caused by such access roads. This would be a positive interaction between the two projects, however, with the level of available information it is not possible to come to any more precise conclusions.

Negative impacts of the pipeline on Rogun HPP are not expected.

7 CONCLUSIONS

In this Chapter, the main conclusions from the detailed discussions of potential cumulative impacts are summarised shortly.

7.1 Pipeline

Definition: The Central Asia-China Gas Pipeline is planned to pass north of Rogun reservoir. No detailed information on this project, which is presently on hold, is available; see Section 6.10 for details.

Interactions and Cumulative Impacts: cumulative impacts with Rogun can be excluded. Two different indications on potential pipeline arrangements were received, namely, (i) the pipeline to pass about 30 km north of Rogun reservoir, and (ii) the pipeline to follow more or less the alignment of the replacement road. None of these should be considered as a reliable plan, however, if the pipeline were to be built in a way as to follow more or less the main replacement road, this latter might provide access to some construction sites of the pipeline, in this way reducing the overall impact of these structures to some extent.

Conclusions: No relevant cumulative effects, no mitigation measures required.

7.2 Transmission Lines and Road Projects

Definition: This includes a number of linear structured of two different types, namely, 500 kV transmission lines built for Rogun and/or as part of the CASA 1000 Project, and two road projects not related to Rogun HPP; see Section 6.9; for details.

Interactions and Cumulative Impacts: There was a concern about a potential conflict between resettlement villages (resettlement triggered by Rogun HPP and therefore part of the Project) and the land requirements for these linear structures. The main concern was that in an extreme case this could mean that households that had been resettled because of Rogun HPP would have to be relocated again because of one of these TL or road projects. As explained in Section 6.9, the two roads in question have been built, and the alignment of the TLs, as far as they have not yet been built as well, is known. There is no conflict with any of the Rogun-related resettlement areas.

Conclusions: No relevant cumulative impacts, no mitigation measures required.

7.3 New Main Road

Definition: The existing road along Vakhsh River in the area of the Rogun reservoir will be submerged during the process of reservoir impoundment. Impoundment has started already and is planned to continue till approximately 2037, when the reservoir will reach its FSL. The road needs to be replaced, and this replacement consists of the following main parts: (i) new main road which provides access to the Garm region, to GBAO and to the border with Kirgizstan, (ii) new main bridge crossing the river (or, finally, the reservoir), and (iii) local access roads to villages on both banks of the river/future reservoir, which lose their present access; see Section 6.8 for details. The local roads are handled as projects on the local level and as direct mitigation measures related to Rogun HPP. The new main road as well as the new bridge are being developed as separate projects with separate financing and are therefore considered as separate projects, to be included in the CIA.

Interactions and Cumulative Impacts: Construction of the new main road in the very rugged terrain along the Northern (right) bank presents a risk of causing additional sediment input into the reservoir. However, since road construction does not take place in the immediate vicinity of the reservoir, this risk is considered as real, but minor and manageable. Another issue is accessibility: the existing road has already been affected by the increasing reservoir water level, and in three places temporary roads had to be built for allowing access to the upper parts of the valley. The ongoing resettlement process for Rogun depends on this access. Should the reservoir interrupt the existing road before the new one is available, the resettlement process could not go on. On the other hand, reservoir filling would not be possible to continue if resettlement had not been done. A delay in reservoir filling could be a problem for the Project since the amount of water that can be retained annually is strictly limited by the relevant water allocation agreements. This means that there is a clear interdependence between reservoir impoundment, resettlement and road construction.

Conclusions: Construction of the new main road is finalised, the road is open for traffic since early 2025; the construction of the main bridge will follow later, reservoir impoundment has not reached that level yet. There is no risk of blocked access to resettlement sites due to submersion of the old road.

7.4 Qosh Tepa Canal

Definition: The Qosh Tepa Canal is a project of a large irrigation canal which will derive water from Amu Darya with the aim of irrigating up to 600,000 ha in Afghanistan. Only limited information on this project is available. 100 out the planed 285 km are built. The canal is expected to derive about 5 km³ of water per year, but depending on source it has the capacity to derive as much as 10 to 20 km³ annually; see Section 6.7 for details.

Interactions and Cumulative Impacts: The canal, located downstream of Rogun HPP, has no impact on this latter, and Rogun HPP, which will be operated under the accepted water allocation rules, will not have any impact on the canal. However, the canal will interfere with water availability in the downstream area (Turkmenistan and Uzbekistan). Rogun HPP has the potential to make additional water available in exceptionally dry years, and the Qosh Tepa canal and the irrigation schemes alimented by it would benefit from this.

Conclusions: Qosh Tepa canal is developed without any relation with Rogun HPP, this latter Is not connected in any way with the canal, and no cumulative impacts are no cumulative impacts to be expected between Rogun HPP and the Qosh Tepa Canal. However, since both projects are related to the very relevant question of water availability and water allocation in the Amu Darya basin, the canal needs to be included in the discussions on water distribution. In this context it also has to be pointed out that Afghanistan is not a member of the organisations regulating water allocation in the basin.

7.5 Irrigation in Tajikistan

Definition: So far, Tajikistan does not make complete use of the water allocated to it by the relevant international agreement, mainly Protocol 566; in an average year, about 1.2 km³ (corresponding to about 6% of the average annual flow of Vakhsh River or 2% of average annual flow of the Amu Darya) are not used and are therefore available further downstream. Tajikistan plans to use this water for filling Rogun reservoir, a process which has started already. Once the reservoir full, expected for 2037, Tajikistan will use this surplus water for expanding its irrigation activities located downstream of Nurek; see Section 6.6 for details.

Interactions and Cumulative Impacts: In any case, Tajikistan intends to make use of the full share of water allocated to it under Protocol 566, and it is committed to remain within the limitations of the protocol also for filling and operating Rogun HPP.

Conclusions: There will be no change in water availability in the downstream area which would not be within the limitations defined by Protocol 566.

7.6 Pyanj HPP Cascade

Definition: There is a plan for developing a cascade of HPPs on the Pyanj River, which, if implemented completely, would consist in 15 HPPs with a total capacity of 17,900 MW and a cumulative storage volume of 32.5 km³; see Section 6.5 for details. None of these potential HPPs is in an advanced planning stage as yet, and it is very unlikely that any one of these would be developed before the finalisation of Rogun HPP. Pyanj forms the border with Afghanistan, which means that these projects would have to be developed as bi-national endeavours.

Interactions and Cumulative Impacts: Since Rogun HPP and the Pyanj cascade are on different rivers, there would not be any direct interactions between the two. However, since they are both located in the headwaters of the Amu Darya, adding this cascade (or relevant parts of it) to the system would increase the potential for influencing water availability in the downstream area.

Conclusions: A potential cumulative impact of Rogun HPP with the Pyanj cascade could be an influence on water availability in the downstream area, mainly in Turkmenistan and Uzbekistan, but also in Afghanistan, once Qosh Tepa Canal built. This, however, would become manifest only at some not yet definable point in the future. Still, the fact that such a situation might actually develop just points out the importance of basin-wide agreements on water use.

7.7 HPP Cascade Upstream of Rogun

Definition: As for Pyanj, there is a plan for developing two additional HPP cascades on Surkhob and Obihingou, the two rivers which at their confluence form Vakhsh River; combined they would comprise 9 HPPs with a total installed capacity of 5,800 MW and a total storage volume of 3.0 km³; see Section 6.4 for details. As for the Pyanj cascade, none of these is in an advanced planning stage, and it is not envisaged to go ahead with this development before Rogun HPP will be commissioned and in operation.

Interactions and Cumulative Impacts: Adding these two cascades to the same river system (Vakhsh) would clearly result in a number of cumulative impacts. Since the planned cascades are upstream of Rogun, this latter would not influence them in any way. However, a few points have to be mentioned:

- Hydrology: Surkhob and Obihingou cascades would add additional storage volume to the Vakhsh cascade. It has to be assumed that they would be developed and operated following the same conditions as for Rogun HPP, i.e. without any additional seasonal shift of water and by filling them using the available water volume according to Protocol 566; therefore, they would not in any way negatively impact water availability along the Amu Darya. Still, it needs to be observed that during the filling phase this water would not be available for irrigation within Tajikistan. On the other hand, the additional storage once filled this would increase the potential for releasing water in extremely dry summers, which would definitely be a positive effect on water use along the Amu Darya; concerning this issue see also Section 9.6.
- River habitat fragmentation: The lower reaches of Vakhsh River were already fragmented by Nurek dam and the HPPs downstream of Nurek, and Rogun HPP adds to this by creating an additional barrier and by fundamentally changing habitat conditions on the entire length of its reservoir. Presently, there is no information available on the value of Surkhob and Obihingou as aquatic habitat, but building these additional dams would add to river fragmentation. The importance of this would have to be analysed in the ESIAs which would have to be prepared for this further development.
- Floodplain submersion: the filling of Rogun reservoir will submerge two major of floodplains. These are considered as natural habitats, although they do not fulfil the conditions as critical habitat. Adding the Surkhob cascade would in all likelihood have a negative impact on the numerous floodplains along this river (see Figure 6-10). This cumulative impact on this habitat type is shortly discussed in Section 6.4.2; see also the suggestions for a potential biodiversity offset in Section 8.3.
- Sedimentation: Additional dams upstream of Rogun would mean additional storage room for sediments. This would have the positive effect of reducing the amount of sediment reaching Rogun reservoir, thereby increasing the potential life span of Rogun HPP (and with it also of Nurek HPP). The overall cumulative effect on the entire Vakhsh cascade would be positive.

Conclusions: There would certainly be cumulative impacts of Rogun and the two upstream cascades, neutral (or slightly positive) concerning hydrology, negative concerning biodiversity and aquatic habitats, and positive concerning sedimentation and overall life span of the Vakhsh cascade.

7.8 Shurob HPP

Definition: Shurob HPP is planned to be built once Rogun has reached the operation stage, with a dam and power house with 850 MW installed capacity at the upper end of Nurek reservoir and a reservoir reaching the toe of Rogun dam. It would use the water released from Rogun and the remaining head between the two large HPPs; see Section 6.3 for details.

Interactions and Cumulative Impacts: Shurob cannot be built without Rogun, as otherwise its small reservoir would be filled with sediment very quickly. Once Rogun in place, the water released from the dam will be almost free of sediments. Shurob reservoir will impound the remaining 17 river km between Rogun HPP and Nurek reservoir. However, this impact is considered as very minor, since this is a short and completely isolated river stretch which in addition to that will be exposed to the regime dictated by the operation pattern of Rogun HPP, which will at least to some extent be a peaking pattern, i.e. with marked short-term fluctuations in water quantity and flow velocity. Shurob will depend completely on water released from Rogun. One additional at least marginally positive effect would be that it will offer job occasions during construction, where at least some of the workers who will lose their job at the end of construction activities for Rogun could find a new source of income. There would be no competition for workers between the two, since there will be no overlap of the two construction phases; note that the two upstream cascades, if actually developed, would have the same effect.

Conclusions: Shurob, in all likelihood, will be a low-impact addition to the Vakhsh cascade, and it will contribute substantially to electricity supply. No negative cumulative impacts are expected.

7.9 Vakhsh Cascade Downstream of Rogun

Definition: Rogun HPP will be a major addition to the cascade on Vakhsh River, which as of now consists of one large storage scheme, Nurek HPP, and a cascade of smaller, basically ROR schemes downstream of it; see Section 6.2 for details.

Interactions and Cumulative Impacts: Given the proximity of Rogun to the downstream cascade (same valley, same river, short distance), potential cumulative impacts have to be analysed carefully. Main facts and conclusions are the following:

- Hydrology, yearly flow pattern: as all large storage dams, Rogun has the potential to retain water during the high-flow season (in this case spring and early summer) for using it for electricity generation in the low-flow, high-demand season (winter). This would be to the detriment of downstream water users who have to rely on water for irrigation, with a high demand in the growing season. Tajikistan has committed itself to build and operate Rogun HPP respecting the agreed-upon rules for water allocation and water use among the riparian states in the Amu Darya basin, and especially Turkmenistan and Uzbekistan. This means that Tajikistan will not use more water than allocated to it under Protocol 566, and it will not shift water from summer to winter in addition to the 4.2 km³ already shifted by Nurek; this quantity corresponds to the live storage volume of Nurek and can be retained only after a winter reservoir drawdown to the Minimum Operation Level (MOL) of Nurek reservoir. The change in the cascade with Rogun HPP will be that yearly regulation will be done largely by Rogun, while Nurek reservoir will be kept at a more or less stable level throughout the year. Overall, this clearly means that for downstream water users the situation with Rogun HPP in place will not change; see also ESIA Vol. 1,. Ch. 13, Water.

- Hydrology, short-term fluctuations: in addition to seasonal storage, hydropower plants also have the potential for changing production very quickly (peaking regime). This allows the utility to very closely follow demand, which as a rule is not constant during the day, but usually follows a distinct pattern with times of high demand and times of low demand. This plasticity in production can be a problem for the river and its surroundings, including people living along and close to the river, since it can mean very marked short-term variations in river discharge and flow velocity, which has a potentially very negative impact on aquatic habitats and can be a safety risk for people. In the case of Rogun, however, it has to be pointed out that the area between Rogun dam and Nurek reservoir is not inhabited or used by people in any way and that therefore there is no safety risk for people, and that the value of this part of the river as habitat for aquatic organisms is very low (see ESIA Vol. 1, Ch. 15, Biodiversity). Presently, seasonal as well as daily peaking is done by Nurek. Once Rogun operational, this will be assumed by Rogun to a large extent. Nurek will still have to do some daily peaking, following the operation pattern of Rogun. The smaller schemes downstream of Nurek, which have only small (hourly or at most daily) regulating capacities, will in turn follow this pattern, smoothing out the short-term fluctuations in the process. At the downstream end of the cascade, river flow is constant with small if any daily fluctuations. The situation with Rogun in place will be the same as today.

- Riverine and aquatic habitats: Construction of Nurek dam and HPP changed the situation in Vakhsh River considerably, mainly in three respects:

    - As mentioned, Nurek shifted 4.5 out of the 20 km³ flowing on average annually in Vakhsh River from summer to winter, in this way reducing the seasonal difference between the high- and the low-flow seasons, reducing the former and increasing the latter.
    - Nurek reservoir retains as good as all the sediments transported by the river. The water downstream of Nurek is largely devoid of sediments, whether bedload or suspended solids.
    - Like all storage reservoirs, Nurek reservoir also has a capacity for flood regulation. This means that flood events are smoothed out a least to some extent, especially by reducing peak flows during floods.

  These changes had a considerable negative impact on one important semi-aquatic habitat, namely the floodplain and Tugai vegetation in Tigrovaya Balka, since this habitat type largely depends on seasonal changes in water discharge and therefore water level, on sediment dynamics, and on occasional flood events. One additional negative impact of Nurek and the downstream cascade on biodiversity was the fact that any long fish migrations between the Amu Darya and the upper reaches of Vakhsh River, which under natural conditions may have been quite important, were completely interrupted.

  Rogun may have added to a small extent to a further reduction in short-range fish migrations from Nurek reservoir upstream. Other than that, the situation in the downstream area, especially concerning Tigrovaya Balka and fish migrations, will not be changed due to Rogun.

- Floods, PMF: Nurek is not able to safely manage PMF (Probable Maximum Flood), however, Rogun HPP was designed in a way as to be able to do so. This is a considerable improvement in risk management for the downstream area, reducing the risk of a dam break and its potentially disastrous consequences in this whole area. This is a very relevant positive cumulative impact of Rogun HPP with

the downstream Vakhsh cascade, which may become even more important in the future, since under the conditions of climate change there is a risk of more marked and important short-time changes in river flow which may result in floods. Details for this still need to be evaluated and described in an Emergency Preparedness Plan (EPP). The EPP for the dam with crest elevation at 1110 m asl was submitted on February 29, 2024. The preparation of the EPP for the full dam is under way.

- Sedimentation: Rogun will retain sediments, in this way avoiding accumulation of additional sediment in Nurek reservoir. This will increase the total life span of Nurek HPP, a positive effect on the entire Vakhsh cascade.
- Joint operation of Rogun and Nurek HPPs will also increase electricity generation in Nurek to some extent; this is mainly due to the fact that there will no longer be a marked drawdown of Nurek reservoir in winter, thus allowing to benefit from the additional head.
- The addition of Rogun HPP to the Vakhsh cascade offers the potential to deliver additional water to the downstream area in the case of exceptionally dry years; this would be a considerable positive effect; see discussion of this topic in Section 9.6.

Conclusions: As main conclusions, the following can be said:

- Operating Rogun and the entire Vakhsh cascade while respecting the conditions defined in Protocol 566 concerning water allocation, and especially by not shifting additional water from summer to winter will prevent any negative cumulative impacts on water users in the downstream area.
- The overall joint operation of the cascade will not lead to additional negative impacts on aquatic habitats and related biodiversity in the downstream area (especially: Tigrovaya Balka and fish migrations).
- The fact that Rogun will be able to handle the PMF is a positive effect for the downstream area by reducing the risk of a dam break event.
- Rogun HPP will add a considerable amount of electricity to the Tajik, and potentially to the Central Asian grid, without changing the water regime in the downstream area.
- Adding Rogun to the cascade will have a number of additional benefits, namely (i) increasing the life span or Nurek by retaining sediments, (ii) increasing to some extent energy production in Nurek HPP, and (iii) giving the possibility of releasing additional water to the downstream area in the case of dry summers.

Overall, it can be concluded that there will be no negative impacts, but some improvements in the downstream area, due to the cumulative effects of Rogun HPP with the Vakhsh cascade.

8 MAIN CONCERN 1: BIODIVERSITY

The three aspects more or less directly related to biodiversity mentioned in Section 3.2.2 are discussed here, with a focus on potential impacts caused by Rogun HPP and the other projects included in the CIA.

8.1 Aral Sea

The situation of the Aral Sea was described in detail in the 2014 ESIA. To summarise it very shortly: the northern, smaller part of the former Aral Sea was separated by a dam from the much larger southern part. This dam serves the purpose to keep the northern part, which is alimented by the Syr Darya, as a lake. The southern section has almost disappeared, only a very small part still exists in the area which was originally the western, deepest part of the Aral sea (Figure 8-1). There, salinity is so hight that no fish can live in this water any longer. When mentioning the Aral Sea in this report, this clearly only refers to the southern (originally large) part of the former Aral Sea.

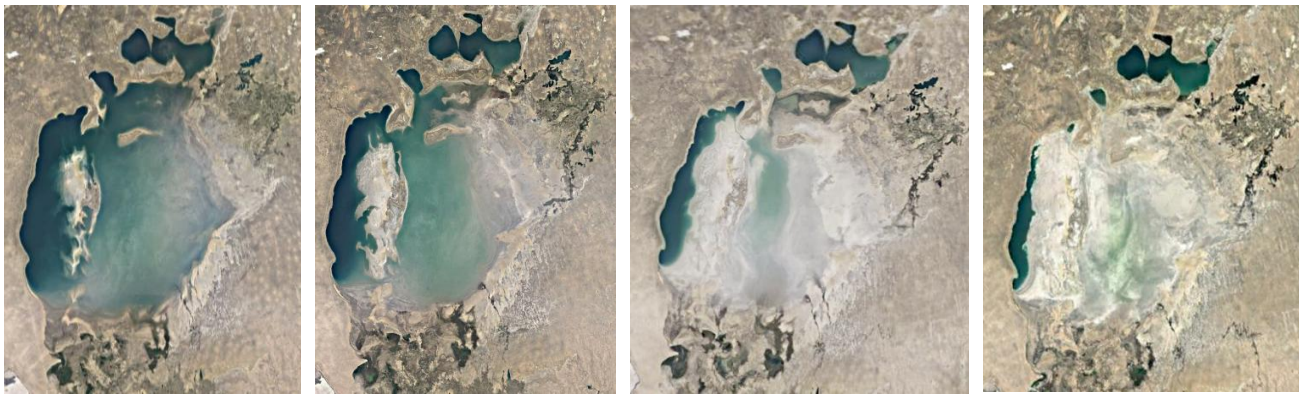


Figure 8-1: Situation of the Aral Sea 1984, 2000, 2010 and 2020 (from left to right)

Source: Google Earth

This situation is caused by the fact that very little water from the Amu Darya, the only relevant tributary, reaches the lake any longer, in dryer than average years usually none at all; see details in Section 6.6.2.3. Ways to save the Aral Sea by adducting water from other sources have been studied, but none of them is feasible.

Under BVO regulations a certain volume of water is allocated to the Aral Sea, but as Figure 8-2 shows, this amount is often (in 10 out of the 15 years on record) not reached. In any case, the amount is too small to have kept the Aral Sea from shrinking further, as Figure 8-1 clearly shows.

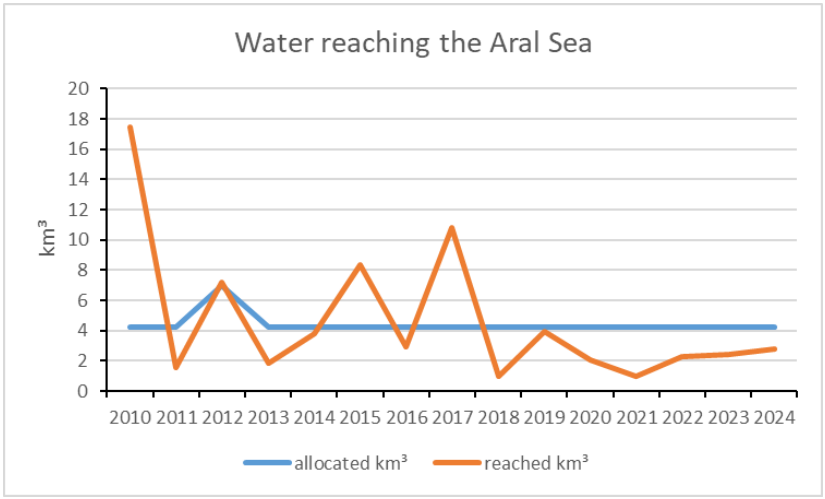


Figure 8-2: Water allocated to and reaching the Aral Sea

Data source: BVO (http://sic.icwc-aral.uz/reports_e.htm)

The following Figure gives an impression on water availability and water use in the Amu Darya basin, showing total actual annual flow and total cumulated use.

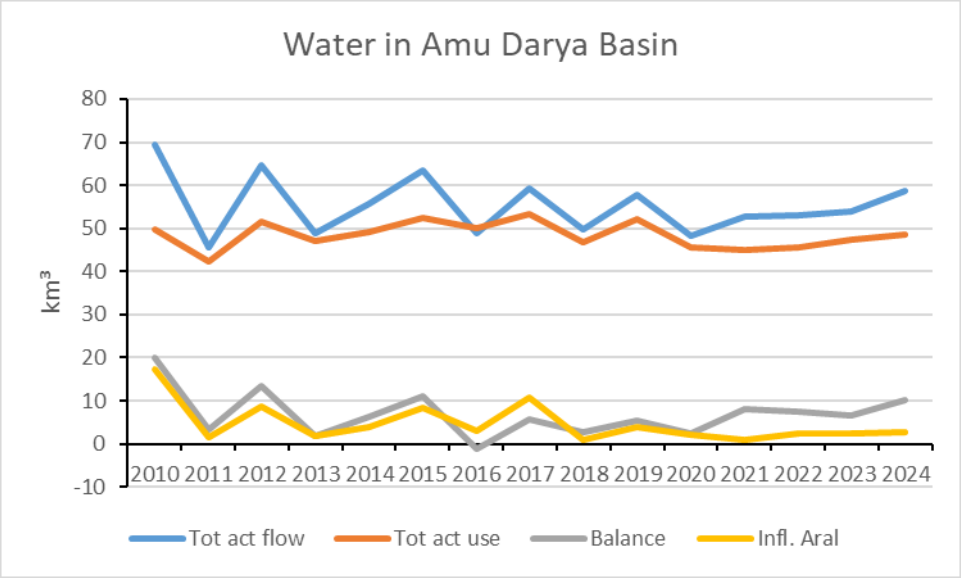


Figure 8-3: Total yearly water flow and use in Amu Darya basin

Data source; http://sic.icwc-aral.uz/reports_e.htm

The Figure also shows something else which is of high relevance in the context with Rogun HPP: while there seems to be some correlation between balance (i.e. water not used) and inflow to the Aral Sea, these two parameters are not directly correlated. It cannot be assumed that the total volume of unused water in the basin would automatically reach the Aral Sea. This is clearly shown by the data for the last few years, where there was a slight increase of unused water without a corresponding increase of water reaching the Aral Sea. This also means that it cannot be assumed that any change in water released from Rogun would result in a same effect on inflow to the Aral Sea.

Recently, USAID has started two projects in the Aral Sea region (https://www.usaid.gov/central-asia-regional/fact-sheets/usaid-environmental-restoration-aral-sea-ii) :

- USAID Environmental Restoration of the Aral Sea I: this is a project "to provide environmental restoration measures to improve the resilience of landscapes in the Northern Aral Sea zone. The implementation of the Environmental Restoration of the Aral Sea I Activity supports regional transboundary cooperation for water and environment and enhances resilience to climate change for vulnerable populations and ecosystems." (UDAID Fact Sheet). The Environmental Restoration of the Aral Sea I Activity aims to introduce innovative measures to create an "Oasis" using black saxaul (*Haloxylon ammodendron*) in the Northern Aral Sea zone.
- USAID Environmental Restoration of the Aral Sea II "aims to employ, demonstrate, and evaluate a variety of innovative technologies and planting and irrigation practices that will add new dimensions to the regional knowledge base on afforestation of desert biomes" (USAID Fact Sheet).

Both of these projects aim at improving the environmental situation in the area of the former Aral Sea, but it must be clearly understood that the aim is not (and cannot be) a restoration of the Areal Sea as it existed until about the 1950s. The Oasis being created by this project is located in Kazakhstan, close to the Northern Aral Sea and far outside the area that could be reached by water flowing into the lake basin from the Amu Darya. A request for additional information sent to the e-mail address indicated in the above-mentioned home page was not answered.

There is no interaction of any kind between Rogun and these two USIAD projects. There is also no cumulative impact between these two projects and Rogun HPP.

As shown in the scenarios in Section 9.7, the fact that Tajikistan will use its full share of water, i.e. on average 1.2 km³ (equal to 2% of the total Amu Darya flow) in addition to the volume used presently, could lead to an increase in frequency of years when very little or no water will reach the Aral Sea, depending on the consumption pattern of Turkmenistan and Uzbekistan. However, as shown above there is no direct relationship between the amount of unused water and inflow to the Aral Sea, and in any case the quantities are too small as to cause a noticeable change in the situation of the Aral Sea, and it has to be pointed out that this situation will materialise with or without Rogun HPP, and is in compliance with ICWC/BVO regulations.

8.2 Fish Migration

It has to be assumed that originally there were rather frequent and relevant fish migrations between Amu Darya and Vakhsh River; a number of fish species as recorded in the 2014 and the 2025 ESIA are in fact migrating species, usually moving upstream for reproduction. However, no detailed data on the situation before the construction of Nurek dam are available. A recent overview of the development of the Aral Sea – and the Aral Sea crisis – mentions three species of fish which originally migrated over a distance of more than 1000 km upstream from the lake, without however giving any further detail, and especially without mentioning if such migrations might have reached into Vakhsh River (Plotnikov et al., 2023). Of the two sturgeon species of the Amu Darya, both critically endangered according to IUCN, one, the Small Amu Darya Shovelnose Sturgeon (*Pseudoscaphirhynchus hermanni*), is endemic to the middle and lower reaches of Amu Darya and may never have reached Vakhsh river, while the second one, the Large Amu Darya Shovelnose Sturgeon (*Pseudoscaphirhynchus kaufmanni*), may still occur in the lower parts of Vakhsh river. Around 2012, an attempt was started for an artificial breeding program for this latter species (https://life-on-earth.ru/sokhranenie-bioraznoobraziya/amudarinskie-lopatonosy-reka-vakhsh-tadzhikistan), which however does not seem to have produced positive results. A later project working with specimens from both species from populations downstream or Tuyamuyun reservoir, Uzbekistan, was stopped in 2021 due to lack of funding and problems presented by the COVID-19 pandemics (https://life-on-earth.ru/amu-darya-and-syr-darya-shovelnose-sturgeons/amu-darya-shovelnose-sturgeons-conservation-uzbekistan).

The fact is that all long-range fish migrations in Vakhsh river were completely interrupted by the construction of Nurek dam. There is no information on whether the Large Amu Darya Sturgeon may have reached the area of Nurek and beyond before its construction. The additional, smaller dams downstream of Nurek contributed to a further fragmentation of the lower reaches of Vakhsh River and may have led to interruptions of short-range migrations.

The construction of Rogun dam does not change this situation. Even if there is a possibility of interrupting some fish migration from Nurek reservoir further upstream, this is considered as an impact of very minor relevance in both ESIAs. Since, as shown above, Rogun HPP will not change river flow patterns, neither seasonal nor short-term ones, downstream of the Vakhsh cascade, it will also not change in any way present conditions for fish migration in the Amu Darya Basin.

8.3 Tigrovaya Balka

Potential impacts of Rogun HPP on Tigrovaya Balka is an issue of concern among organisations involved in biodiversity conservation.

Tigrovaya Balka is a nature reserve in the lower reaches of Vakhsh River, at its confluence with Pyanj River. It protects a Tugai habitat, a type of wetland characteristic for Central Asia, which is getting increasingly rare; see the 2014 ESIA (Chapter 12) for a detailed description. It is also a UNESCO World Heritage Site (see https://whc.unesco.org/en/list/1685).

Like all such floodplain wetlands, its long-term existence depends on river dynamics, and especially on the following conditions:

- a meandering river which will shift its bed from time to time, creating in the process so-called oxbows, i.e. lake-like sections of former river beds cut from the present river flow;
- seasonal flooding due to a strong seasonal regime of the river, with a high-flow season (which here is the snow melt season, i.e. late spring and summer) and a low flow season (winter);
- occasional very high floods, often capable of changing the landscape by leading to shifts in river bed and sediment transport; and

- sediment dynamics, including transport, deposition and remobilisation of sediments depending on river discharge and flood events.

> Tugai: The typical floodplain forests (riparian forests) grow on slightly higher areas, which are covered by water only for short durations. The soils are alluvial silts or sandy silts. The most important tree species is *Populus diversifolia* (Turanga) with *Populus pruinosa* (Petta). The trees grow to a height of 13-15 m and reach an age of 35-40 years. Timber stock amounts to 90-200 m³ per ha. Undergrowth is formed by willows (*Salix*) with *Eleagnus orientalis* on dryer places. *Tamarix* spp. and *Halimodendron halodendron* occur on slightly brackish soils. Lianas are abundant and reach up to the tree crowns (*Clematis orientalis, Cynanchium sibiricum, Asparagus persicus*).
>
> Source: Walter and Breckle 1986: p. 292 (translated from German)

As described in the 2014 ESIA, water regime and sediment transport in the downstream area of Vakhsh River were changed fundamentally by the construction of Nurek dam and its operation as a seasonal storage reservoir. This caused changes in the Tigrovaya Balka Tugai, which still continue.

Rogun HPP will not change this situation (see Section 6.2.3 for a detailed discussion of this issue), and the habitat dynamics (or its absence) in Tigrovaya Balka will still be determined by Nurek HPP. There will be no additional negative effect of Rogun HPP on Tigrovaya Balka. This means that a negative impact of Rogun HPP, or a cumulative impact of Rogun in combination with the Vakhsh cascade, can be excluded, and that therefore there is no obligation for Rogun HPP to mitigate the impact.

Having said this, however, it has to be pointed out that Tigrovaya Balka is still a very valuable and fragile habitat type in the wider project area, which could benefit greatly from careful management aiming at improving the prevailing conditions. In case such an undertaking should be envisaged, the following would need to be done:

- Checking whether any of the measures proposed in the 2014 ESIA were implemented; this includes the habitat improvement program that was envisaged or under way at that time.
- Checking whether in the meantime any other habitat management programs were proposed and implemented.
- Analysis of the present situation (field work including vegetation, fish and avifauna, potentially other groups as well). Description of the development of the situation in comparison with earlier assessments.
- Extensive involvement of relevant stakeholders (local inhabitants, local, national and international nature conservation organisations which were involved in the protection of the area, etc.).

Based on this, a plan for improving the situation could then be established and implemented. It is probable that the main contribution of the HPP cascade to an improvement of the situation would be the creation of occasional floods during the natural flooding season, i.e. between April and July. Under present conditions, i.e. almost without any sediments being transported, these floods could only serve the purpose of periodically reaching a normal high water level within the floodplain, with the aim of eliminating plants that do not belong to the floodplain habitats, but are now invasive in some parts which are no longer covered with water more or less regularly. This would serve the purpose of maintaining the specific Tugai vegetation. Such seasonal flooding, however, could not restore the floodplain dynamics as such, which under natural conditions would include the occasional shift of the river bed as well as local accumulations or removals of sediment. In no case should such floods be undertaken without a careful preparation, planning and monitoring.

As already mentioned in Section 6.4.3, such a rehabilitation program, especially if it would also include other sites and types of floodplain habitat, would have to be done independently of Rogun HPP.

Loss of floodplains due to Rogun reservoir is one of the impacts to be addressed for reaching NNL. The BMP (2025 ESIA, Volume 3, A04: Biodiversity Management Plan, Table 3-3 - BMP Actions) specifies this as follows:

> "1a(i): An off-site area will be managed to compensate for the loss of approximately 77ha of floodplain habitat. This compensation will be developed and delivered through a no net loss plan. At this stage, a No Net Loss Framework (NNLF) has been produced and is appended to this BMP. The NNLF will demonstrate how the requirements of ESS6 will be delivered with regards to losses of floodplain Natural Habitat and will also identify key stakeholders required to be engaged with/consulted as the NNL process develops. Measures to compensate for losses will comprise:

- Restoration and protection of ‘tugai’ habitat
- A contingency restoration and protection action for native fruit and nut woodland

Both options represent ‘better than like for like’’ measures based upon the higher conservation importance of both of these habitat types (compared with the floodplain habitat being lost).

1a(ii) Upon agreement of the option(s) available to achieve no net loss to floodplain habitat, a shortlist of NNL sites will be produced and submitted for Government/Lender approval. A NNL management, protection and monitoring plan will be produced that will provide detail necessary to deliver the required NNL. This will be an operational document that will be produced and implemented by end-2030 (i.e. dam completion date).”

The No Net Loss Framework (NNLF) developed as part of the ESIA (Vol. 3, A5) carefully identifies and evaluates possibilities for achieving NNL. In this process, Tigrovaya Balka was eliminated as a suitable candidate location for this purpose.

9 MAIN CONCERN 2: WATER AVAILABILITY IN THE DOWNSTREAM AREA

9.1 Water Use and Potential Conflicts of Interest

As mentioned in the Report, water availability, water use and water allocation among riparian states is a major issue in Central Asia, and specifically in the Amu Darya basin. In terms of quantity of water used, there are two main types of water uses, namely, hydropower and irrigation. Irrigation is a consumptive type of water use: once diverted from the river, much of the water is lost through evaporation, evapotranspiration from plants and infiltration, especially in the case of inefficient irrigation systems where losses due to infiltration are very substantial. This means that little if any of the water diverted to irrigation systems finds its way back to the river. Unlike irrigation however, hydropower is a non-consumptive type of water use, meaning that if in the upstream region water is used for generating electricity it is still available for irrigation in the downstream area. Therefore the reason for potential conflicts between hydropower and irrigation are not founded in the use of water as such, but in the different seasonal requirements: irrigation needs water in the growing season, mainly spring and summer, low flows in winter are not an issue. Hydropower, on the other hand, requires more water during winter, when electricity demand is highest, but which is also the low-flow season; storage dams with their large reservoirs therefore aim at retaining water during summer for using it in winter.

9.2 Present Water Use in Tajikistan

As outlined in Section 5.2, water allocation among the riparian states Kirgizstan, Tajikistan, Turkmenistan and Uzbekistan is defined by ICWC/BVO. Based on the forecast on expected water quantity in the following vegetation period derived from observations of snow cover in the upper reaches of the Amu Darya basin, each country is allocated a certain amount of water. Figures on this allocation as well as on actual consumption are provided in a BVO home page (http://sic.icwc-aral.uz/reports_e.htm); these figures are also shown in Annex 2. The following Figures show present use of this water in Tajikistan for the period 2010 to 2024, the period for which data are available on the internet site mentioned above.

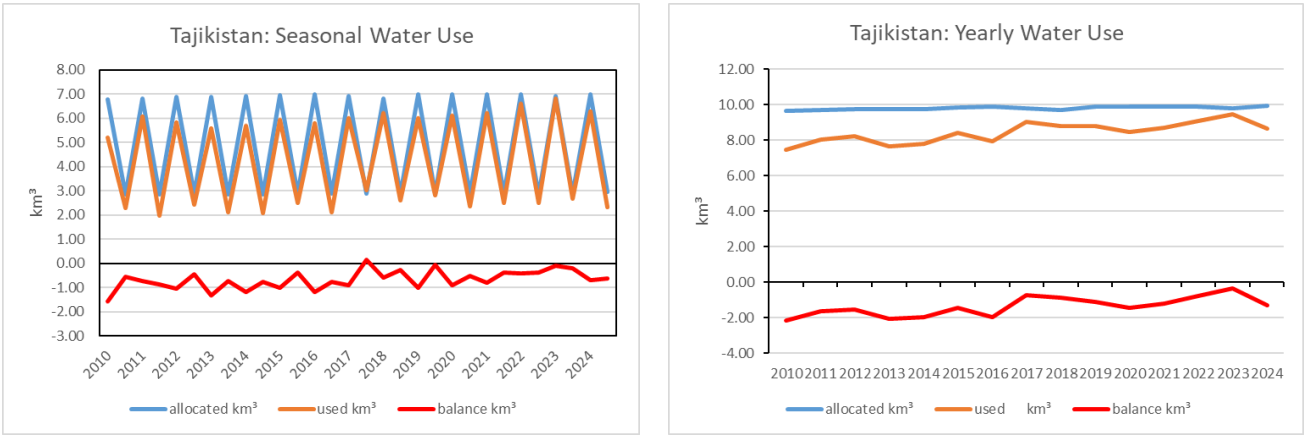


Figure 9-1: Seasonal and yearly water use by Tajikistan

In the BVO homepage, values for the winter 2012-2013 are missing; they were replaced here by the avarage of all 13 winter values on record.

The Figure shows that Tajikistan uses less water than its allocated share, as shown also in the following Table.

Table 9-1: Yearly water use by Tajikistan

Year	allocated km³	used km³	used %	balance km³
2010	9.63	7.48	77.67	-2.15
2011	9.67	8.05	83.25	-1.62
2012	9.75	8.24	84.51	-1.51
2013	9.72	7.67	78.91	-2.05
2014	9.75	7.79	79.90	-1.96
2015	9.82	8.41	85.64	-1.41
2016	9.88	7.91	80.06	-1.97
2017	9.77	9.03	92.43	-0.74
2018	9.67	8.80	91.00	-0.87
2019	9.88	8.80	89.07	-1.08
2020	9.88	8.46	85.63	-1.42
2021	9.88	8.69	87.96	-1.19
2022	9.86	9.09	92.19	-0.77
2023	9.78	9.46	96.73	-0.32
2024	9.94	8.63	86.82	-1.31
Water not used (average)				-1.36

This shows that on average during the period on record, Tajikistan was not using 1.36 km³ of its allocation per year. According to information received from the Energy and Water Policy Department (oral comm.), the fact that recently consumption almost reached allocation is mainly due to the fact that there were some dry years, but also some major usage of water for flushing fields of salts that had accumulated in past years. However, it has to be seen that some water has already been retained in Rogun reservoir, and this amount of water is included here. In the middle and long term, as already mentioned, Tajikistan intends to use its full share, first for filling Rogun reservoir, later on for expanding its irrigation. The important point here is that this will be done within the limitations defined by BVO.

9.3 Importance of Electricity

For Tajikistan, and in the context of the conditions in Central Asia, electricity has the following characteristics and importance:

- Abundant water resources in combination with the mountainous terrain provide ideal conditions for hydropower in Tajikistan.
- Electricity is required for satisfying the increasing domestic demand; until very recently, electricity supply was not sufficient for supplying the entire population, especially in winter, and in some remote areas this is still an issue.
- Given the abundant resources, electricity is also a potential source of income for Tajikistan by selling it to neighbouring countries (CASA 1000 project).
- Hydropower is very suitable for peaking, i.e. for responding to short-term demand changes in the grid; this could be supplied by base-load from thermal power plants in neighbouring countries.
- Hydropower also plays an important role in decarbonising the energy sector, i.e. as a measure to reduce climate change.

The 2017 Energy Sector Master Plan for Tajikistan lists a potential for hydropower of 28,610 MW (see Table 9-2).

Table 9-2: Hydropower potential in Tajikistan

River	Estimated capacity* MW	Comments
Vakhsh	4,450	Capacity includes Rogun HPP (3,600MW) + Shurob HPP (850 MW)
Surkhob	1,800	MoEWR 2024: 2,100 MW**
Obihingou	1,750	MoEWR 2024: 3,700 MW
Kafirnigan	1,450	Tajik tributary to Amu Darya downstream of Vakhsh
Zeravshan	1,260	River in the North of Tajikistan, tributary of Syr Darya, not part of the Amu Darya basin.
Pyanj	17,900	MoEWR 2024: 17,900 MW
Total	28,610	MoEWR data bring total up to 30,860 MW

*Source: Corporate Solutions, 2017: 84
** Data received from MoEWR (Ministry of Energy and Water Resources), see Sections 6.4 and 6.5.

In 2017, installed hydro capacity amounted to 4,926 MW (Corporate Solutions 2017). This indicates that there is still a very considerable potential for additional capacity.

Comments on the 2014 and the updated ESIA noted that selection of a lower dam would reduce the number of people who would have to be resettled, causing only a small reduction in electricity generation. It is certainly correct that a lower dam height would have reduced the need for resettlement, as was discussed in the 2014 ESIA. However, the point of "small reduction electricity generation" needs to be considered with somewhat more detail. This is done in Table 9-3.

Table 9-3: Comparison of dam height alternatives

Parameter	Dam height alternatives		
	FSL 1290	FSL 1255	FSL 1220
Dam height	335	300	265
Reservoir area km²	159	114	68
Reservoir volume km³	13.3	8.5	5.2
Installed capacity MW	3,600	3,200	2,800
Resettlement Villages	77	36	25
Households	6,035	2,433	1,825
Persons*	42,000	18,000	13,000
Electricity TWh/y	14.4	12.4	10.1
Life span years	115	75	45
Life span electricity TWh	4,830,000	1,350,000	585,000

* Figures from the 2014 ESIA; present estimation is at about 55'000 persons to be relocated in total, and Rogun HPP installed capacity is 3,780 MW.

Just looking at installed capacity and yearly electricity output, a reduction by 11% and 14% respectively might be considered as minor. However, the issue is the life span of the alternatives. If electricity output over the life span is considered, a reduction of the dam height by 35 m would reduce electricity output by 72%. It has to be assumed that this difference would have to be compensated by building alternative power plants, which would create impacts, probably in the form of resettlement, as well.

9.4 Potential Future Development

It cannot be the aim of this report to prepare a detailed analysis of the future changes in the water sector in the Amu Darya basin. However, as shown there is a clear potential – and certainly a requirement – for further development. The most important items are:

- Implementation of additional hydropower schemes, some of which potentially with large storage volumes.
- Additional water demand for irrigation (in Tajikistan, but to a large extent in Afghanistan, see Section 6.7); this latter has the potential for greatly increasing water abstraction from the system, to the detriment of existing infrastructure.
- Efforts in existing irrigation systems for increasing efficiency, in this way reducing water demand.

All this will happen under the influence of climate change (see the following Section).

9.5 Climate Change

Whatever the success – or failure – of measures for reducing GHG output to the atmosphere will be, Rogun HPP and the further development of water resources in the Amu Darya basin will have to deal with the effects of climate change. One main concern is that, since water shortage regularly causes severe problems in dry years, especially in the lower reaches of Central Asian rivers, this situation could worsen in the future, given the fact that climate change is expected to have some negative effects, although overall precipitation will probably not diminish. However, rising temperatures will lead to an increase in evapotranspiration, the expected higher irregularity in precipitation could lead to an increase in the number of extremely wet and extremely dry years, and earlier snow melt will mean more water in spring and less in summer.

9.6 Role of Rogun

Rogun HPP is only one, although certainly rater important, component of the entire water use systems and structures within the Amu Dary basin. Since it will be operated in compliance with the water allocation rules according to Protocol 566, it will not cause any difference in water availability for the downstream water users.

However, as analysed in detail in the 2014 ESIA, Rogun HPP will have the potential to provide additional water during the growing season of an exceptionally dry year, and this would be a considerable benefit for the irrigation systems in the entire downstream area. This could only be done under the following conditions:

- Releasing additional water from Rogun (and/or Nurek) reservoir in summer would mean less capacity for electricity generation in the following winter.
- It would also require the possibility for refilling the reservoirs after such a dry year, which would certainly need an amount of water which would be outside of current ICWC allocations.

Having said this, it still has to be seen that Rogun HPP certainly has the potential to change the situation if it would be operated in a way which would not respect the international agreements. The 2014 TEAS and ESIA studies have demonstrated that Rogun HPP can be added to the Vakhsh cascade and operated in a way that will not change water availability and seasonal distribution in the downstream area. This is also recognised in the final report of the Environmental and Social Panel of Experts in its Final Report (E&S POE, 2014), which nevertheless points out the potential that Rogun HPP would have for being operated in a different way, mainly by shifting additional water from summer to winter, with potentially very negative impacts on water users, especially irrigation, in the downstream riparian countries. It is understandable that this is still a concern of stakeholders who would potentially be affected by such changes. Therefore, this issue needs to be discussed, and this is done in the following Section, which describes and analyses a number of scenarios, as also asked for by the Amendments to the CIA TOR dated September 2024 by WB, covering potential outcomes.

9.7 Alternative Operation Patterns of Rogun HPP

9.7.1 Purpose of the Section

The main conditions for operating Rogun HPP, as defined in the 2014 TEAS and ESIA and adopted by Tajikistan are the following:

- Filling Rogun reservoir only with the surplus water not used so far from the volume allocated by BVO, i.e. 1.2 km³ per year on average (potentially somewhat more in wet years and considerably less in dry years). With this amount, the reservoir could be filled in about 11 years, but in reality it might take longer; the 16 years foreseen as filling period take potential delays in the process into account.
- No additional shift of water from summer to winter.

By respecting these two conditions, which are operative design constraints for developing the project, Tajikistan will operate Rogun HPP within the limits determined by Protocol 566 and the yearly water allocation by BVO.

Still, the possibility for alternative forms of operation of Rogun HPP remain, a fact that raises concern among stakeholders. In this Section, such possibilities are developed in the form of a number of scenarios, and their potential outcome and consequences are discussed.

9.7.2 Available Data

The scenarios are built on the data shown in Annex 2, available from the website already mentioned (http://sic.icwc-aral.uz/reports_e.htm). This site provides data for the time span of 2010 to 2024, i.e. for 14 years (where by "year" here has to be understood as the period from April 1 till March 31 of the following year). For the purpose of scenario development, this time span was extended to a duration of 25 years in the following way:

- The missing data for winter of October 2012 to March 2013 were replaced by the calculated average of all available winter values.
- The data of a number of years were duplicated in order to simulate a total duration of 25 years.

This means that, while all the data represent real recorded values, the 25 years shown in the graphs in the following sections do not represent a real 25 years period. Therefore in the graphs no actual years are indicated, they are just numbered 1 to 25.

9.7.3 Formulation of Scenarios

For the purpose of this report, 5 scenarios were developed, as follows:

- **Scenario 1: Situation without Rogun HPP.** Assumptions:
  - all countries continue to use water as they did till now;
  - Tajikistan continuing to not use the full share allocated;
  - Afghanistan (which is not included in BVO) assumed to use the 2.1 km³ annually as per the standard BVO distribution (see Table 5-1).
- **Scenario 2: Tajikistan Using Full Allocation.** Assumptions:
  - conditions as in Scenario 1;
  - starting in year 9, Tajikistan uses its full allocation (whether for filling Rogun reservoir or for irrigation purposes);
  - this is assumed to be, in addition to the water consumed as per the available data,
    - +1.2 km³ in a wet year
    - +1.0 km³ in an average year
    - +0.8 km³ in a dry year
    - 0.2 out of which in winter.
  - TKM and UZB keeping their share; in this simplified approach, it is assumed that the difference would represent a direct reduction of water reaching the Aral Sea.
- **Scenario 3: Rapid Reservoir Filling.** Assumptions:
  - Same conditions as Scenario 2, but Tajikistan filling the reservoir rapidly with the following assumptions:
    - Filling in years 15 to 17;
    - 3.5 km³ in year 15;

        - 5 km³ each in years 16 and 17;
    - Difference shared by TKM and UZB, with a slightly larger reduction for UZB.
    - After filling of Rogun reservoir return to same conditions as in Scenario 2.
- **Scenario 4: Additional Shift.** Assumptions:
    - Same conditions as Scenario 3, but after filling the reservoir, starting in year 18 Rogun HPP is operated by shifting an additional 5 km³ of water from summer to winter.
- **Scenario 5: Qosh Tepa.** Assumptions:
    - Same conditions as Scenario 4, but starting in year 20 Qosh Tepa canal operates by deviating 10 km³ of water yearly, 8 of which in summer and 2 in winter.

The number of scenarios could be greatly increased just by changing the assumptions made for each one, but this would only produce gradual and overall rather minor differences in outcome. The main consequences of these outcomes is shown and discussed in the following Section.

9.7.4 Potential Outcomes

On the following pages, the results according to the 5 scenarios are shown as follows:

- All countries: seasonal water consumption of all BVO countries plus Afghanistan is shown, in order to indicate the consequences of the different conditions for all affected parties.
- Situation for Uzbekistan, seasonal consumption. As mentioned above (scenario 3), it is assumed that the loss in available water will be somewhat greater for Uzbekistan than for Turkmenistan; this is done because Uzbekistan, being the most downstream of the potentially affected countries, is likely to suffer most in case of water shortages. Nevertheless, the situation for Turkmenistan will be similar.
- Situation for Uzbekistan, summer (vegetation period, April to September). The critical period for the countries depending largely on irrigation, is the summer period, while water flowing in winter cannot be used. For a better understanding of the consequences, in these graphs the average values for wet, average and dry summers are indicated. The definition of these three groups is based on the data used, which show a range for summer values between 17.2 and 11.3 km³, and was made as follows: wet summer: >15.3 km³, average 16.52 km³; average summer: 13.3 to 15.3 km³, average 14.27 km³; dry summer: <13.3 km³, average 12.21 km³.
- Situation of the Aral Sea. This is the Large Aral Sea, i.e. the former larger, southern, part of the original Aral Sea, which by now has almost disappeared and receives only the small remaining amount of water not used further upstream. Here, it is assumed that a reduction of water due to increased consumption in Tajikistan would directly lead to a reduction in inflow to the Aral Sea, which, as was discussed in Section 8.1, is not necessarily the case.

Table 9-4: Water use, all countries

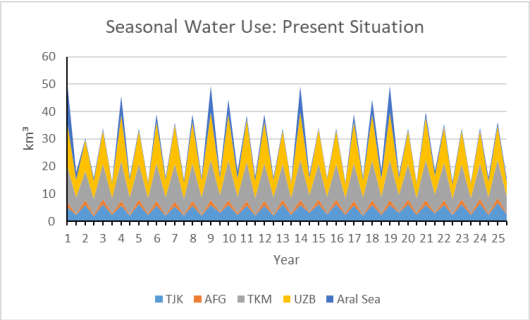
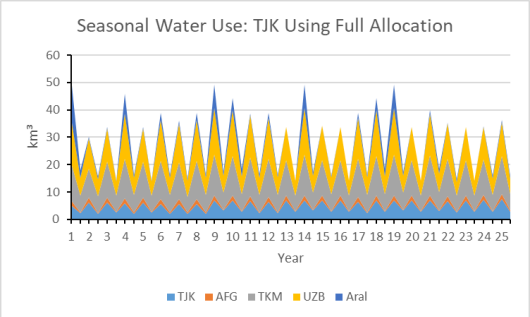
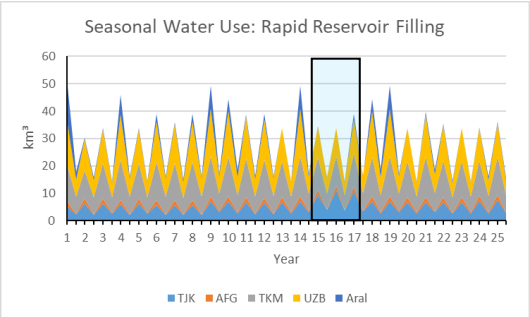
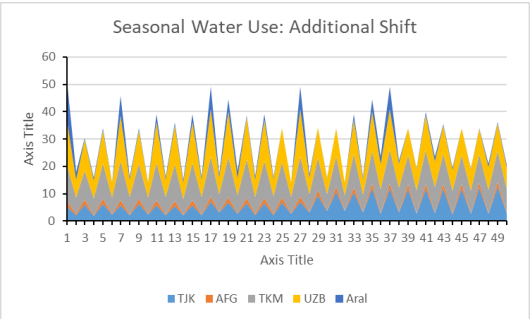
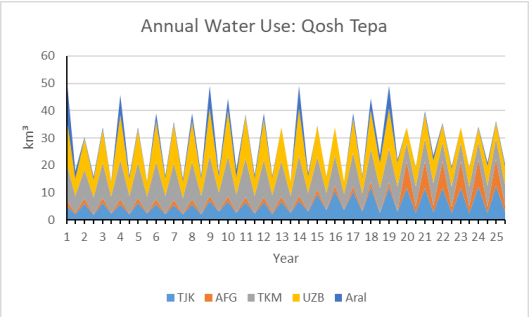
	**Scenario 1:** Present situation, Tajikistan not using the full share of the water allocated to it. **Baseline condition.**
	**Scenario 2:** Tajikistan using the full share of the water allocated to it, with the following assumptions: • starting in year 9 • additional quantity used: ○ +1.2 km³ in a wet year ○ +1.0 km³ in an average year ○ +0.8 km³ in a dry year ○ out of which +0.2 km³ in winter. TKM and UZB keeping their share, difference deducted from the share of the Aral Sea. **Future condition with TJK using full share (with or without Rogun), assuming all other condition remain unchanged.**
	**Scenario 3:** Same conditions as Scenario 2, but Tajikistan filling the reservoir rapidly with the following assumptions: • Filling in years 15 to 17 (frame) ○ 3.5 km³ in year 15 ○ 5 km³ each in years 16 and 17 • Difference shared by TKM and UZB, with a slightly larger reduction for UZB. • After filling of Rogun reservoir return to same conditions as in Scenario 2. **Violation of Protocol 566, ICWC/BVO agreements.**
	**Scenario 4:** Same conditions as Scenario 3, but after filling the reservoir, starting in year 18 Rogun HPP is operated by shifting an additional 5 km³ of water from summer to winter. **Violation of Protocol 566, ICWC/BVO agreements.**
	**Scenario 5:** Same conditions as Scenario 4, but starting in year 20 Qosh Tepa canal operates by deviating 10 km³ of water yearly, 8 of which in summer and 2 in winter. **Violation of Protocol 566, ICWC/BVO agreements, additional issue caused by increased water consumption by Afghanistan.**

Table 9-5: Situation of Uzbekistan, seasonal water use

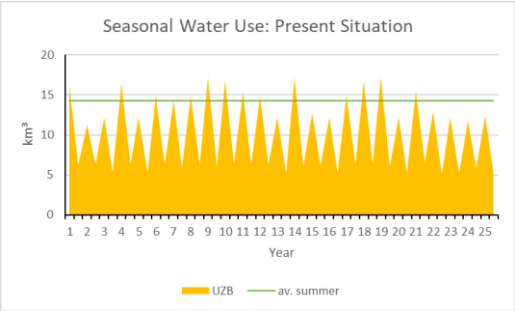
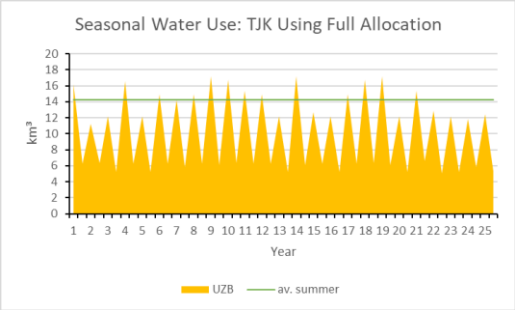
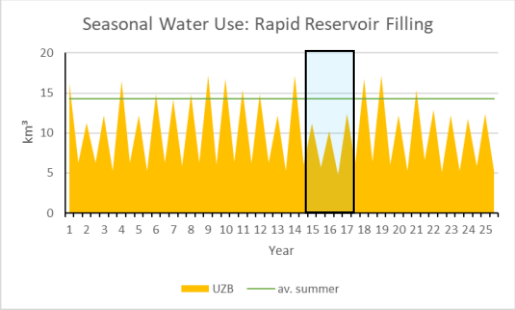
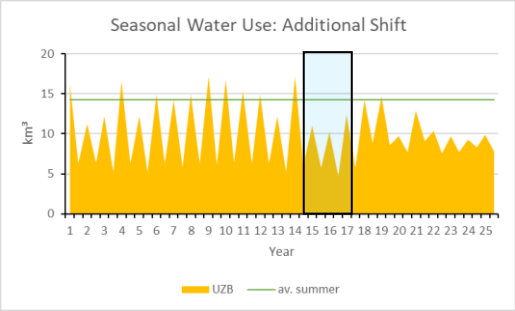
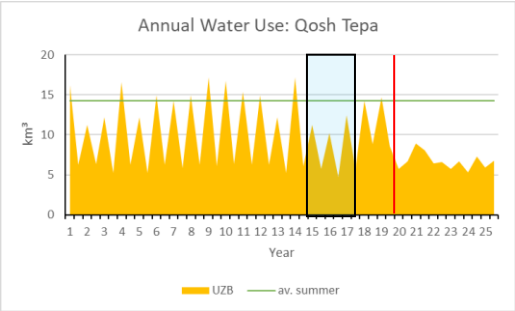
	**Scenario 1:** **Baseline situation.**
	**Scenario 2:** If, as assumed here, UZB will continue to use water as done so far, there will be no change in comparison with Scenario 1.
	**Scenario 3:** Rapid reservoir filling (indicated by the frame years 15 to 17) would change the three summers, in this case, from two rather dry and one average to two very dry and one rather dry summer, for returning to "normal" afterwards. Note that, as here it is assumed that the deficit caused by the additional water retained in Rogun would be shared by Uzbekistan and Turkmenistan to approximately equal parts, the same situation would result in Turkmenistan.
	**Scenario 4:** Same conditions as Scenario 3, but after filling the reservoir, starting in year 18 Rogun HPP is operated by shifting an additional 5 km³ of water from summer to winter. Situation for both Uzbekistan (illustrated) and Turkmenistan: dry summers during rapid reservoir filling as for Scenario 3, then transition to a situation with constantly dry summers (far dryer than an average dry summer was before that change) and constantly high winter flows.
	**Scenario 5:** Same conditions as Scenario 4, but starting in year 20 (red vertical line) Qosh Tepa canal operates by deviating 10 km³ of water yearly, 8 of which in summer and 2 in winter. In this scenario, the water regime for both Uzbekistan and Turkmenistan would turn into conditions of extremely dry summers never experienced before; the seasonal differences in river flow would almost disappear, the year-round situation would be similar to what were winter flows before.

Table 9-6: Situation of Uzbekistan, summer water availability

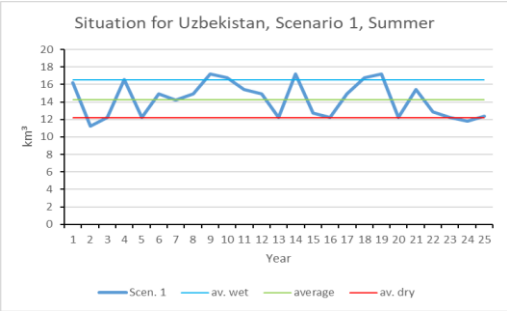
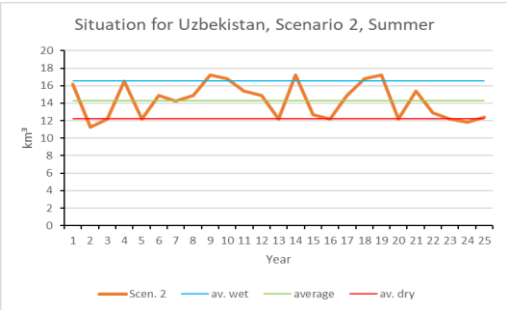
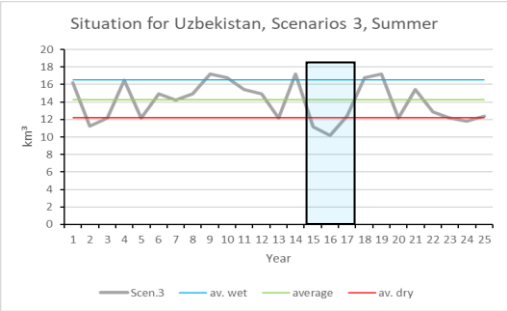
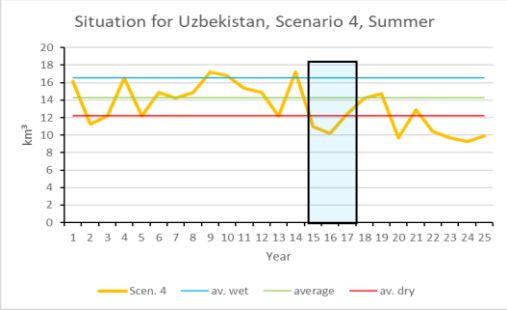
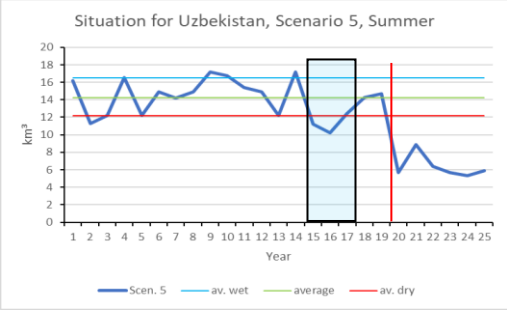
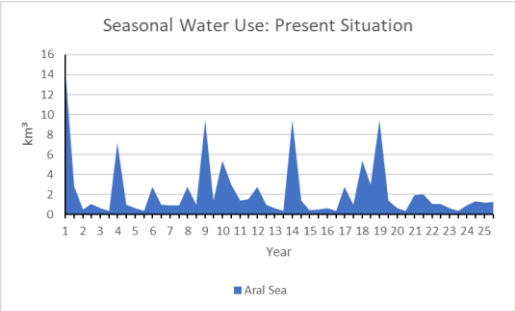
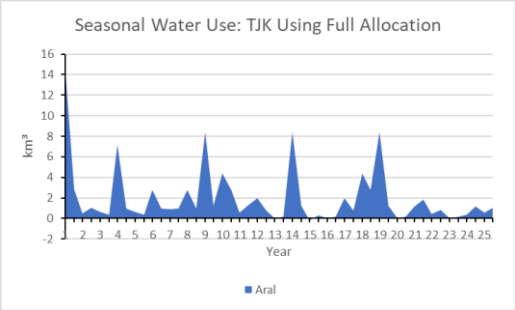
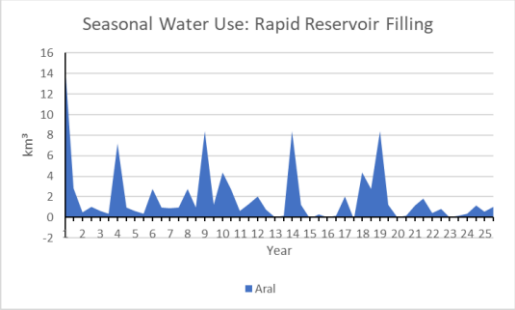
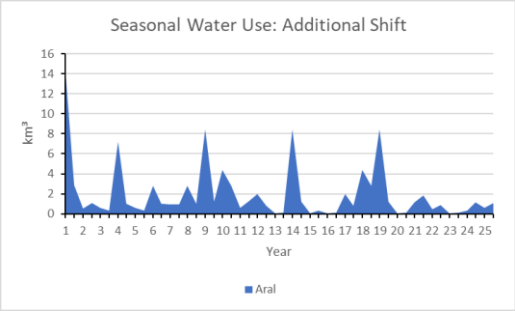
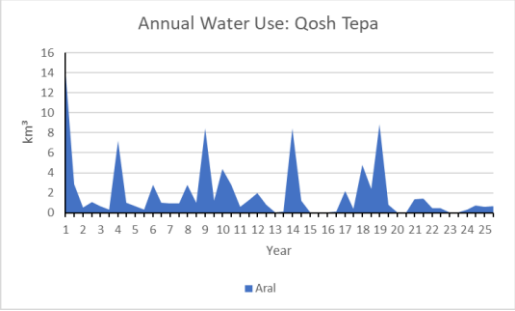
	**Scenario 1:** **Baseline condition.** In this Table, only water availability in summer (the vegetation period, April to September), is shown, since this is the decisive season for irrigated agriculture. In order to better understand the potential consequences of the different scenarios, three values derived from the available data are shown in addition to water consumption: • average wet summer (16.52 km³, light blue); • average summer (14.27 km³m, light green), • average dry summer (12.21 km³, red).
	**Scenario 2:** As in Table 9-5, no change under current assumptions.
	**Scenario 3:** As in Table 9-5, change to dry and very dry summers during the filling phase, then back to normal.
	**Scenario 4:** As in Table 9-5, dry to very dry summers during filling, then transition to a situation with constantly dry or very dry summers Here again; very similar situation in Turkmenistan.
	Scenario 5: As in Table 9-5, but starting in year 20 transition to constantly dry summers like never before, with summer flows in the range of former winter flows Similar situation in Turkmenistan.

Table 9-7: Situation of the Aral Sea

	**Scenario 1:** **Baseline scenario.** Years with inflow <0.5 km³: 5.
	Scenario 2: Since in this scenario it is assumed that UZB and TKM would continue to use water like before, starting in year 9 the inflow to the Aral Sea would be reduced by: • +1.2 km³ in a wet year • +1.0 km³ in an average year • +0.8 km³ in a dry year Years with inflow <0.5 km³: 10.
	**Scenario 3:** Years with inflow <0.5 km³: 12.
	**Scenario 4:** Years with inflow <0.5 km³: 13.
	**Scenario 5:** Years with inflow <0.5 km³: 14. Note that in scenarios 3 to 5, there is a high probability that all of the remaining water would be used leaving nothing for the Aral Sea. However, since water demand in winter is much lower, at least some of the water additionally released in winter, i.e. the 5 km³ here assumed to be shifted by Rogun HPP from summer to winter, would actually reach the Aral Sea.

9.7.5 Discussion of Outcomes

As already mentioned, the five scenarios presented in the previous Section show a number of possible outcomes, but they could be modified. Here, just a few potential alternatives to the ones emphasised are listed:

- Situation of the Aral Sea: as shown, under baseline conditions the inflow to the Aral Sea varies from 17.4 km³ (year 1 in the graphs, 2010, apparently exceptionally humid in the original data) to almost 0 (five years with an inflow of <0.5 km³ in the data series). All scenarios show an increase in the number of years with such a minimum inflow, but in reality, should e.g. scenario 4 or 5 become reality, there is a high probability of many more such dry years, while on the other hand, if winter flows should increase, there might actually be a possibility for substantially higher total annual inflows, with much of it in winter.
- Water distribution between Uzbekistan and Turkmenistan: as indicated, in the scenarios it is assumed that the two countries would bear the loss in available water to about similar shares, with however the assumption that the losses for Uzbekistan, being the lowermost in the supply chain (with the exception of the Aral Sea), would be slightly greater. Still, it could also happen that in the case Tajikistan would no longer honour the international agreements, Turkmenistan could decide to act in the same way, taking a similar volume of water as before. This would put Uzbekistan in a still much more difficult situation.
- Additional shift of water from summer to winter by Tajikistan: the figure of 5 km³ annually was chosen for the scenario, but it could be smaller or potentially even somewhat larger, with the corresponding differences in outcome.
- Qosh Tepa canal deviating 10 km³ of water annually was chosen in order to create a worst case scenario. According to estimates, 5 km² per year seems to be a more realistic assumption, but even this would have serious consequences.

The five scenarios as described in the previous Sections are shortly evaluated here.

- **Scenario 1: Situation without Rogun HPP.**
    - This is the baseline case, i.e. the situation before impoundment at Rogun started.
    - No change in the downstream area.
    - In conformity with Protocol 566.
    - No additional generation of electricity, continuing energy shortage in Tajikistan.
    - Nurek still at risk by a PMF, which it is not able to handle safely; no reduction in flooding risk for the downstream area.
    - Life span of Nurek will not increase, limited by sediment input.
- **Scenario 2: Tajikistan using its full share.**
    - In the downstream area, water availability will be reduced by on average 1.2 km³ (corresponding to 6% of Vakhsh or 2% of Amu Darya flow in an average year) as compared to the baseline case.
    - In the scenario it was assumed that this difference in water availability will not change water consumption in Turkmenistan and Uzbekistan, but that the inflow to the Aral Sea would be reduced.
    - This is the situation which will become reality as soon as Tajikistan is using its full share, which it will do, first for filling Rogun reservoir and then for increasing irrigation. This situation will arise with or without Rogun.
    - **This scenario is in conformity with Protocol 566 (ICWC/BVO regulations).**
- **Scenario 3: Fast filling of Rogun reservoir.**
    - Assumes that the reservoir will be filled within a period of 3 years, by retaining 3.5, 5 and 5 km³ of water in three consecutive years.
    - Would cause serious water shortage in the downstream riparian countries during these 3 years.
    - **Procedure in clear violation of international agreements (Protocol 566, ICWC/BVO).**
- **Scenario 4: Additional shift of water.**

- This scenario assumes that after the fast filling of the reservoir Rogun HPP would shift a volume of 5 km³ per year from summer to winter, in addition to the volume already shifted by Nurek HPP.
- This would sharply decrease the water volume available in the downstream riparian countries in summer, turning basically all summers into dry to very dry ones as compared to the baseline condition.
- At the same time river discharge in winter would increase, i.e. during the non-vegetation period.
- **Procedure in clear violation of international agreements (Protocol 566, ICWC/BVO).**

- **Scenario 5: Qosh Tepa**
  - Situation like in Scenario 4.
  - In addition, it is assumed that Afghanistan would divert 10 km³ of water annually via the Qosh Tepa canal.
  - This would turn the situation for Turkmenistan and Uzbekistan in a state of perpetual extremely dry summers, with far less water available than ever before.
  - **Clear violation of international agreements (Protocol 566, ICWC/BVO) by Tajikistan.**
  - **Operation of Qosh Tepa canal would greatly contribute to a deterioration of the situation, but is outside of Protocol 566 and cannot be influenced by ICWC/BVO.**

The conclusions from this analysis are rather clear and obvious:

- Scenario 2 will be realised in any case, with or without Rogun, since Tajikistan has clearly announced its intention to use the water which is allocated to the country by the corresponding international agreements. This is a situation which is accepted by BVO/Protocol 566. The question where these on average 1.2 km³ per year will actually be missing, in Turkmenistan and/or Uzbekistan or in the Aral Sea, may need some further discussions and decisions, but the procedure is in line with international agreements.
- Scenarios 3 and 4 would mean that Tajikistan would no longer respect its agreements and obligations with the other BVO states, but would act in clear violation of these rules. As shown, such a procedure would have serious consequences for the downstream riparian states. Given their consequences these scenarios are clearly not acceptable.
- Scenario 5 would have the same consequences as Scenarios 3 and 4. However, the situation would be further aggravated by the fact that a very large volume of water would be diverted by Afghanistan. It has to be stated once again that this has nothing to do whatsoever with Rogun HPP, and that it is an activity which also cannot be controlled by ICWC/BVO, since Afghanistan is not a member of these organisations. This is clearly the worst case scenario.
- Scenarios 3 to 5 describe situations with a degree of impact on downstream water users (Turkmenistan and Uzbekistan) that would clearly not be acceptable. It has to be pointed out that the assumed role of Tajikistan within these scenarios, namely, rapid filling of the reservoir and additional seasonal shift of water, would cause inacceptable negative environmental and socio-economic impacts on the downstream area, with no possibility for mitigation, and that for these reasons none of these scenarios had ever been considered for implementation. In addition, **these would be clear violations of ICWC/BVO agreements**, **while Tajikistan has clearly committed itself to respecting these agreements.** The contribution of Afghanistan to the situation as outlined in scenario 5 however cannot be influenced by ICWC/BVO regulations, since Afghanistan is not a member of these institutions.

As a final conclusion to this the following can be said:

- Tajikistan has clearly signalled its intention to develop and operate Rogun HPP while respecting international agreements on water allocation. This means that it will be done according to Scenario 2, while Scenarios 3 and 4, as well as the part of Tajikistan in Scenario 5, are clearly unacceptable.
- The part which Afghanistan plays in Scenario 5 is clearly outside of the influence of the BVO states. The fact that Afghanistan is building Qosh Tepa canal demonstrates the intention of the country to develop its own irrigation. This indicates once again the necessity to integrate Afghanistan in the Amu Darya basin water allocation mechanisms, a necessity that was pointed out already in the 2014 ESIA and was supported and emphasised in the Final Report of the E&S POE of 2014.

9.8 Recommendations

From all this it results clearly that the situation of water availability and water use in the Amu Darya basin can only be seen by including all potential cumulative impacts of present projects and future developments. Many of the new hydropower projects mentioned and discussed shortly in this reports will be implemented, if ever, only at some time in the future, certainly none of them before 2037, i.e. before the time envisaged for commissioning Rogun HPP. The following can be assumed:

- Overall water availability and seasonal distribution will change to some extent due to the effects of climate change.
- Demand for water, especially for irrigation, will increase, e.g. due to the creation of additional irrigation schemes in Afghanistan.
- Modernising irrigation by applying water saving technology would reduce overall water consumption.
- Further development of hydropower will cause an additional water demand for reservoir filling, will create additional potential for shifting water from summer to winter, but will also increase the potential for providing .additional water in summer in the case of dry years, if managed accordingly.

In this situation, the importance of international agreements regulating water allocation cannot be overstressed. Presently, and probably still for the immediate future, Protocol 566 is the relevant framework for this, since it is accepted by the parties and has shown its applicability and usefulness in the past. However, under changing conditions modifications of this agreement might be required; just a few of such potential modifications are listed here:

- Under changing climatic conditions, storage of water for being able to make use of excess water in extremely wet years and to face droughts in exceptionally dry years, both of them situations expected to become more severe in the future, may get increasingly important.
- It may also be required to add additional storage capacity to the system for increasing its flexibility and potential to react.
- Such increased storage and water regulation capacity would also require agreements for refilling storage after an exceptional drawdown.
- International regulating bodies, in this case ICWC/BVO, and their agreements will play an increasingly important role.
- It will certainly get increasingly important to have all interested parties, i.e. all riparian states, included in any agreements concerning the use of water resources.

This last point is of special importance. Presently, ICWC/BVO for the Amu Darya basin includes Kirgizstan, Tajikistan, Turkmenistan and Uzbekistan. Afghanistan should be included in future agreements on the use of this important common resource.

ANNEXES

Annex 1: Meetings Held

Date	Persons met	Institution, contact	Met by	Main Topics / Observations
2024-02-27	Mr. Pulod Mukhiddinov Mr. Parviz Atoev Mr. Mr. Bakhtiyor Begmuradov	Director, Rogun HPP PMG PMG Project Coordinator PMG Environmental Specialist	Robert Zwahlen	1st Weekly Meeting. Short meeting for official start of the assignment and introductions.
2024-02-28	Mr. Manucher Jamilzoda Mr. Rustam Sardzoda Mr. Ayub Fayzullozoda	Director DFZ Deputy Director DFZ Senior Constr. Specialist DFZ	Robert Zwahlen PMG: Mr. Mr. Bakhtiyor Begmuradov Mr. Akbar Vatanshoev	CIA: aspects concerning resettlement. Replacement for main road that will be submerged. • Is a different project, not handled by Rogun PMG. • Financing from three different international banks: EBRD, ADB and AIIB. • Is built to 75%, expected to be finalised this summer, with the exception of the main bridge. • Bridge under different financing, construction started. • Since part of the old road was already submerged at the present water level of 1110 m asl, DFZ built 3 sections of temporary roads (800 m near Obi Garm, 10 km near Sicharog, and appr. 4 km including 2 bridges near Chorsada. • 5-6 HH had to be resettled due to the road project; this was also handled by DFZ. • Coordination between PMG Rogun and PMG Road established. • The replacement road provides access to the villages now to be resettled. For the program to continue, the replacement road needs to be finished before the water in the reservoir raises above 1110 m. Gaz Pipeline Turkmenistan – China: • Alignment follows, to the extent possible, the replacement road. • Replacement road will provide access to construction sites for the pipeline. • Conceptual planning done, but no detailed project as yet. • Project is presently on hold. • No interactions with the resettlement program expected. No other projects that could interact with the resettlement program.

Date	Persons met	Institution, contact	Met by	Main Topics / Observations
2024-03-04	Group Meeting	AIIB Delegation DSPOE DFZ (with AIIB)	Robert Zwahlen	Introductory meetings. Discussed approach to CIA with the environmental specialist of AIIB. Participated in discussion of resettlement issues with DFZ and AIIB.
2024-03-05	Mr. Daler Abdurazoqzoda	Head of Energy and Water Policy Department.	Robert Zwahlen PMG: Mr. Bakhtiyor Begmuradov	Points discussed: • Water allocation in the Amu Darya Basin. • Relation and recent agreements between states (TJK, TKM, UZB). • Project in Afghanistan for irrigation. • HPPs in the pipeline in Pyanj catchment.
2024-03-06	Mr. Muhamadir Jurabek	PMG Deputy Director	Robert Zwahlen Mr. Akbar Vatanshoev	• HPPs in the pipeline on Pyanj River. • HPPs in the Pipeline u/s of Rogun HPP.
2024-03-06	Mr. Parviz Atoev	PMG Project Coordinator	Robert Zwahlen	• 2nd Weekly Meeting; clarification of certain contractual points, discussion of ongoing program.
2024-03-13	Mr. Bakhtiyor Begmuradov	PMG E&S Specialist	Robert Zwahlen	• 3rd Weekly Meeting (Call). • Discussed project management issues. • Confirmation of acceptance of the Work Plan as Final.
2024-04-15 to 16	Lenders' meeting in Brussels In person: 23 participants Virtual: 34 participants	Lenders' representatives: WB, AIIB, ADB, OPEC Fund ESPOE Rogun OJSC WSP	Robert Zwahlen (in person)	• 04-15: Environmental issues (including presentation of approach to CIA by ZR). • 04-16: Issues related to Resettlement .
2024-04-18	ESPOE and PMG		Robert Zwahlen (participated virtually)	• Main point: discussion of operation mode of the Rogun-Nurek cascade, pointing out the importance of having a clear picture on this issue, and avoiding contradictions between different reports.
2024-04-30	1. Khairullo Safarzoda 2. Mehriddin Tohirzoda 3. Murod Saduloev 4. Anvar Mirzoev 5. Nurullo Sharifzoda 6. Rustam Huseinov 7. Howard Fries	1. Director General, JSC 2. Admin. Director, JSC 3. Technical Director, JSC 4. Construction Director, JSC 5. Operational Director, JSC 6. Dept. Technical Director, JSC 7. Acting Resident Engineer, ER	Bakhtiyor Begmuradov, E&S Specialist, PMG Robert Zwahlen, E&S Specialist, PMG	• Main point of discussion: operation pattern of Rogun HPP now (2 units with partial capacity) and in the final stage (6 units with full capacity). • Received information on reservoir filling, operation and production. • Short visit of the site.

Date	Persons met	Institution, contact	Met by	Main Topics / Observations
	8. Bahodur Nurov 9. Umed Kosimov	8. Deputy Contract Manager, ER 9. Translator, ER		
2024-05-01	Mr. Manucher Jamilzoda Mr. Rustam Sardzoda	Director DFZ Deputy Director DFZ	Robert Zwahlen Bakhtiyor Begmuradov	• Conflict between resettlement villages and new TLs: issue was raised in a consultation meeting with resettled persons, where one participant asked whether a TL to be built in proximity of the village would present any risk for him, his family and his house. It was clarified that the distance between the house and the TL was sufficient for excluding such a risk. • Conflict between resettlement villages and new roads: o Road Dushanbe-Turzunzoda-border with Uzbekistan: was built in 2018, minimal distance to nearest resettlement village 10 km. o Road Dushanbe-Bokhtar: built in 2022, about 50 km away from nearest resettlement village. o No conflict with either of them. • Replacement road and interaction with reservoir: in 3 places, the existing road was already submerged at a reservoir water level of 1070 m asl. The temporary roads in these places were built to be respect a water level of 1100 m asl.
2024-05-06	Firuz Khairiddinovich Azizov Alexey Vitalevich Poltavets Umidjon Ulugov	Director SAZOVOR SAZOVOR, Env. Proj. Coord. PESHSAF, Proj. Coord.	Robert Zwahlen Bakhtiyor Begmuradov	• Discussion topic: potential conflict between TL projects and resettlement villages. The organisation is preparing the ESIA for the 50 km 500 kV TL from Dushanbe to Rezar. • No conflict with resettlement villages in the area of Turzunzade, TL does not pass neat these villages.
2024-05-06	Mr. Jamshed Shoimzoda	First Deputy Minister Ministry of Energy and Water Resources	Robert Zwahlen Bakhtiyor Begmuradov	• Discussed request for hydrological/cascade operation data for the CIA. • According to Mr. Shoizoda, not much has changed since the modelling for the 2024 TEAS and ESIA was done. He confirms that daily/hourly data for operation are available. Meeting to be arranged with Barki Tojik. • Shurob HPP: old project dating from Soviet times. Potential lenders will carry out new feasibility study, dimensions etc. may change to a certain extent. • CASA 1000: TL in Afghanistan expected to be built/finalised in 2026, now that WB has accepted to finance the project (special arrangement for CASA 1000).
2024-05-07	Mr. Dustmurod Toirov	Head of Dispatch Service, Barki Tojik	Robert Zwahlen	• Subject: Vakhsh cascade operation. Key results:

Date	Persons met	Institution, contact	Met by	Main Topics / Observations
			Bakhtiyor Begmuradov	• He will send data on daily operation of Nurek HPP. • Nurek has a total of 9 units. In the process of upgrading, 2 units already replaced. Old units have a capacity of 300 MW, the new ones will have 375 MW per unit. • Water output depending on reservoir level between 150 and 165 m³/s per unit. • Nurek presently important for peaking. The new units will react faster (can be turned to full capacity in 2 sec.), which will allow for more flexibility in operation. • A minimum of 3 units are always working, although not necessarily on full capacity. • The entire cascade participates in covering peak demand. In the future, Rogun HPP will take over much of this role, but the operation regime of the cascade will not change fundamentally. • Nurek will transit to a ROR type of operation, but will still do some peaking (taking into account water delivered from Rogun): It will be operated at a level of 5 to 10 m below FSL in order to have space for flow regulation. • Peaking can become more important in the future when Tajikistan rjoins the Central Asian grid (downstream countries having mainly thermal power with little potential for peaking). • Filling of Rogun reservoir reduces electricity production in the cascade to some extent. This can at least partly be compensated by the two units working now already in Rogun HPP. • The entire d/s cascade is being or will be upgraded, and this also increases efficiency, so that in the future more electricity will be produced.
2024-10-21 and 22	Lenders' delegations	Lenders' meeting in Vienna, OPEC Fund premises	Robert Zwahlen	• Discussion of E&S issues.
2024-10-28	Delegations from ministries (morning) Representatives of NGOs and CSOs (afternoon)	Riparian meeting in Tashkent, Uzbekistan, organised by WB	Robert Zwahlen Jack Mozingo Bakhtiyor Begmuradov	• Presentation of Rogun HPP (J. Mozingo). • Presentation of results of the Cumulative Impact Assessment (R. Zwahlen). • Questions and answers.

Annex 2: Water Allocation and Use Data

		Total forecast BVO				Total Withdrawal				Tajikistan				Turkmenistan				Uzbekistan				Aral Sea			
Year	Season	km³	km³	%	km³	km³	km³	%	km³	km³	km³	%	km³	km³	km³	%	km³	km³	kmn³	%	km³	km³	km³	%	km³
		Tot. prog.	Tot. actual	availability	balance	Tot. prog	Tot. actual	availability	balance	Tot. prog	Tot. actual	availability	balance	Tot. prog	Tot. actual	availability	balance	Tot. prog	Tot. actual	availability	balance	Tot. prog	Tot. actual	availability	balance
2010	veg	46.40	58.31	125.67	11.91	39.50	34.90	88.00	-4.60	6.78	5.20	77.00	-1.58	15.50	13.52	87.00	-1.98	17.22	16.18	94.00	-1.04	2.10	14.59	911.00	12.49
2010-2011	non	13.04	11.19	85.81	-2.75	15.70	14.74	93.90	-0.96	2.85	2.28	80.10	-0.57	6.50	6.17	95.00	-0.03	6.35	6.28	98.90	-0.07	2.10	2.84	118.20	0.38
Total		59.44	69.50	116.92	9.16	55.20	49.64	89.93	-5.56	9.63	7.48	77.67	-2.15	22.00	19.69	89.50	-2.01	23.57	22.46	95.29	-1.11	4.20	17.43	415.00	12.87
2011	veg	34.68	32.33	93.22	-2.35	39.54	27.90	70.60	-75.00	6.82	6.08	89.20	-0.74	15.50	10.55	68.10	-4.95	17.22	11.27	65.40	-5.95	2.10	0.52	24.90	-1.58
2011-2012	non	12.09	13.33	110.26	1.24	15.70	14.36	91.50	-1.34	2.85	1.97	69.30	-0.88	6.50	6.17	96.90	-0.20	6.35	6.30	95.90	-0.26	2.10	1.05	50.00	-1.05
Total		46.77	45.66	97.63	-1.11	55.24	42.26	76.50	-76.34	9.67	8.05	83.25	-1.62	22.00	16.72	76.00	-5.15	23.57	17.57	161.30	-6.21	4.20	1.57	74.90	-2.63
2012	veg	60.73	53.28	87.73	-7.45	39.60	36.83	93.00	-2.77	6.88	5.82	84.50	-1.06	15.50	14.48	93.50	-1.02	17.22	16.53	95.90	-1.02	7.00	7.19	102.71	0.19
2012-2013	n.a.																								
Total		71.31	67.35	94.45	-3.96	55.30	51.65	93.40	-3.65	9.73	7.91	81.29	-1.82	22.00	20.96	95.27	-1.12	23.57	22.78	96.65	-1.12	9.10	8.18	89.89	-0.93
2013	veg	46.41	38.48	82.91	-7.92	39.61	33.27	84.00	-6.33	6.89	5.57	80.90	-1.31	15.50	13.47	86.90	-2.03	17.22	14.23	82.61	-2.03	2.10	0.92	44.00	-1.18
2013-2014	non	11.99	10.38	87.00	-0.18	15.58	13.91	88.70	-1.77	2.83	2.10	74.20	-0.73	6.50	5.81	92.30	-0.50	6.35	5.81	91.50	-0.54	2.10	0.94	44.70	-1.16
Total		58.40	48.86	83.66	-8.10	55.19	47.18	85.49	-8.10	9.72	7.67	78.91	-2.04	22.00	19.28	87.64	-2.53	23.57	20.04	85.02	-2.57	4.20	1.86	44.29	-2.34
2014	veg	42.94	41.52	96.69	-1.42	39.60	34.40	86.90	-5.20	6.90	5.70	82.40	-1.20	15.50	13.80	89.20	-1.70	17.20	14.90	86.80	-2.30	2.10	2.80	134.10	0.70
2014-2015	non	10.58	14.07	132.99	3.49	15.70	14.82	94.40	-0.88	2.85	2.09	73.20	-0.76	6.50	6.48	99.30	-0.10	6.35	6.25	98.40	-0.10	2.10	0.99	46.90	-1.12
Total		53.52	55.59	103.87	2.07	55.30	49.22	89.01	-6.08	9.75	7.79	79.90	-1.96	22.00	20.28	92.18	-1.80	23.55	21.15	89.81	-2.40	4.20	3.79	90.24	-0.42
2015	veg	44.28	50.83	114.79	6.54	39.66	37.25	92.00	-2.41	6.94	5.92	82.00	-1.02	15.50	14.56	94.00	-0.94	17.22	16.77	95.00	-0.45	2.10	5.37	256.00	3.27
2015-2016	non	12.77	12.63	99.00	-0.14	15.73	15.17	96.00	-0.56	2.88	2.49	87.00	-0.38	6.50	6.32	97.00	-0.17	6.35	6.36	100.00	0.01	2.10	3.00	143.00	0.90
Total		57.05	63.46	111.24	6.40	55.39	52.42	94.64	-2.97	9.82	8.41	85.64	-1.40	22.00	20.88	94.91	-1.11	23.57	23.13	98.13	-0.44	4.20	8.37	199.29	4.17
2016	veg	39.48	39.76	100.71	0.29	39.70	35.40	89.00	-4.30	7.00	5.80	83.00	-1.20	15.50	14.20	83.00	-1.20	17.20	15.40	89.00	-1.80	2.10	1.40	67.00	-0.70
2016-2017	non	12.93	8.98	69.45	-3.95	15.73	14.58	93.00	-1.15	2.88	2.11	73.00	-0.77	6.50	6.24	96.00	-0.26	6.35	6.23	98.00	-0.12	2.10	1.51	72.00	-0.60
Total		52.41	48.74	93.00	-3.66	55.43	49.98	90.17	-5.45	9.88	7.91	80.06	-1.97	22.00	20.44	89.19	-1.46	23.55	21.63	91.85	-1.92	4.20	2.91	69.29	-1.30
2017	veg	61.88	50.30	81.29	-11.57	39.70	38.00	96.00	-1.70	6.90	6.00	86.00	-1.00	15.50	14.80	96.00	-0.70	17.20	17.20	100.00	0.00	2.10	9.42	449.00	7.32
2017-2018	non	12.54	8.87	71.00	-3.67	15.72	15.41	98.00	-0.31	2.87	3.03	106.00	0.16	6.50	6.32	97.00	-0.81	6.35	6.05	95.00	-0.30	2.10	1.41	67.00	-0.69
Total		74.42	59.17	79.51	-15.24	55.42	53.41	96.37	-2.01	9.77	9.03	92.43	-0.84	22.00	21.12	96.00	-1.51	23.55	23.25	98.73	-0.30	4.20	10.83	257.86	6.63
2018	veg	39.37	37.19	94.46	-2.10	38.50	31.87	83.00	-6.70	6.80	6.20	92.00	-0.60	15.00	13.00	87.00	-2.00	16.80	12.70	76.00	-4.10	2.10	0.46	22.00	-1.60
2018-2019	non	9.34	12.44	133.19	3.09	15.72	15.02	96.00	-0.70	2.87	2.60	90.00	-0.27	6.50	6.20	95.00	-0.30	6.35	6.22	98.00	-0.13	2.10	0.50	24.00	-1.60
Total		48.71	49.63	101.89	0.99	54.22	46.89	86.48	-7.40	9.67	8.80	91.00	-0.87	21.50	19.20	89.30	-2.30	23.15	18.92	81.73	-4.23	4.20	0.96	22.86	-3.20
2019	veg	50.26	47.28	94.07	-2.99	39.67	36.12	91.00	-3.50	7.00	6.00	86.00	-1.00	15.50	14.70	95.00	-0.80	17.20	15.40	90.00	-1.80	2.10	1.94	93.00	-0.20
2019-2020	non	10.32	10.41	100.87	0.08	15.73	16.16	103.00	0.43	2.88	2.80	97.00	0.08	6.50	6.78	104.00	0.28	6.35	6.59	104.00	0.24	2.10	2.03	97.00	-0.07
Total		60.58	57.69	95.23	-2.91	15.73	52.28	332.36	-3.07	9.88	8.80	89.07	-0.92	22.00	21.48	97.64	-0.52	23.55	21.99	93.38	-1.56	4.20	3.97	94.52	-0.27
2020	veg	46.28	38.00	82.11	-8.29	39.67	32.50	82.00	-7.20	7.00	6.10	88.00	-0.80	15.50	13.50	87.00	-2.00	17.20	12.90	75.00	-8.00	2.10	1.04	50.00	-1.10
2020-2021	non	11.42	10.18	89.14	-1.24	15.73	13.17	84.00	-2.56	2.88	2.36	82.00	-0.52	6.50	5.76	89.00	-0.74	6.35	5.05	80.00	-1.30	2.10	1.05	50.00	-1.05
Total		57.70	48.18	83.50	-9.53	55.40	45.67	82.44	-9.76	9.88	8.46	85.63	-1.32	22.00	19.26	87.55	-2.74	23.55	17.95	76.22	-9.30	4.20	2.09	49.76	-2.15
2021	veg	41.61	41.16	98.92	-0.46	39.67	31.38	79.00	-8.30	7.00	6.20	90.00	-0.70	15.50	13.00	84.00	-2.50	17.20	12.20	71.00	-5.10	2.10	0.63	30.00	-1.50
2021-2022	non	10.83	11.71	108.13	0.88	15.73	13.50	86.00	-2.23	2.88	2.49	86.00	-0.39	6.50	5.79	89.00	-0.71	6.35	5.22	82.00	-1.13	2.10	0.34	16.00	-1.76
Total		52.44	52.87	100.82	0.42	55.40	44.88	81.01	-10.53	9.88	8.69	87.96	-1.09	22.00	18.79	85.41	-3.21	23.55	17.42	73.97	-6.23	4.20	0.97	23.10	-3.26
2022	veg	41.47	41.23	99.42	-0.24	39.68	31.38	79.00	-8.30	7.00	6.60	95.00	-0.30	15.50	12.90	95.00	-2.60	17.20	11.80	69.00	-5.40	2.10	0.94	45.00	-1.20
2022-2023	non	9.96	11.82	118.67	1.85	15.71	14.32	91.00	-1.39	2.86	2.49	87.00	-0.37	6.50	6.02	93.00	-0.48	6.35	5.81	92.00	-0.54	2.10	1.35	64.00	-0.75
Total		51.43	53.05	103.15	1.61	55.39	45.70	82.51	-9.69	9.86	9.09	92.19	-0.67	22.00	18.92	86.00	-3.08	23.55	17.61	74.78	-5.94	4.20	2.29	54.52	-1.95
2023	veg	43.82	43.46	99.18	-0.36	39.45	33.19	84.00	-6.30	6.90	6.80	91.00	-0.10	15.40	14.00	91.00	-1.40	17.10	12.40	91.00	-4.70	2.10	1.19	57.00	-0.90
2023-2024	non	11.57	10.33	89.28	-1.23	15.74	14.04	89.00	-1.70	2.88	2.66	92.00	-0.22	6.50	6.10	94.00	-0.40	6.37	5.28	83.00	-1.09	2.10	1.25	60.00	-0.85
Total		55.39	53.79	97.11	-1.59	55.19	47.23	85.58	-8.00	9.78	9.46	96.73	-0.32	21.90	20.10	91.78	-1.80	23.47	17.68	75.33	-5.79	4.20	2.44	58.10	-1.75

Data source: http://sic.icwc-aral.uz/reports_e.htm

On this ICWC site, yearly data for water forecast and use are provided, separated in summer (vegetation period, Apr. to Sep.) and winter (non-vegetation period, Oct. to Mar.). Data for winter 2012-2013 are missing. Before 2010, data were provided in a different format and can therefore not be directly compared with the data shown here.

Annex 3: List of References

ADB, 2009: Safeguard Policy Statement. ADB Policy Paper. Asian Development Bank, 92 pp.

ADB, 2022: Environmental Assessment Guidelines. Asian Development Bank, 167 pp.

AIIB, 2022: Environmental and Social Framework. Asian Infrastructure Development Bank, 89 pp.

Corporate Solutions, 2017: Power Sector Development Mater Plan. ADB GRANT NO: 0213 -TAJ. ADB, 218 pp.

E&S POE, 2014: Final Report of the Environmental and Social Panel of Experts. Rogun Hydropower Project

EIB, 2022: The EIB Environment Framework. European Investment Bank, 30 pp.

EIB, 2022: The EIB Group Environmental and Social Policy Environment and Social Sustainability Framework. European Investment Bank, 11 pp.

Fichtner, 2021: Sebzor HPP. Updated Feasibility Study. Pamir Energy, 168 pp.

Gruner, 2024: Main Dam at 1110 m asl: Emergency Preparedness and Action Plans. Webuild, Doc. No. S-0214-A-GE-B-GE-TR-003-A0

Hydrosolutions, 2023: Tipping the Scales: The Future of the Amu Darya River Amidst Agricultural Ambitions. https://www.hydrosolutions.ch/projects/tipping-the-scales-the-future-of-the-amu-darya-river-amidst-agricultural-ambitions

IFC, 2013: Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets.

Plotnikov, I.S., Aladin, N.V., Zhakova, L.V., et al., 2023: Past, Present and Future of the Aral Sea -A Review of its Fauna and Flora before and during the Regression Crisis. Zool Stud. 2023 May 12;62:e19. doi: 10.6620/ZS.2023.62-19

Spaling, H., 1994: Cumulative Effects Assessment: Concepts and Principles. Impact Assessment, 12:3, 231-251, DOI: 10.1080/07349165.1994.9725865

USAID, (n.d., ca. 2022): Feasibility Study for Charsem Hydropower Plant. Power the Future. 106 pp.

Watler, H., and Breckle, S.W., 1986: Ökologie der Erde, Band 3: Spezielle Ökologie der Gemässigten und Arktischen Zonen Euro-Nordasiens. Gustav Fischer-Verlag, 587 pp.

WB 2014: CASA-1000: Central Asia South Asia Electricity Transmission and Trade Project. Regional Environmental Assessment (REA). https://www.casa-1000.org/Docs/0104/CASA-1000%20REA%20Main%20February-14%20Final.pdf

WB, 2016: World Bank Environmental and Social Framework. World Bank, Washington D.C., 106 pp.

Zwahlen, R., 2022: Assessing the Environmental Impacts of Hydropower Projects. Environmental Earth Sciences Series. Springer Nature Switzerland; xxx + 622 pp. https://doi.org/10.1007/978-3-030-91185-0

Zwahlen, R., Kahongo, L.W., and de Genot de Nieukerken, V., 2019: Kafue Gorge Lower HPP - a low-impact addition to an existing HPP cascade, Zambia. Paper presented at the Africa 2019 Hydropower Conference, Windhoek, Namibia, April 2019.