

# Initial Environmental Examination

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## Bhutan: Water Flagship Program Support Project – Hetshotsangchhu Integrated Water Supply Scheme Subproject

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## CURRENCY EQUIVALENTS

(as of 26 August 2025)

Currency unit	–	Bhutanese Ngultrum (Nu.)
Nu.1.00	=	\$ 0.011
\$1.00	=	Nu.87.83

## List of Abbreviations

<b>Abbreviation</b>	<b>Full Term</b>
ADB	Asian Development Bank
AQG	Air Quality Guidelines
BC	Biological Corridor
BHP	Basochhu Hydropower Plant
BoQ	Bill of Quantities
CF	Community Forest
CFMG	Community Forest Management Group
dBa	A-weighted Decibels
DGPC	Druk Green Power Corporation
DoFPS	Department of Forest & Park Services
EC	Environmental Clearance
EDRR	Early Detection and Rapid Response
EHS	Environment, Health, and Safety
EMP	Environmental Management Plan
EPRP	Emergency Preparedness and Response Plan
ES	Environmental Standards
ESCP	Erosion and Sediment Control Plan
E-flow	Environmental Flow
GRC	Grievance Redress Committee
GRF	Government Reserve Forest
GRM	Grievance Redress Mechanism
HDPE	High-Density Polyethylene
HIRA	Hazard Identification and Risk Assessment
IAS	Invasive Alien Species
IBAT	Integrated Biodiversity Assessment Tool
IEE	Initial Environmental Examination
IPM	Integrated Pest Management
IUCN	International Union for Conservation of Nature
Leq	Equivalent Continuous Sound Level
lps	Liters Per Second
masl	Meters Above Sea Level
MEMR	Monthly Environmental Monitoring Report
MLD	Million Liters per Day
MOIT	Ministry of Infrastructure and Transport
MoU	Memorandum of Understanding
NCHM	National Center for Hydrology and Meteorology
NDWQS	National Drinking Water Quality Standards
NEC	National Environment Commission
NO2	Nitrogen Dioxide
Nu.	Ngultrum (Bhutanese Currency)
O&M	Operation and Maintenance
OHS	Occupational Health and Safety
PCR	Physical Cultural Resources
PIU	Project Implementation Unit
PMU	Project Management Unit
PMSC	Project Management Supervision Consultant
PPE	Personal Protective Equipment
QEMR	Quarterly Environmental Monitoring Report
ROB	Royal Government of Bhutan
RoW	Right-of-Way
RSTA	Road Safety and Transport Authority
SCADA	Supervisory Control and Data Acquisition
SEMP	Site-Specific Environmental Management Plan
SEMR	Semi-Annual Environmental Monitoring Report

SMP	Spoil Management Plan
SOP	Standard Operating Procedures
SPS	Safeguard Policy Statement (ADB)
TSP	Total Suspended Particulates
WFP	Water Flagship Program
WHO	World Health Organization
WSP	Water Safety Plan
WUA	Water User Association

## WEIGHTS AND MEASURES

ha	hectare
km	kilometer
km <sup>2</sup>	square kilometer
lpcd	liter per capita per day
lps	liter per second
masl	meter above sea level
MLD	million liters per day

## Glossary of Dzongkha Terminologies

<b>Dzongkha Term</b>	<b>English Equivalent/Translation</b>
Dzongkha	National Language
Dzongkhag	District
Gewog	Block or Sub-district
Gup	Head of a Gewog
Mangmi	Deputy Head of a Gewog
Ngultrum (Nu.)	Bhutanese Currency
Tshogde	Committee or Assembly
Tshogpa	Village Representative
Chiwog	Electorate or Village Cluster
Lhakhang	Temple
Goenpa	Monastery or Hermitage
Dzong	Fortress-Monastery
mani-dungdrup	A specific Buddhist prayer ceremony
Nye	Sacred Site or Natural Shrine
Phub	Ritual Dagger

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## Executive Summary

1. This Initial Environmental Examination (IEE) report documents the environmental assessment for the Hetshotsangchhu Integrated Water Supply Scheme in Wangdue Phodrang, a key subproject under the ADB-financed Water Flagship Program Support Project. A preliminary IEE was prepared during the project processing phase based on a feasibility-level design. This report is a comprehensive update to that preliminary IEE, revised to reflect the final detailed engineering design for Package 1 (Mainline and Headworks). Crucially, it also incorporates the findings from recent site-specific environmental surveys and a final round of stakeholder and public consultations conducted from 13-14 October 2025, ensuring that the mitigation measures are both technically sound and informed by direct community feedback.

2. To combat water scarcity in Bhutan, the Royal Government of Bhutan (RGOB) is implementing the national Water Flagship Program (WFP) titled "Access to 24x7 Safe Drinking Water with Irrigation," supported by the Asian Development Bank (ADB) through the Water Flagship Program Support Project. This initiative aims to enhance climate resilience for approximately 11,000 residents and farmers facing water insecurity in Zhemgang and Wangdue Phodrang Dzongkhags and Thimphu Thromde by developing climate and disaster-resilient infrastructure, integrating digital technologies, and strengthening local capacities. It also seeks to promote sustainable water management through public awareness efforts. The project is aligned with broader development goals of achieving sustainable water access and improving food self-sufficiency and nutrition security, with its core outcome focused on bolstering climate resilience in the targeted communities.

3. Project Impact, Outcome, and Outputs: The Hetshotsangchhu subproject is designed to contribute to the overall project's development impacts of (i) sustainable water access achieved and (ii) food self-sufficiency and nutrition security enhanced, and its outcome of climate resilience of residents and farmers strengthened in the project area.

4. It will achieve this by directly supporting the four main outputs of the ADB-funded project:

- Output 1: Drinking water supply and irrigation infrastructure for communities' resilience developed.
- Output 2: Climate smart water management systems established.
- Output 3: Capacity, governance and awareness of resilient and sustainable water management strengthened.
- Output 4: Farmers' livelihood improved and made climate resilient.

5. Changes from Preliminary to Detailed Design and Final Refinements: The transition from the preliminary concept to the final, implementation-ready design involved several significant project optimizations. These changes were further refined based on the final stakeholder and community consultations held in October 2025. Key changes include:

- Significant Reduction in Environmental Footprint: A strategic re-alignment of the pipeline to follow existing footpaths and a narrowing of the construction Right-of-Way (RoW) to 3.5 meters resulted in a substantial decrease in environmental impact. This reduced the required forest clearance from an initial estimate of 31.2 hectares to 7.4 hectares and the number of trees to be felled from 5,653 to a confirmed 774.

- Avoidance and Minimization of Social Impacts: Following a joint site verification with landowners and local officials in October 2025, the alignment was further adjusted. This proactive engagement successfully avoided any impact on two of the three potentially affected private agricultural plots and minimized the impact on the third.
  - Optimization of Offtake Structures: The original concept of replacing 22 individual irrigation schemes was streamlined. The final design consolidates these into a more efficient system managed by 10 robust, multi-purpose primary offtakes.
  - Clarification of Project Packaging: The project scope was formally divided into two distinct packages for efficient implementation: Package 1 for the heavy civil works of the main intake and transmission line, and Package 2 for the final fittings, treatment units, and distribution networks.
6. The Ministry of Infrastructure and Transport (MOIT) is the Executing Agency, with the Wangdue Phodrang Dzongkhag Administration serving as the Implementing Agency.
7. Subproject Description. The Hetshotsangchhu Integrated Water Supply Scheme will be implemented in the Gasetsho Gom and Gasetsho Wom Gewogs of Wangdue Phodrang to address critical water shortages. The scheme is designed as a fully integrated, climate-resilient system to meet the region's water demands for the next 30 years.
8. The infrastructure will be constructed in two main packages, both funded under this project. The system is designed around two primary gravity-fed transmission pipelines: a main transmission line (Mainline A) and a separate, secondary line for the Hetshokha area (Line B).

### **Package 1: Raw Water Transmission System**

9. This package, for which the detailed engineering design has been finalized, covers the construction of the primary raw water conveyance infrastructure:
- Intake and Headworks: A 100-year flood-resilient intake on the Hetshotsangchhu river and an adjoining 28-meter-long primary desilting tank.
  - Mainline A (Primary Transmission Line): Installation of a ~21.1 km gravity-fed main transmission line (710mm OD HDPE and DN700 Carbon Steel pipe). This is the backbone of the system, designed to carry the bulk flow of 608 lps and supply 10 primary offtakes along its route.
  - Hesokha Line B (Secondary Transmission Line): Installation of a separate 5.6 km transmission line to serve the Hetshokha area. This smaller line (180mm OD HDPE) is designed for a flow of 29 lps and starts from an offtake at Break Pressure Tank 2 (BPT02) on Mainline A. Its final delivery point is located just after chainage km 6 of the main alignment.
  - Ancillary Structures: Construction of all associated structures, including the primary offtakes, valve chambers, and break pressure tanks.

### **Package 2: Water Treatment and Distribution Networks**

10. This package, to be finalized during implementation, covers the final delivery of water from the infrastructure built in Package 1:
- Drinking Water Treatment: Installation of local sedimentation and chlorination units at a subset of the primary offtakes.

- Final Distribution Pipelines: Construction of an aggregate ~30 km of smaller-diameter HDPE pipelines to distribute treated water to community storage tanks and raw water from the offtakes to the irrigation command areas.

11. **Description of the Environment.** The subproject is located in a remote, mountainous region of central Bhutan, characterized by steep terrain and sensitive ecological and social features. The baseline assessment, enhanced by site surveys and community consultations in October 2025, identified key environmental characteristics that have directly informed the project's final design and mitigation strategy:

- Ecological Sensitivity: The project's water intake and an initial ~5 km of the pipeline are situated within Biological Corridor No. 2, a protected landscape. A biodiversity assessment confirmed this area is a habitat for protected species, including Dhole (Endangered) and Snow Trout (Vulnerable). While the assessment concluded the immediate project area is not a critical habitat, its high ecological value necessitates stringent protection protocols. The presence of invasive alien species like *Solanum viarum* near the intake site was also confirmed, requiring a specific management plan.
- Atmospheric and Acoustic Conditions: Monitoring shows that the area has a clean but very sensitive environment. The air does not move much—it's calm about half the time—so pollution tends to stay trapped. Even now, levels of Nitrogen Dioxide (NO<sub>2</sub>) are already higher than what the World Health Organization considers safe, likely due to pollution drifting in from other regions and the shape of the land keeping it in place. The area is also extremely quiet at night, and even small increases in noise could cause harm.
- Hydrology and Climate Vulnerability: The water source, the Hetshotsangchhu, is perennial but exhibits extreme seasonal variability, with a recorded minimum flow of 117 lps in December. The area's vulnerability to climate change was starkly demonstrated by a community-reported severe, unseasonal flash flood in November 2024, which underscores the need for a highly resilient design.
- Community and Cultural Context: The project alignment passes through and adjacent to several communities, including Hetshokha and Tonglabji. It intersects critical, often sole-source community infrastructure such as irrigation channels, spring-fed drinking water pipelines, and a farm road. The alignment is also located within 50 meters of the Hetshokha Lhakhang, a significant Physical Cultural Resource (PCR).

12. The project's environmental setting was established through a combination of field surveys, instrumental monitoring, specialist studies, and a review of secondary data. The key baseline conditions that have informed the project's design and mitigation strategy are summarized below.

#### Summary of Baseline Environmental Conditions

Parameter	Description of Baseline Conditions
<b>Physical Environment</b>	The project is located in a rugged, mountainous terrain with highly variable slopes, frequently ranging from 20° to 50%. The alignment is underlain by Granitic Gneiss and traverses areas with a high inherent risk of soil erosion and localized landslides.
<b>Climate and Hydrology</b>	The climate is dominated by a summer monsoon, leading to extreme seasonal variability in the flow of the Hetshotsangchhu river, with a recorded low of 117 lps in December. The area's vulnerability to climate change is confirmed by a community-reported severe, unseasonal flash flood in November 2024.
<b>Ecological Environment</b>	The project is situated in a highly sensitive ecological zone. The intake and ~5 km of the pipeline are located within Biological Corridor No. 2. A biodiversity assessment confirmed the presence of protected species, including Dhole (Endangered) and Snow Trout (Vulnerable), but concluded the area is not a critical habitat. The presence of invasive alien species, including <i>Solanum viarum</i> , was also confirmed near the intake.

<b>Ambient Air and Noise</b>	Monitoring shows that the area is clean but very sensitive. The air doesn't move much, it's calm about half the time - so pollution tends to stay trapped. Because of this and pollution drifting in from other regions, Nitrogen Dioxide (NO <sub>2</sub> ) levels are already higher than what the World Health Organization considers safe. The area is also very quiet, especially at night, and even small increases in noise could cause harm.
<b>Socio-Economic Environment &amp; Community Assets</b>	The project will benefit 2,278 people in Gasetsho Gom and Gasetsho Wom Gewogs, where communities face significant water insecurity, leading to 28% of agricultural land being left fallow. The pipeline alignment intersects and runs alongside critical, often sole-source community infrastructure, including farm roads, irrigation channels, and spring-fed drinking water pipelines.
<b>Physical Cultural Resources</b>	The area has a rich cultural heritage. One site, the Hetshokha Lhakhang, is located approximately 40-50 meters from the pipeline alignment, requiring specific, community-agreed mitigation measures (e.g., no rock breakers) to avoid disturbance from construction vibration and noise.

13. **Assessment of Environmental Impacts and Mitigation.** This updated IEE concludes that while the project will generate significant socio-economic benefits, it also has notable adverse impacts that require a robust, site-specific, and community-informed mitigation strategy. The most significant impacts and their corresponding mitigation measures, detailed in the Environmental Management Plan (EMP), are summarized below by project phase.

- **Pre-construction/Design Phase:** The most significant potential impacts were addressed through proactive design optimization and the establishment of formal agreements. This included a major re-alignment of the pipeline to reduce its length in the Biological Corridor (from 16 km to ~5 km) and to avoid impacts on two of three potentially affected private agricultural plots. Key agreements that have been or will be finalized before construction include: a formal Water Sharing MoU with the Druk Green Power Corporation, the signing of detailed MoUs with all affected Community Forest Management Groups (CFMGs), and the preparation of a Resettlement Plan for the one remaining affected household. The design also incorporates a mandatory 30% environmental flow to protect the downstream ecosystem.
- **Construction Phase:** Temporary construction impacts will be managed through a comprehensive and legally binding Environmental Management Plan (EMP). The Contractor will be required to prepare a detailed, site-specific EMP (SEMP) for approval before any works commence. Key mitigation strategies include:
  - Special rules will be followed for all work inside the Biological Corridor to protect wildlife and forests. These include no night-time work, no worker camps, and careful control of blasting activities. Before any trees are cut, a wildlife survey must be done to check for active nests. Workers must also follow a strict code of conduct to avoid harming the environment.
  - For Community and Cultural Heritage: The EMP includes specific, community-informed mitigation measures, such as using "gradual excavation" methods near the Hetshokha Lhakhang, providing mandatory protection for all identified local irrigation channels and drinking water pipelines, and maintaining community access along footpaths and farm roads.
  - For General Environmental Management: Implementing detailed sub-plans for spoil management (prohibiting side-casting), erosion and sediment control (e.g., silt fences, check dams), air quality control (e.g., dust suppression, wheel washing), and water quality protection (e.g., bunded fuel storage, spill response).
  - For Health and Safety: Implementing a robust Occupational Health and Safety (OHS) Plan, including mandatory worker training, provision of PPE, and adherence to

Bhutan's workmen compensation laws, as well as a Community Health and Safety Plan to manage risks from traffic and open trenches.

- **Operation Phase:** Long-term environmental sustainability will be managed by the Wangdue Phodrang Dzongkhag Administration as the designated O&M agency. They will be responsible for preparing and implementing a comprehensive O&M Manual, which will include a Water Safety Plan (WSP), a Source Sustainability Management Plan, and an Emergency Preparedness and Response Plan (EPRP).
  - As a firm environmental commitment under this project, the section of the access road within the Biological Corridor will be fully decommissioned and closed after construction. This restoration will involve ripping the compacted surface and replanting the area with native tree species to restore the forest habitat. Following decommissioning, access for future maintenance in this section will be by foot only.
  - During stakeholder consultations, a view was expressed to explore retaining the route as a managed eco-trail. It is understood that such a proposal is outside the scope of this project and its environmental approvals. The Dzongkhag Administration may take this stakeholder view into consideration for further assessment, which would require a separate feasibility study, a new IEE, and obtaining all required environment and forest clearances before any such plan could be considered.

14. Environmental Management Plan (EMP). An Environmental Management Plan (EMP) has been developed to provide a clear and actionable framework for managing all identified environmental and social impacts. The EMP translates the mitigation measures into a set of legally binding commitments, defines institutional roles, and establishes a robust monitoring and reporting program. This EMP has been updated to incorporate specific, practical mitigation measures derived from the final round of community consultations.

15. The EMP is a core component of this IEE and will be integrated into the bidding and contract documents, making its implementation a legal obligation for the selected Contractor. The Contractor will be required to prepare a detailed Contractor's Environmental and Social Management Plan (C-ESMP) based on this EMP for approval by the PIU prior to the commencement of any civil works. To facilitate this, a detailed "Guidance Note on the Preparation of the C-ESMP" has been prepared and is attached as Appendix 16 for the Contractor's reference.

16. The C-ESMP will detail the specific procedures for managing key impacts through a series of sub-plans, including:

- Protection of the Biological Corridor and Forest Resources.
- Protection of Community Infrastructure and Physical Cultural Resources.
- Spoil and Waste Management Plan.
- Air Quality, Noise, and Vibration Management Plan.
- Comprehensive Occupational Health and Safety (OHS) Plan.
- Community Health and Safety Plan.

17. A copy of the approved C-ESMP must be maintained on-site at all times. The Contractor will be fully responsible for its implementation, under the direct supervision of the PIU and with overall oversight from the PMU.

18. **Consultation and Participation.** Meaningful stakeholder engagement has been an integral part of the project's development. Initial consultations were conducted in June 2022 to secure in-principle agreements and broad-based support. This was followed by a comprehensive round of site-specific stakeholder and community consultations from 13-14 October 2025 to discuss the final design and refine mitigation measures.

19. These consultations confirmed the communities' overwhelming support and growing urgency for the project due to the progressive failure of their local water sources. The engagement process was instrumental in:

- Permission to use the forest area was first granted by the Community Forest Management Groups (CFMGs) in 2022. This agreement was confirmed again in 2025. The project team is committed to making this agreement official by preparing detailed Memoranda of Understanding (MoUs) to be between the PIU and CFMGs.
- Facilitating the Water Sharing Agreement with the downstream Basochhu Hydropower Plant.
- Informing the EMP with Site-Specific Mitigation: The October 2025 consultations were critical in identifying on-the-ground risks. All environmental concerns raised by the community have been directly incorporated into the updated EMP. This includes specific, community-proposed mitigation measures for:
  - The protection of the Hetshokha Lhakhang from construction vibrations.
  - The safeguarding of critical irrigation channels and drinking water pipelines.
  - The management of community access along the farm road.
  - Enhanced safety protocols for blasting near populated areas.

20. This two-way engagement process ensures that the final Environmental Management Plan is not only technically sound but is also practical and directly responsive to the needs and concerns of the affected communities.

21. **Grievance Redress Mechanism (GRM).** A formal, three-tiered Grievance Redress Mechanism (GRM) will be established to provide an accessible, transparent, and no-cost platform for affected persons to raise concerns and seek timely resolutions.

- Tier 1 (On-Site): Immediate, construction-related issues will be addressed at the site level by the Contractor and the Project Implementation Unit (PIU) within 5 working days.
- Tier 2 (Dzongkhag Level): Unresolved or more significant issues will be escalated to a Dzongkhag-level Grievance Redress Committee (GRC), chaired by the Dasho Dzongdag, for resolution within 15 working days.
- Tier 3 (Central Level): Grievances not resolved at the Dzongkhag level can be elevated to a central committee at the ministry level for a final decision within 10 working days.

22. Information about the GRM, including contact details of focal persons, will be widely disclosed to the communities. It is important to note that the GRM does not impede an aggrieved person's right to access the country's legal system at any stage of the process.

23. **Implementation Arrangement.** The Ministry of Infrastructure and Transport (MOIT) is the Executing Agency, with a Project Management Unit (PMU) providing overall strategic oversight, reporting, and project-wide compliance management. The Wangdue Phodrang Dzongkhag Administration is the Implementing Agency, with a Project Implementation Unit (PIU) responsible for

frontline, day-to-day supervision and monitoring of the Contractor's performance on-site. The PMU and PIU will be supported by a Project Management Supervision Consultant (PMSC).

24. The Civil Works Contractor holds the direct responsibility for the on-the-ground implementation of all mitigation measures. To ensure full compliance, the following framework will be enforced:

1. The full Environmental Management Plan (EMP) will be included as a legally binding part of the civil works contract.
2. The Contractor will be required to prepare a detailed and costed Site-Specific Environmental Management Plan (SEMP) based on this IEE.
3. No civil works will be permitted to commence until the SEMP has been formally approved by the PIU and PMU.

25. Monitoring and Reporting. A multi-tiered monitoring and reporting framework will be implemented to ensure compliance with the EMP.

- Contractor's Internal Monitoring: The Contractor will conduct daily internal monitoring of its activities and submit Monthly Environmental Monitoring Reports to the PIU.
- PIU and PMSC Supervision: The PIU will conduct regular site inspections to supervise the Contractor's performance. The Project Management Supervision Consultant (PMSC) will provide independent verification.
- Instrumental Monitoring: The Contractor will be required to commission an independent third-party agency to conduct biannual instrumental monitoring for air, noise, and water quality at sensitive locations.
- Reporting to ADB: The PMU will consolidate all monitoring data and submit Semi-Annual Environmental Monitoring Reports (SEMRs) to the ADB for review and public disclosure. This reporting will continue until a Project Completion Report is issued.

26. **Conclusion.** This updated Initial Environmental Examination (IEE) confirms that the Hetshotsangchhu Integrated Water Supply Scheme remains classified as Category B for Environment. The assessment, revised to reflect the final detailed engineering design and informed by recent community consultations, concludes that the project will deliver significant and lasting socio-economic benefits by addressing a critical and worsening water crisis in the Gasetsho Gom and Gasetsho Wom Gewogs.

27. The project has received all necessary statutory approvals, confirming that its environmental impacts are considered acceptable and manageable under national law. The Environmental Clearance (EC) was secured from the Department of Agriculture on 24 October 2025, providing the overall legal authorization for the project to proceed. Furthermore, the most significant specific impact the felling of 774 trees along the 21.1 km main transmission line including temporary construction within a sensitive Biological Corridor - is formally endorsed by the Forestry Clearance (Application ID: 919151) issued by the Department of Forests and Park Services on 13 August 2025. This clearance mandates key mitigation measures, particularly compensatory plantation, which form a core part of the project's EMP. These legal requirements, combined with the project's firm

commitment to fully decommission the access road and restore the habitat within the Biological Corridor, ensure that environmental safeguards are both regulatory and project-integrated.

28. **Recommendations.** It is recommended that the project proceed to implementation, subject to the strict adherence to the following mandatory conditions:

1. Full and Legally Binding Implementation of the Updated EMP: The EMP, which includes specific mitigation measures derived from community consultations, must be an integral and enforceable part of the civil works contract.
2. Finalization of All Pre-Construction Requirements: All pending legal and community agreements, including the signing of Memoranda of Understanding (MoUs) with the Community Forest Management Groups and the Resettlement Plan, must be completed prior to the commencement of any works in the respective areas.
3. Mandatory Contractor Compliance and Capacity: The appointed Contractor must prepare a comprehensive Site-Specific EMP (SEMP) for PIU approval before mobilization and must appoint qualified key personnel, including a full-time EHS Officer and a Biodiversity Supervisor for works in sensitive areas.
4. All construction work inside the Biological Corridor and near sensitive sites like Hetshokha Lhaxhang must strictly follow the "Special Environmental Management Protocols." These rules are in place to protect the area's natural and cultural heritage and must be fully enforced at all times.
5. Strengthened Institutional Oversight and Reporting: The defined institutional roles for the PIU, PMU, PMSC, and DoFPS must be followed to ensure rigorous supervision, and the full monitoring and reporting program, including the submission of Semi-Annual reports to ADB, must be implemented.

# **I. Introduction**

## **A. Background**

29. Bhutan is known to be abundant in water,<sup>2</sup> which is estimated to have 109,000 m<sup>3</sup>/capita/year. It has one of the highest reported water availability per capita in the region. However, the paradox exists since most parts of the country are running short of drinking and irrigation water. The issues are that most of the existing water sources are slowly drying up and thus becoming difficult to cater to the increasing demands, especially in town areas. This is primarily due to urbanization leading to more infrastructures, better facilities and population growth in town areas. The increase in population is also due to 'rural-urban' migration for better opportunities for commerce and economic growth. Despite the scenario of high-water availability, the grim reality is there is a low accessibility. The country is slowly but steadily facing a demand and supply situation. This is mainly due to insufficient source management, inadequate infrastructure development and inadequate and timely maintenance of existing drinking water supply systems. Issues in water quality are also becoming pertinent.

30. Bhutan is known to be abundant in water,<sup>2</sup> which is estimated to have 109,000 m<sup>3</sup>/capita/year. It has one of the highest reported water availability per capita in the region. However, the paradox exists since most parts of the country are running short of drinking and irrigation water. The issues are that most of the existing water sources are slowly drying up and thus becoming difficult to cater to the increasing demands, especially in town areas. This is primarily due to urbanization leading to more infrastructures, better facilities and population growth in town areas. The increase in population is also due to 'rural-urban' migration for better opportunities for commerce and economic growth. Despite the scenario of high-water availability, the grim reality is there is a low accessibility. The country is slowly but steadily facing a demand and supply situation. This is mainly due to insufficient source management, inadequate infrastructure development and inadequate and timely maintenance of existing drinking water supply systems. Issues in water quality are also becoming pertinent.

31. Access to water is a fundamental human right and an essential resource that supports life and livelihoods. Potable water is required for drinking and sanitation, food preparation and for maintaining personal hygiene. The Water Act of Bhutan 2011 and the Water Regulation of Bhutan 2014 state that water for drinking and sanitation is to be the first priority for water allocation. Therefore, provision of adequate, reliable and clean drinking water is an essential service that the state needs to ensure its citizens.

32. Inaccessibility and imbalance in water supply with some areas having abundant water while adjacent ones experience shortages can be attributed to the rugged terrain and altitudinal variations. Abundant water is available in the form of major rivers and tributaries flowing in the low-lying river valleys and deep gorges. Whereas most of the communities are located along slopes and depend on smaller streams, springs and lakes for drinking.

33. Flagship Programs have been introduced in the 12th Five Year Plan (FYP) as an additional means to achieve the national, agency and local government key result areas. Flagship Programs are

high-priority multi-sectoral programs to address national issues in a targeted manner. To address the current drinking water supply issues and requirements, the Water Flagship Program (WFP or government program) "Access to 24x7 Safe Drinking Water with Irrigation" has been prioritized and approved by the Royal Government of Bhutan (RGOB) as a Flagship Program for the 12th FYP period. The WFP is to contribute to the National Key Result Area (NKRA) 17 titled "Sustainable Water Ensured". Wangdue Phodrang Dzongkhag (District) was selected as one recipient of WFP.

34. In support to this government program, the Water Flagship Program Support Project (the project) is proposed for ADB financing to implement the following: (i) strengthen climate resilience of about 11,000 residents and/or farmers who suffer from water insecurity in Zhemgang and Wangdue Phodrang Dzongkhags (Districts) and Thimphu Thromde (Municipality); (ii) build climate- and disaster resilient systems through infrastructure development, digital technology, and capacity support of local communities and institutions.; and (iii) raising public awareness in sustainable water management.

## **B. Development Impact, Outcome and Outputs of the Project**

35. Impacts and Outcome. The project will be aligned with the following development impacts: (i) sustainable water access achieved and (ii) food self-sufficiency and nutrition security enhanced; and with the following outcome: climate resilience of residents and farmers strengthened in the project area.

36. Output 1: Drinking water supply and irrigation infrastructure for communities' resilience developed. The project will develop two integrated drinking water supply with irrigation systems in Wangdue Phodrang and Zhemgang districts. The systems will tap into sustainable sources upstream to improve water security, which will be critical to strengthening communities' resilience to climate change and promote local economic development. The systems will include (i) raw water intake, (ii) piped transmission line, (iii) rehabilitation of irrigation networks including canals and pipes up to farm level, (iv) expanding and rehabilitating of drinking water treatment infrastructure, including disinfection, (v) improvements to the drinking water distribution network for efficient and equitable supply in Zhemgang town and Gasetsho-wom and Gasetsho-gom gewogs (community blocks). The project will also develop a drinking water supply system in Thimphu-Pamtsho (northern) area which will include a new water treatment plant (1.4 million liters per day capacity), a new district metering area-based distribution network (at least 18 km) with 300 automatic meter reading households' connections to improve access to safe and continuous drinking water supply that meet national standards and resilience by switching to sustainable water sources from small and unreliable springs. All systems will adopt climate- and disaster- resilient designs. The three systems implemented in different (urban-rural) contexts will serve as a functional model for improving resilience to climate- and disasters-risks and water sector performance in the country, which will be replicated to other areas.

37. Output 2: Climate smart water management systems established. The project will establish user-friendly climate smart water management (digital) systems for each of the three schemes established under output 1, which will integrate (i) climate and hydrological information such as rainfall, temperature, and river flow data upstream and at intake, with (ii) Supervisory Control and Data Acquisition (SCADA) or smart devices such as flow meters, pressure control and flow valves

connected to the infrastructure. This will enable early warning and faster response to extreme climate events (floods) through remote and/or automatic control, and improved planning, monitoring, and management capacity of extensive water infrastructure. especially in view of climate change (climate adaptation).

38. Output 3: Capacity, governance and awareness of resilient and sustainable water management strengthened. To improve resilience, sustainability, and quality of water service delivery, the project will strengthen the capacity of 20 staff (at least 30% women) from MOIT, Ministry of Agriculture and Livestock (MOAL), municipalities and districts, in climate-resilient and sustainable water service delivery, and their awareness of public private partnership. The project will train local communities (at least 50% women) and/or water users' associations in rural areas in sustainable O&M, asset management, water governance and allocation, climate adaptation, and geophysical hazards reduction. Service level improvement and sustainability plans, with clear responsibilities and financing mechanisms and revenue improvement for O&M, and water and sanitation safety plans will be developed for project towns, and villages. The project will raise community awareness (at least 50% women) on water resources conservation, integrated water resource management, water, sanitation, and hygiene (including limiting spread of infectious diseases such as COVID-19), and climate change, to maximize the health and economic impact of the investments in water supply.

39. Output 4: Farmers' livelihood improved and made climate resilient. The project will assist farm-level support activities to strengthen farmers' livelihood resilience to climate change and realize economic benefits from irrigation service improvement through crop diversification, production upscaling, processing, and marketing. This will include tailored training and mobilization of at least 300 farmers (50% women) and implementation of a minimum ten pilots per scheme covering key issues for resilient agriculture such as crop diversification (e.g., combination of food crops and trees), pest control, marketing, local processing to increase shelf life, and climate change variation. This output will be entirely supported by the proposed grant from Japan Fund for Prosperous and Resilient Asia and the Pacific.

### **C. Purpose of the IEE**

40. This document is the updated Initial Environmental Examination (IEE) for the Hetshotsangchhu Integrated Water Supply Scheme subproject. A preliminary IEE was prepared and disclosed during the project processing phase based on feasibility-level designs. As per ADB and RGOB requirements, this report has been comprehensively updated to reflect the final detailed engineering design, as presented in the "Hydraulic Structure Design Report (August 2025)."

41. The purpose of this updated IEE is therefore to:

1. Enhance the Baseline: Build upon the preliminary environmental baseline with new, site-specific data collected along the finalized pipeline alignment, including the findings from instrumental monitoring and specialist surveys.
2. Re-assess Impacts: Re-evaluate the potential environmental impacts based on the specific construction methods, final component locations, and detailed scope of works confirmed in the final design.

3. Refine the EMP based on Design and Consultation: Update and detail the Environmental Management Plan (EMP) to provide specific, actionable, and contractually binding mitigation measures. Crucially, this refined EMP incorporates direct feedback and concerns raised by stakeholders and affected communities during the final round of public consultations held in October 2025, ensuring the mitigation strategy is both technically sound and socially responsive.
42. This document supersedes the preliminary IEE and serves as the definitive basis for environmental management for the subproject.
43. The subproject was screened using ADB's rapid environmental assessment checklists and remains classified as Category B for Environment under ADB's Safeguard Policy Statement (SPS, 2009), as its potential adverse environmental impacts are site-specific, few if any are irreversible, and in most cases mitigation measures can be readily designed. Accordingly, this IEE has been prepared in accordance with the requirements for Category B projects.

## **D. Methodology for Environmental Assessment**

### **1. Purpose and Compliance**

This Initial Environmental Examination (IEE) has been prepared to meet the environmental safeguard requirements of both the Asian Development Bank's Safeguard Policy Statement (SPS, 2009) and the Royal Government of Bhutan's Environmental Assessment Act, 2000. The findings and mitigation measures detailed herein will be incorporated as a binding component of the bidding and contract documents to ensure their full implementation by the selected contractor.

### **2. IEE Preparation Process**

44. The preparation of this IEE was conducted in three main phases: an initial assessment during the feasibility stage, a technical update upon completion of the detailed engineering design, and a final refinement based on pre-construction stakeholder & public consultations.

#### *a) Initial IEE Preparation (up to June 2022)*

The preliminary version of this report was developed through a systematic, multi-stage process:

- (i) Desktop Review: Collection and review of all relevant information, including feasibility reports, maps, preliminary designs, and the applicable legal and policy frameworks of both the Royal Government of Bhutan and the ADB.
- (ii) Field Investigations: Site visits, supported by the Project Implementation Unit (PIU), to assess the project's topography, verify ground conditions, and identify sensitive environmental and social receptors along the proposed alignment.
- (iii) Specialist Biodiversity Assessment: A full-scale, expert-led biodiversity assessment was commissioned to confirm the habitat's status, identify any species of conservation concern, and develop specific, targeted mitigation measures, particularly for the Biological Corridor.
- (iv) Stakeholder Consultations: Extensive and meaningful consultations were conducted with all relevant stakeholders, including the PIU, PMU, Dzongkhag and Gewog administrations, Community Forest Management Groups, and the Divisional Forest Office.
- (v) Data Analysis and Reporting: Data from all sources was systematically analyzed, and a preliminary IEE report was prepared based on the information gathered up to June 2022.

b) *Technical Update and Finalization (August 2025)*

45. Following the finalization of the project's detailed engineering design, this IEE was substantially updated in August 2025. This update was based on a final field verification visit and instrumental monitoring (for air, noise, and water quality) conducted to:

- (i) Confirm the precise pipeline alignment and locations of all ancillary facilities.
- (ii) Verify and enhance the baseline environmental data.
- (iii) Technically refine the mitigation measures in the EMP to align with the final design specifications.

c) *Final Refinement based on Pre-Construction Consultations (October 2025)*

46. A final round of intensive stakeholder and community consultations was conducted from 13-14 October 2025. The purpose of this engagement was to:

- (i) Disclose the final, detailed alignment to the directly affected communities.
- (ii) Identify any site-specific, on-the-ground risks or concerns that were not apparent during the broader design-phase surveys.
- (iii) Incorporate direct community feedback into the EMP, leading to the final refinement of specific mitigation measures for the protection of cultural heritage, community water infrastructure, and public safety.

47. Therefore, this version of the IEE represents the final, definitive assessment based on the detailed engineering design, enhanced by site-specific data and refined through direct community engagement. It supersedes all previous versions and forms the binding basis for environmental management during the project's construction and operation phases.

## **E. Structure of the Report**

48. The IEE report has been structured in accordance with ADB's requirement and suggested report format. The report has been compiled and presented as follows:

- i. **Executive Summary.** This chapter provides an overview and summary of the outcome of the IEE;
- ii. **Chapter 1.** Introduction, which includes the background, outcome and outputs of the subproject, purpose of the IEE, methodology and structure of the IEE report;
- iii. **Chapter 2.** Policy Legal and Administrative Framework, which includes ADB Safeguard Policy Statement, National Environment Assessment Framework, National Environmental Acts and Legislations, Legislation relating to Occupational Health and Safety, Relevant International Conventions and Treaties, Gaps in Legal and Guiding Instruments, Permits and Clearances and Applicable Environmental Standards;
- iv. **Chapter 3.** Description of the Subproject, which focuses primarily on subproject location and area, subproject rationale, subproject alternatives, subproject
- v. development plan and subproject components, subproject phase, and schedule and resource utilization;
- vi. **Chapter 4.** Description of the Environment, which includes a description of the baseline information, subproject influence area, land environment, water environment, air

- environment, noise environment, ecological environment, socio- economic environment, and physical and cultural resources;
- vii. **Chapter 5.** Anticipated Environmental Impact and Mitigation Measures, which includes impacts rating methodology, impact assessment, anticipated impacts and mitigation measures during design, pre-construction, construction and operation phases, cumulative impacts and mitigation, environmental benefits and enhancement measures, and a summary of impacts and mitigation;
  - viii. **Chapter 6.** Analysis of Alternatives, which discusses how the alternatives were assessed in terms of site location, design and technology, environmental implications of alternatives, including implication of No-Project alternative
  - ix. **Chapter 7.** Information, Disclosure, Consultation and Participation, which details the process and the approach and methodology for preliminary consultations, and discusses future consultations during detailed design stage and implementation phase, and information disclosure;
  - x. **Chapter 8.** Grievance Redress Mechanism for the subproject;
  - xi. **Chapter 9.** Environmental Management Plan, which includes the institutional arrangement, roles and responsibilities of stakeholders including contractors and environmental performance criteria;
  - xii. **Chapter 10.** Monitoring and Reporting, which includes capacity building, cost and other reporting obligations;
  - xiii. **Chapter 11.** Conclusion, which provides overall analysis, conclusion and recommendations of the IEE.

## II. POLICY LEGAL AND ADMINISTRATIVE FRAMEWORK

49. The existing policies and laws of both ADB and RGOB require that prior to execution of any project an IEE is prepared. A brief description of the existing policy, legal and administrative framework for the project is provided to understand the applicable acts and rules to the project and a summary of environmental clearances required before initiating construction/implementation.

### A. ADB Safeguard Policy statement

50. ADB's Safeguard Policy Statement (SPS) governs the environment and social safeguards of ADB's operations. The goal of the SPS is to promote the environmental and social sustainability of ADB-supported projects by protecting people and their environment from potential adverse impacts and enhancing the benefits provided. The SPS requirements for environmental safeguards support the integration of environmental considerations into the project decision-making process. These requirements are triggered if a proposed project is likely to have environmental impacts and risks to the physical, biological, socioeconomic, and/or physical cultural resources in the subproject's area of influence<sup>1</sup>. Subproject screening and categorization using the sector-specific rapid environmental assessment (REA) checklists determines the categorization of the subproject based on the significance of the subproject's potential environmental impacts and risks.

51. Screening and Categorization. Subprojects are to be screened for their expected environmental impacts and are assigned one of the four categories given below. Categorization is to be based on the most environmental sensitive component:

- i. Category A: A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment is required.
- ii. Category B: A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible and, in most cases, mitigation measures can be designed more readily than for category A projects. An initial environmental examination is required.
- iii. Category C: A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.
- iv. Category FI: A proposed project is classified as category FI if it involves investment of ADB funds to or through a financial intermediary.

52. Initial screening using the REA checklist indicates that the Hetsotsangchhu Subproject will not cause any significant negative environmental impacts and that most impacts are site-specific, temporary and therefore the subproject is classified as Category B for Environment per ADB SPS.

53. For Category B project, ADB SPS also requires the conduct of initial environmental examination (IEE); preparation of corresponding IEE report, which includes an environmental management plan (EMP), consultation and disclosure requirements, establishment of a grievance

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<sup>1</sup> ADB. 2009. Safeguard Policy Statement. Manila.

redress mechanism (GRM), compliance monitoring and reporting, updating of the IEE in the event of unanticipated impacts, applying pollution prevention and control technologies and practices consistent with international good practices, ensuring that workers are provided with a safe and healthy working environment, and other elements as indicated in the suggested outline of IEE report in the SPS.

54. The project must also identify and assess the risks to, and potential impacts on, the safety of affected communities during the design, construction, operation, and decommissioning of the subproject, avoid significant damage to physical cultural resources and the institutional responsibilities of all key parties involved in EMP implementation and project environmental management must be clearly designated. The work must not be initiated, or a contract awarded unless the project is approved by ADB and the EMP is included in the contract documents.

55. Mitigation measures and Environmental Management Plan. Once potential impacts and risks are identified, mitigation measures are required to be developed for each impact and risk. As a general rule, a mitigation hierarchy is followed, starting with avoidance, minimization, mitigation, and lastly, compensatory measures to offset significant residual impacts. Key environmental considerations can also be incorporated upfront into the project design.

56. Meaningful Consultation. ADB SPS, 2009 requires meaningful consultation with affected people that:

- i. begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle;
- ii. provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people;
- iii. is undertaken in an atmosphere free of intimidation or coercion;
- iv. is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and
- v. enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.

57. As a minimum, stakeholders of each subproject will be consulted regarding the scope of the environmental study and will then be informed during environmental assessment about the likely impacts of the subproject and proposed mitigation measures. The report will record the views of stakeholders and indicate how these have been taken into account in project development. A variety of approaches for consultations include public meetings, focus group discussions, workshops, and public information campaigns. Public consultations may include newspaper advertisements in the local and national newspapers well before the consultations giving brief project description, location, and specific contact data (including telephone numbers). In the meetings, presentations will be provided about the subproject's potential environmental and social impacts. Consultation sessions must have attendance sheets prepared and included as part of the documentation.

58. Information Disclosure. Information will be disclosed through public consultation and more formally by making documents and other materials available in a form and at a location in which

stakeholders can easily access. This will involve making reports available at public locations within the vicinity of the sites and providing a mechanism for the receipt of comments and making documents available more widely by lodging them on the ADB and project websites.

59. Per requirements of ADB SPS 2009 and Access to Information Policy 2018, the project, through PMU, shall submit the following reports to ADB for disclosure on ADB website so affected people, other stakeholders, and the public can provide meaningful inputs into the subproject design and implementation<sup>4</sup>. ADB will disclose upon receipt of acceptable reports and endorsement from the PMU:

- i. the final IEE report for each subproject;
- ii. new or updated IEE reports and corrective action plan prepared during project implementation, if any; and
- iii. semi-annual environmental monitoring reports.

60. PMU will provide relevant environmental information, including information from the relevant documents in a timely manner, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders. For illiterate people, other suitable communication methods will be used. For the benefit of the community, the summary of the IEE will be translated in the local language (Dzongkha) and made available at: (i) offices of PMU; and (ii) offices of the PIUs.

61. Per ADB SPS, 2009, prior to disclosure on ADB website, ADB reviews the "borrower's/client's social and environmental assessment and plans to ensure that safeguard measures are in place to avoid, wherever possible, and minimize, mitigate, and compensate for adverse social and environmental impacts in compliance with ADB's safeguard policy principles and Safeguard Requirements 1-4."

62. Hard copies of the IEE will be available in the PMU and PIUs, and accessible to citizens as a means to disclose the document and at the same time creating wider public awareness. On demand, the person seeking information can obtain a hard copy of the complete IEE document at the cost of photocopy from these offices. Electronic version of the IEE reports will be placed in the project website after approval of the documents by the government and clearance from ADB. PMU will issue notification on the disclosure mechanism in local or national newspapers, ahead of the initiation of implementation of the project, providing information on the project, as well as the start dates, etc. This will create awareness of the project implementation among the public. PMU will consider other additional means of information disclosure depending on practicality, such as the distribution of posters to community billboards within the vicinity of the subproject sites to mass-campaign the basic tenets of the IEE.

63. Grievance Redress Mechanism (GRM). A GRM must be established to allow affected people a trusted way to voice and resolve project-related concerns, and to enable the project to effectively address affected people's concerns. The GRM can be used to cover the environmental, involuntary resettlement and/or Indigenous Peoples safeguard requirements.

64. Monitoring and Reporting. PMU shall monitor, measure and document the progress of implementation of the EMP. If necessary, PMU will identify the necessary corrective actions, and reflect them in a corrective action plan. PMU will prepare and submit to ADB semi-annual environmental monitoring reports that describe progress with implementation of the EMP and compliance issues and corrective actions, if any.

65. Environmental Audit. When the subproject involves existing activities or facilities, PMU is responsible to ensure that relevant external experts will perform environmental audits to determine the existence of any areas where the subproject may cause or is causing environmental risks or impacts. If the subproject does not foresee any new major expansion, the audit constitutes the environmental assessment for the subproject.

66. Occupational Health and Safety. PMU<sup>2</sup> shall ensure that workers<sup>3</sup> are provided with a safe and healthy working environment, taking into account risks inherent to the sector and specific classes of hazards in the subproject work areas, including physical, chemical, biological, and radiological hazards. Borrower shall take steps to prevent accidents, injury, and disease arising from, associated with, or occurring during the course of work, including: (i) identifying and minimizing, so far as reasonably practicable, the causes of potential hazards to workers; (ii) providing preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances; (iii) providing appropriate equipment to minimize risks and requiring and enforcing its use; (iv) training workers and providing them with appropriate incentives to use and comply with health and safety procedures and protective equipment;(v) enforcing appropriate protocols necessary to prevent the spread of communicable and infectious diseases; (vi) documenting and reporting occupational accidents, diseases, and incidents; and (vi) having emergency prevention, preparedness, and response arrangements in place.

67. PMU shall ensure to apply preventive and protective measures consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines.

68. Community Health and Safety. The PMU must identify and assess the risks to, and potential impacts on the safety of affected communities during the design, construction, operation, and decommissioning of the subproject, and establish preventive measures and plans to address them in a manner commensurate with the identified risks and impacts. The borrower shall ensure to apply preventive and protective measures for both occupational and community health and safety consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines. PMU shall also adhere to necessary protocols in response to emerging infectious diseases such as the coronavirus disease (COVID-19) consistent with the guidelines of relevant government healthcare agencies and the World Health Organization.

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<sup>2</sup> In case where responsibility is delegated to subproject contractors during construction phase, borrower shall ensure that the responsibilities on occupational health and safety are included in the contract documents

<sup>3</sup> Including non-employee workers engaged by the borrower/client through contractors or other intermediaries to work on project sites or perform work directly related to the project's core functions.

69. Biodiversity Conservation and Sustainable Natural Resource Management. The PMU will assess the significance of project impacts and risks on biodiversity and natural resources as an integral part of the environmental assessment process. The assessment will focus on the major threats to biodiversity, which include destruction of habitat and introduction of invasive alien species, and on the use of natural resources in an unsustainable manner. The PMU will need to identify measures to avoid, minimize, or mitigate potentially adverse impacts and risks and, as a last resort, propose compensatory measures, such as biodiversity offsets, to achieve no net loss or a net gain of the affected biodiversity.

70. Pollution prevention and control techniques. During the design, construction, and operation of the project, PMU, shall apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines<sup>4</sup>. These standards contain performance levels and measures that are normally acceptable and applicable to the project infrastructures. When the government's regulations differ from these levels and measures, the project shall achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, PMU, will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB SPS.

71. Unanticipated Environmental Impacts. Where unanticipated environmental impacts become apparent during subproject implementation, PMU shall update the environmental assessment and EMP or prepare a new environmental assessment and EMP to assess the potential impacts, evaluate the alternatives, and outline mitigation measures and resources to address those impacts.

72. The Project Management Unit (PMU) is responsible for siting and designing subprojects to avoid significant damage to Physical Cultural Resources (PCR), in line with ADB's Safeguard Policy Statement (SPS), which mandates the identification of potentially affected PCRs and assessment of impacts by qualified experts through field-based surveys as part of the environmental assessment. When subproject components are proposed in areas where PCRs are expected, based on consultations and baseline studies, the project must implement three key measures: (i) a Mitigation Hierarchy prioritizing avoidance of impacts, with a management plan developed in consultation with affected communities and cultural heritage authorities if avoidance is not feasible; (ii) a formal Chance Finds Procedure, integrated into the Environmental Management Plan (EMP) and civil works contract, requiring contractors to halt work, notify the PMU, secure the site, and await expert assessment upon discovery of previously unknown artifacts or sites; and (iii) a Grievance Redress Mechanism (GRM) to address concerns or disputes related to PCRs.

73. Bidding and Contract Documents. This IEE report, which contains the EMP, after updating with detailed designs (for works contracts), submitted to ADB and cleared and disclosed, shall be included in bidding and contract documents and verified by PMU. The PMU shall also ensure that bidding and contract documents include specific provisions requiring contractors to: (i) comply with all other conditions required by ADB, and (ii) to submit to PMU, for review and approval, a site specific

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<sup>4</sup> World Bank Group. 2007. Environmental, Health, and Safety General Guidelines. Washington, D.C.; <https://www.ifc.org-ehs-guidelines>

environmental management plan (SEMP), including (i) proposed sites/locations for construction work camps, storage areas, hauling roads, lay down areas, disposal areas for solid and hazardous wastes; (ii) specific mitigation measures following the approved EMP; (iii) monitoring program as per EMP; and (iv) budget for SEMP implementation, among others as may be required. No works can commence prior to approval of SEMP. A copy of the EMP and/or approved SEMP will be kept on site during the construction period at all times. Non-compliance with, or any deviation from, the conditions set out in the EMP and/or SEMP constitutes a failure in compliance and shall require corrective actions.

74. Conditions for Award of Contract and Commencement of Work. PMU shall not award any works contract under the subproject until (i) IEE and relevant provisions from the EMP are incorporated into the works contract; (ii) IEE report is updated to reflect any changes in subproject's design after bidding and PMU has obtained ADB's clearance of such updated IEE report and disclosed; and (iii) other necessary permits from relevant government agencies have been obtained. For "design, build, and operate" type contracts, PMU shall ensure no works for a subproject which involves environmental impacts shall commence until (i) relevant provisions from the EMP are incorporated into the works contract; and (ii) this IEE report is updated to reflect subproject's detailed design and PMU has obtained ADB's clearance for such updated IEE.

## **B. Application of National and International Standards**

75. This project is committed to complying with the environmental laws and regulations of the Royal Government of Bhutan (RGOB) and the environmental safeguard requirements of the Asian Development Bank's Safeguard Policy Statement (SPS, 2009).

76. As per the SPS, the project will apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in the World Bank Group's Environmental, Health, and Safety (EHS) Guidelines.

77. In cases where RGOB regulations and the IFC/WHO standards differ; the project will adhere to the more stringent standard. This "whichever is more stringent" principle will be applied to all relevant aspects of the project, including but not limited to: ambient air quality, noise levels, water and wastewater quality, and occupational and community health and safety. The specific standards are detailed in the following section and will be used as the benchmark for the project's performance monitoring and compliance.

## **C. National Environmental Act and Legislation**

78. Bhutan has a well-defined institutional and legislative framework for the protection of the environment encompassing air; water; noise; flora and fauna; biodiversity, sensitive habitats and other natural resources.

79. National Environmental Protection Act, 2007: This act came into force on 31st July 2007 and provided the establishment of an effective system to conserve and protect the environment through the National Environment Commission (NEC), designation of competent authorities and constitution of other advisory committees, to independently regulate and promote sustainable development in an equitable manner. The act empowers NEC as an independent authority and the highest decision-making body on all matters relating to the environment and its management in the country. The

commission shall exercise the jurisdiction and powers and discharge the functions and duties conferred or imposed by or under this Act. The subproject has components that could potentially impact the environment, and therefore, all actions or activities under the subproject should adopt principles and practices that will help avoid or mitigate these impacts.

80. Environmental Assessment Act 2000: The RGOB has in place detailed policies regarding environmental assessment that are founded in the Environmental Assessment Act (2000). The NEC through its Secretariat is empowered to implement the EA Act, which sets out the guidelines for obtaining an Environmental Clearance (EC) for a project. Article 9 states that if the activity is going to be implemented by a Competent Authority (CA), the application for EC is to be forwarded to the NEC for approval. The application for an EC must include a description of potential environmental effects. The Secretariat of the NEC determines if the information provided is sufficient to identify effects, and if not, the Secretariat can request that environmental assessment documents be prepared, following approved terms of reference. Additional information may be required by the NEC Secretariat if the EIA is considered incomplete. The EC is issued when the Secretariat is satisfied that: a) effects are foreseeable and acceptable, b) the applicant is capable of carrying out the terms of the EC, c) the Project is seen to contribute to sustainable development of the country, d) the interests of concerned people have been taken into account, and e) the project is consistent with the Nation's environmental commitments. Once a decision is made, the environmental terms, description of mitigation measures and non- technical summary of the EC are made available to the public. The Secretariat also controls and monitors compliance with the terms of the EC (Art. 34.2). The EA Act provides the right of access to work sites for monitoring and penalty provisions in cases of offense under the Act, including providing false information, denying access and other infractions. (Art. 49). The EA Act contains rules for appeals, dispute resolution, and other provisions. This Act covers the subproject as it requires said subproject to undergo environmental assessment and obtain corresponding EC from a Competent Authority.

81. Regulation for the Environmental Clearance of Projects 2016. Describes the responsibilities and procedures for the implementation of Environmental Assessment Act 2000 in relation to the issuance and enforcement of environmental clearances at the project level. It defines specific activities of projects where competent authorities can issue an environmental clearance (EC) and those requiring NEC evaluation and approval.

82. The Regulation requires that environmental units be established in agencies and projects. There is an Environment Unit within the Wangdue Phodrang dzongkhag which looks after all environmental related issues. The regulation is one implementing rule of the EA Act, with the procedures of which are needed by the subproject to obtaining its EC.

83. Waste Prevention and Management Regulation 2012 was adopted under section 53 of the Waste Prevention and Management Act, 2009. The Act defined the roles and areas of implementation of the implementing agencies for the purpose of establishing a sound waste management system including monitoring procedures at every organization level, through efficient collection, segregation, treatment, storage, transportation, reduction, reuse, recycling and safe disposal of solid, liquid and gaseous wastes. It also provides control and prohibits illegal dumping or releasing of waste into the environment. The act also provided the requirements for the management of

hazardous wastes to include labeling, pre-treatment process, storage, record keeping, transportation, and disposal of hazardous waste by the generator. Sanctions and penalties are provided for non-compliance. Construction phase and operation phase activities of the subproject will involve generation of wastes. Therefore, the subproject is required to comply with this regulation.

84. Forest and Nature Conservation Act (FNCA), 1995. The Forest and Nature Conservation Act (FNCA), 1995 includes policies for activities that are prohibited in forested areas and stipulates activities that need special permits from the Department of Forests and Park Services. It describes the types of activities such as forest clearing, tree felling, hunting and polluting that are not allowed in Government Reserved Forests. All wild animals, whether enlisted under Schedule I (totally protected species) or not, cannot be killed, injured, captured or collected unless under special conditions of self-protection and other genuine reasons. Several components of the subproject are located in forests (government-owned, biological corridor, community forests). Therefore, the subproject is required to comply with this Act particularly with regard to obtaining Forest Clearance. As well, Forest Clearance is a mandatory requirement in obtaining Environmental Clearance.

85. Forest and Nature Conservation Rules and Regulations 2017: Further to the FNCA, the Forest and Nature Conservation Rules and Regulations (FNCR) of Bhutan 2017, provides rules for many of the activities that will be undertaken in the project, such as clearing and felling of trees, blasting and others. The Act describes activities that are prohibited and restricted in forested areas and outlines procedures for sourcing stone, sand, gravel, rock, peat and surface soil from forested areas.

86. Chapter X Section 364 states "Other than surface collection of sand and stones, all other minerals including stone quarry shall remain under the control of the department of Geology and Mines, Ministry of Economic Affairs".

87. Biodiversity protection provides an additional framework within which the Project must develop due to the presence of national parks and wildlife sanctuaries within the project area. Management areas were also established under the Act to enable protection of the rich biodiversity of the region. FNCR is the implementing rules of the FNCA. The subproject is likewise required to follow this Rules and Regulations in order to obtain the necessary Forest Clearance.

88. Biological Corridor Rules 2007: Biological corridor (BC) rules were promulgated in July 2007 as an addendum to Forest and Nature Conservation Rules 2006. "Biological Corridor" means an area set aside to connect one or more protected areas, which shall be conserved and managed for the safe movement of wildlife. BC is managed centrally by the Department of Forests and Park Services (DOFPS). Any form of construction activities is prohibited inside BC except with a written permit or authorization such as Forestry Clearance from the Department based on technical regulations. Any person who, within a Biological Corridor conducts any activity undertaken in contravention of prohibitions listed shall be guilty of an offense punishable under these Rules. This Rules is an integral part of the FNCR which the subproject should likewise comply with considering that several components are located within the biological corridor.

89. Dzongkhag Yargay Tshogchung (DYT) Chathrim and Geog Yargay Tshogchung (GYT) 2002: The Chathrim were enacted to support the decentralization policy and empower locally elected

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<sup>5</sup> Superseded the earlier Forest and Nature Conservation Rules 2006 by FNCR 2017.

community bodies, DYT's and GYT's, with the authority and responsibility to decide, plan and implement development programmes and activities, including those concerning environmental management. Powers and functions vested in the DYT's and GYT's in relation to environmental management are specified below. The DYT has the power and function to promote awareness and dissemination of national objectives; adopt procedures and rules to implement national laws, wherever relevant; and make recommendations on activities with major environmental impacts such as construction of roads, extraction and conservation of forests, mining and quarrying. They also have jurisdiction among others, over i) designation and protection of areas of special scenic beauty of biodiversity, such as dzongkhag parks and sanctuaries; control of noise pollution; establishment of quarries and mines; and protection of public health as per prevailing national guidelines or Acts (section 14). The subproject will be implemented in one of the Dzongkhags of the country. These Acts pertain to the mandates of the Dzongkhag in the environmental impact management of projects implemented within its jurisdiction. Therefore, the subproject, as an undertaking with potential environmental impact, is required to comply with any of the requirements of these Acts.

90. Rules and Regulation on Explosives: The Department of Law and Order under the Ministry of Home and Cultural Affairs is the custodian of this Rule and Regulation. The project may, depending on types of rocks, require use of explosives at some stretches. These rules and regulations will guide the project, particularly, pertaining to import, transportation and handling of explosives.

91. The Water Act of Bhutan 2011: The Act recognizes that water is one of the most important natural resources in the country and needs to be economically and environmentally managed in all times to come. The Act provides comprehensive legislation to guide various water user sectors in Bhutan. It also aims to ensure that every Bhutanese has assured access to adequate, safe and affordable water to enhance the quality of their lives. The National Environment Commission shall be an independent authority and shall exercise the powers to discharge the functions conferred under this Act (Article 12). Relevant sections of the Act pertaining to this project are:

- i. To ensure that the water resources are protected, conserved and/or managed in an economically efficient, socially equitable and environmentally sustainable manner. (Article 4a).
- ii. Water resources are the property of the State. The rights over water resources, including the bed and banks of water courses shall vest in the State. (Article 5a).
- iii. Every individual shall have access to safe, affordable and sufficient water for basic human needs. (Article 5c).
- iv. The NEC shall set the minimum environmental flow of water courses required to support and conserve the riverine habitats and its flora and fauna. The minimum environmental flows shall be reflected in the environmental clearance. (Article 25).
- v. A Person intending to abstract water shall seek an approval from the Commission prior to conducting feasibility studies. The approval shall contain terms and conditions including upstream and downstream water use issues. (Article 31).

92. A person shall not abstract and use water except in accordance with Environmental Clearance issued under this Act. (Article 32).

93. Water Regulation of Bhutan 2014. The Regulation was promulgated to (i) enforce the objectives and purposes of the Water Act of Bhutan 2011; (ii) effectively implement and enforce the Water Act by Competent Authorities; and (iii) identify the roles and responsibilities of Competent Authorities and other relevant organizations. The Regulation applies to all issues relating to water resource and their management, which include the scope of the subproject. In particular, the Regulation sets the minimum environmental flow to be maintained in a watercourse to sustain its water ecology and environment based on an Environmental Impact Assessment (EIA). Where scientific study reports are unable to determine the minimum environmental flow to be maintained in a watercourse, the Regulation requires that at least 30% of lean season flow shall be maintained.

94. The subproject is a water resource-intensive undertaking and will have the potential negative impact over water supply sustainability in the subproject area. Therefore, the subproject is required to comply with all the requirements of the Water Act and Water Regulation to ensure it does not cause any significant impact to the ecology, communities and industries that depend on this water resource.

#### **D. Legislation relating to Occupational Health and Safety**

95. The Labour and Employment Act of Bhutan 2007. The Act applies to matters relating to labor and employment in Bhutan. It prohibits 'forced or compulsory' labor and 'worst forms of child' labor. Discrimination against an employee with regard to wages and working conditions and prohibition against sexual harassment are also prohibited. (Chapter-II, Sections 6, 9, 11, 12, 16, 17, 18 & 19). The Act also touches on Compensation and benefits of employees (Chapter-VI) and Chapter -IX deals with Occupational Health and Safety.

96. Regulation on Occupational Health, Safety and Welfare, 2012. The regulation effective from 1 May 2012 establishes standards to ensure safety, health and welfare for employees from work-related risks at workplaces. Chapter 8 deals with Personal Protective Equipment (PPE) to be provided free by the employer at work sites. This regulation superseded the "General Rules and Regulation on Occupational Health and Safety in Construction, Manufacturing, Mining, and Service Industries, 2006".

#### **E. National Policies and Protocols for Public Health Emergencies**

97. The Royal Government of Bhutan has established a robust framework for managing public health emergencies, including infectious disease outbreaks. This framework was extensively utilized and strengthened during the COVID-19 pandemic. The national response system includes a National Task Force, multi-sectoral regional and district-level task forces, and a Health Emergency Management Committee (HEMC) responsible for surveillance, quarantine, and testing protocols.

98. Key measures that can be activated during a public health emergency and are relevant to the project include:

- Restrictions on movement and travel.
- Mandatory health and hygiene protocols (e.g., use of personal protective equipment, social distancing).
- Protocols for managing worksites, worker camps, and public spaces.
- Quarantine requirements for workers.

99. The project will be required to comply with all prevailing national and local directives, standard operating procedures (SOPs), and guidelines issued by the Ministry of Health (MOH) in the event of any communicable disease outbreak or public health emergency during the project implementation period.

## **F. Relevant International Conventions and Treaties**

100. Bhutan is party to twelve multilateral environmental agreements including those on biodiversity, climate change-Kyoto protocol, desertification, endangered species and hazardous wastes. Those with particular relevance to the subproject include: i) UN Framework Convention on Climate Change signed on 11 June 1992 and ratified on 25 August 1995, and ii) Kyoto Protocol to the United Nations Framework Convention on Climate Change. Instrument of accession was signed on 26 August 2002, and a member after Kyoto came into force from 2005. These international conventions explicitly make reference for the application of environmental assessment to address the effects of human activities. Approach road construction and subsequent operation are not carbon neutral, contributing to a small overall increase in continuous CO<sub>2</sub> emissions due to construction vehicular use and also during maintenance works. There will also be some carbon release due to removal of biomass in road rights-of-way and laying of pipelines that require removal of vegetation.

101. The UN Convention on Biological Diversity was signed on 11 June 1992 and ratified on 25 August 1995. The Convention promotes the use of appropriate procedures requiring environmental impact assessment of proposed projects that are likely to have significant adverse effects on biological diversity.

## **G. Gaps in Legal and Guiding Instruments**

102. The ADB SPS and national environmental laws are aligned with screening to determine the potential impact of a project on the environment, followed by appropriate environmental assessment, preparation of environmental management plans to avoid, mitigate, minimize and offset environmental impacts. While minor gaps are identified in terms of the other more specific ADB SPS requirements vis-à-vis the national environmental laws, gap-filling measures are available and can be readily complied with by the government through MOWHSMOIT as implementing agency. See Table 1 below.

103. The national procedures are comprehensive enough to ensure that any developmental activity/enterprise in sensitive and critical habitats/ecosystems, and affected rare or endangered species, or extraction of resources in large quantities are avoided from the screening stage. This includes impacts on religious and cultural sites as well.

104. Once a project is approved, it requires the proponent to comply with the terms and conditions of the approved Environmental Clearance with compliance monitoring and reporting during implementation of the EMP by the proponent. The project may also be independently monitored by the competent authority covering the subproject.

*Table 1: Comparison of ADB SPS Requirements and National Environmental Regulations*

#	ADB SPS Principles	National requirements	Extent of Equivalence or Gaps	Gap-filling Measures
1	Conduct screening to determine the extent	Projects are screened into Green, Blue and Red categories that determine whether	No gaps	None required

#	ADB SPS Principles	National requirements	Extent of Equivalence or Gaps	Gap-filling Measures
	and type of required environmental assessment	the level of environmental assessment If the development is within the E-1 (environmental conservation), E-2 (forest environments) precincts, the application has to be accompanied by a no objection certificate from the National Environment Commission (NEC).		
2	Conduct environmental assessment	<b>Green project</b> – No environmental assessment. <b>Blue project</b> - initial environmental examination (IEE) is required <b>Red project</b> - environmental impact assessment (EIA) is required	No gaps	None required
3	Examination of project alternatives	Under RECOP, Annex 3, Sections 6 and 8, the project must provide a detailed analysis of the negative and positive impacts of the proposed project and its alternatives including the “alternative of not undertaking the project”.	No gaps	None required
4	EMP preparation is part of IEE and EIA Process	The Environmental Assessment Act (EAA) provides for the formulation of environmental management plans (EMPs). The EMPs must identify environmental risks and address means of avoiding or minimizing adverse impacts (including direct, indirect and cumulative effects) and enhancing positive impacts. Applicants must also set out a monitoring program (both baseline and compliance monitoring) and are responsible for all project monitoring. Project monitoring is undertaken by the Competent Authority (CA) or NEC.  The RECOP provides that: (i) “the CA shall be responsible for monitoring compliance” for projects requiring development consent and environmental clearance (EC), and (ii) the Secretariat [of NEC] shall monitor projects “that do not require development consent”.	No gaps	None required
5	Conduct environmental assessment	<b>Green project</b> – No environmental assessment <b>Blue project</b> - initial environmental examination (IEE) is required <b>Red project</b> - environmental impact assessment (EIA) is required	No gaps	None required
6	Conduct meaningful consultation with affected people	Public consultation is mandatory for any IEE/EIA. Under the EAA, applicants have a duty to inform and consult with “concerned people” and organizations before submitting the environmental assessment documents to the CA where the project is classified as a “significant project”. NEC or the CA is authorized to “ensure that concerned people are given adequate opportunity to express their views on the project and that their views are adequately taken into account.”	No gaps	None required
7	EMP implementation and monitoring (with corrective actions, when needed)	The EAA mentions that Applicants must [also] set out a monitoring program (both baseline and compliance monitoring) and are responsible for all project monitoring (project monitoring is undertaken by CA or NEC).  RECOP requires that EMPs include the proposed mitigation measures, the need to budget mitigation measures, supervision, monitoring and evaluation requirements for the construction, operation and maintenance phases of the project cycle.  RECOP provides that: (i) “the CA shall be responsible for monitoring compliance” for projects requiring development consent and EC, and (ii) the Secretariat [of NEC] shall monitor projects “that do not require development consent”.  The Environmental Assessment Act states that “compliance monitoring of projects” is undertaken by the Secretariat [of NEC]... on becoming aware of non-compliance with the terms or other activities related to a project that may be dangerous to the environment.”	No outstanding gaps in terms of policy. However, EMPs are not normally included in Contractor’s contracts to ensure implementation of EMPs.	Include EMP into Contracts and ensure compliance monitoring and submission of environmental monitoring reports.
8	Establish Grievance Redress Mechanism (GRM)	Different agencies have different GRMs.	Partial gap due to lack of specific guidelines that can be followed by projects.	To ensure equivalence, the project needs to establish a GRM process that could be adopted from the site level to the agency level, including option for access to

#	ADB SPS Principles	National requirements	Extent of Equivalence or Gaps	Gap-filling Measures
				country's legal system independently and regardless of the outcome of the project GRM process.
9	Appropriate public disclosure of EIA/IEE and EMP	Not mandatory to disclose, but documents are available in relevant government agencies.	Partial gap due to lack of specific directives or guidelines requiring mandatory disclosure of environmental assessment documents.	To ensure equivalence, the project needs to disclose the IEE through any means that could reach the general public.
10	Do not implement project activities in areas of critical habitats.	Forest and Nature Conservation Act, 1995; Forest and nature Conservation Rules, Sections 62, 70 and EAA and RECOP relate to this issue.  Under Bhutan's laws and regulations, it is prohibited to undertake any human activities within the core zone of a protected area unless determined necessary by forest/protected area officials to achieve nature conservation objectives. Outside the core area, no construction is allowed except with a written permit or authorization from the MoA, acting as CA under the EAA. A permit for land clearance may be granted in private lands under strict conditions but not to alter protected area status, water catchment areas and areas containing high forest.	No gaps	None required
11	Apply pollution prevention and control technologies and practices consistent with international good practices as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines. Adopt cleaner production processes and good energy efficiency practices.	The NEC sets the permissible emission standards for a) ambient water quality, Industrial Effluent Discharge Standard, Sewage Treatment Plant (STP) Discharge Standards, Ambient Air Quality, Workplace Emission Standards, Vehicular Emission and Noise Limit Standards, Noise Level Limits but this is monitoring is not mandatory for construction. The Vehicle fitness test must be done annually by the vehicle owner. The agency responsible for this is The Road Safety and Transport Authority (RSTA)	No gaps in terms of availability of standards in the country. However, the implementation of regulations pertaining to these standards is an issue. Further, the values of the national standards are less strict than the internationally recognized standard values. Partial gap in terms of the legislation having no explicit requirement for adopting cleaner processes and good energy efficiency practices, although it might be considered implicit in the legislation	To ensure equivalence, the Project should: (i) comply with the stricter internationally recognized standards or provide justification if the option under the Project is to use the national standards; and (ii) require the adoption of cleaner technologies and energy efficiency measures.
12	Safe working conditions	The Labor and Employment Act, 2007 governs employment and Occupational health and safety (OHS), including physical or mental health problems related to work.  The Regulation on Occupational Health and Safety for the Construction Industry, 2012 and the Regulation on Occupational Health, Safety and Welfare, 2016 have detailed requirements for contractors to follow to ensure the safety, health and welfare for employees and other persons at workplaces.	No gaps	None required
13	Conserve physical cultural resources Provide for the use of	Any development activity within a heritage precinct requires a No objection certificate from the Ministry of Home and Cultural Affairs (MH&CA)	Partial gap due to the absence of legislation or	To ensure equivalence, the Project should

#	ADB SPS Principles	National requirements	Extent of Equivalence or Gaps	Gap-filling Measures
	“chance find” procedures.	Any valuable cultural property discovered must be immediately reported to the Department of Culture, Ministry of Home and Cultural through the concerned Dzongkhag.	Regulations to protect “chance finds”.	include a chance find procedure that will be used during the implementation.

## H. Permits, Clearances, No-objection Certificates and Other Agreements

105. As a result of stakeholder consultations, various permits, clearances, no-objection certificates and other agreements have been identified to ensure that these statutory requirements and no-objections are obtained prior to implementation of the subproject. At this stage, the following requirements have already been obtained:

- I. No objection Clearance from the Community Forest Groups for the project. See Appendix 12; and
- II. Memorandum of Understanding among Wangdue Phodrang District, the 2 gewogs and Druk Green Power Corporation on Hetsotsamchu river water sharing, including subsequent agreement on the proposed increase of water withdrawal from the original agreement of 500 lps to 608 lps See Appendix 13 and Appendix 14.

106. Relevant and required clearances for the subproject will be obtained and included in the updating of this report. These are (i) Forestry Clearance from DOFPS, (ii) Environment Clearance from the relevant Competent Authority, Ministry of Agriculture and Forest, and (iv) No Objection Letters from Divisional Forest Office, Wangdue Phodrang, Gasetsho Gom and Gasetsho Wom Community Forest Groups. No works can commence until all these clearances are obtained. The most recent updates on clearances, permits, and agreements are summarized in Table 2.

Table 2: Status of Required Clearances, Permits, and Agreements (as of August 2025)

Clearance / Permit / Agreement	Issuing Authority / Counterpart	Purpose	Status	Remarks / Next Steps
<b>STATUTORY CLEARANCES (National Level)</b>				
<b>1. Environmental Clearance (EC)</b>	National Environment Commission (NEC) / Competent Authority	Main legal authorization for the project to proceed under the Environmental Assessment Act.	Secured	The EC was issued on 24 October 2025 (Ref: DoA/PD/PSP-04/2025-26/437). It is valid for 12 months and must be renewed one month prior to expiry if works are not complete. The EC includes several binding conditions that must be incorporated into the contractor's SEMP, including limits on water abstraction (max 608 l/s), waste management protocols, and OHS measures. Refer Appendix 17.
<b>2. Forestry Clearance</b>	Department of Forest and Park Services (DoFPS)	Authorization for all project activities within Government Reserve Forests and the Biological Corridor, including tree felling.	Secured	Forestry Clearance (Application ID: 919151) was officially issued on August 13, 2025. The project must comply with all conditions stipulated in the clearance.
<b>ADMINISTRATIVE APPROVALS (Sub-national Level)</b>				
<b>3. Dzongkhag Administration Approval</b>	Wangdue Phodrang	Formal administrative approval for project	Secured	Approval has been provided through the Dzongkhag's role as the Implementing Agency.

<sup>6</sup> A fresh Forestry Clearance for the Wangdue Phodrang Integrated Water Supply Scheme Project was officially approved on August 13, 2025. This milestone marks a key regulatory advancement, enabling the project to proceed with activities within designated forest areas in compliance with national environmental standards.

	Dzongkhag Administration	implementation within the district.		
<b>4. Gewog Administration Approval</b>	Gasetsho Gom and Gasetsho Wom Gewog Administrations	Consent and approval for project works within the respective Gewogs.	Secured	Secured during the public consultation process in June 2022.
<b>THIRD-PARTY AGREEMENTS</b>				
<b>5. Water Sharing Agreement with DGPC</b>	Druk Green Power Corporation (DGPC)	Formal agreement on water abstraction from the Hetshotsangchhu and the release of environmental flows to the downstream Basochhu Hydropower Plant.	Secured	The original Memorandum of Understanding (MoU) from 2019 has been supplemented by a formal Agreement on Additional Water Withdrawal dated June 13, 2022, confirming DGPC's consent for the final design flow of 608 lps.
<b>6. Community Forest Management Group (CFMG) Agreements</b>	Respective CFMGs (Shingkey Gaki, Tabchaykha Draktsen, etc.)	Formal consent and agreement on the terms for construction within community forests.	NOC Secured; MoU in Preparation	"No Objection" Certificates (NOCs) were secured in June 2022. Formal Memoranda of Understanding (MoUs) based on the final design are currently being prepared and their signing is a mandatory prerequisite before construction in these areas. Sample MoU is attached as Appendix 16.

## I. Applicable Environmental Standards

107. The project's environmental performance will be monitored against both the national standards of Bhutan and relevant international guidelines (WHO/IFC EHS Guidelines). In line with the project's commitment to applying the more stringent standard, the following tables present a direct comparison of these requirements. For example, for the 24-hour ambient Nitrogen Dioxide (NO<sub>2</sub>) standard, the WHO guideline of 25 µg/m<sup>3</sup> is more stringent than the national standard of 120 µg/m<sup>3</sup> and will therefore be the primary benchmark for assessing the significance of impacts and the effectiveness of mitigation measures. This principle will be applied to all applicable parameters throughout the project's lifecycle.

108. Bhutan Environmental Standards 2010 (revised 2020). The Bhutan Environmental Standards sets the minimum standards for (i) ambient water quality, (ii) industrial effluent discharge, (iii) sewage effluents, (iv) ambient air quality, (v) industrial emission, (vi) workplace emission, (vii) vehicle emission, and (viii) noise level limits.

109. The Water Act of Bhutan, 2011 and the Water Regulation of Bhutan 2014 apply to all issues relating to water resources and their management. Based on these, there are water quality standards and guidelines, and effluent discharge standards into water resources. For example, the Drinking Water Quality Standards, 2016 ensures safe drinking water. It protects consumer health by describing the quality parameters for drinking water and the maximum permissible limit for each parameter. The Effluent Discharge Standard requires effluents to be treated using best available technology before discharging directly or indirectly to any water resource.

110. The Drinking Water Quality Standards, 2016, was developed in accordance with Section 13 (f) and Section 42 (a) and (b) of the Water Act of Bhutan, 2011, with the aim of ensuring safe drinking water and to protect consumer health. The standard describes the quality parameters set for drinking water and the maximum permissible limit for each of the set parameters, in order to limit the level of contaminants in drinking water.

111. Following the requirements of ADB SPS, the Project shall apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in EHS Guidelines. When the government regulations differ from these levels and measures, the executing

agency shall achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the executing agency will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB SPS, 2009. In view of this, tables below show the ambient air quality standards, noise level standards, drinking water quality standards, and workplace-specific standards to be followed by the Project.

Table 3: Ambient Air Quality Standards (Source: ES 2020 & WHO)

Parameter	Averaging Period*	Bhutan's Ambient Air Quality Standard, 2010**(µg/m <sup>3</sup> )			World Health Organization's 2021 Global Air Quality Guidelines, (µg/m <sup>3</sup> )
		Industrial Area	Mixed Area***	Sensitive Area****	
TSP	Annual	360	140	70	-
	24-hour	500	200	100	-
PM10	Annual	120	60	50	15
	24-hour	200	100	75	45
PM2.5	1-year	40	40	40	5
	24-hour	60	60	60	15
SO <sub>2</sub>	Annual	80	60	15	-
	24-hour	120	80	30	40
NO <sub>2</sub>	Annual	80	60	15	10
	24-hour	120	80	30	25
O <sub>3</sub>	24-hour	180	180	180	-
	8-hour	180	180	180	100
CO	24-hour	5,000	2,000	1,000	4
	8-hour	10,000	4,000	2,000	-

\* Due to short term duration of civil works, the shortest period will be more practical to use.

\*\* Taken from Environmental Standards, National Environment Commission, Royal Government of Bhutan, November 2010.

\*\*\* Mixed Area means area where residential, commercial or both activities take place.

\*\*\*\* Sensitive Area means area where sensitive targets are in place like hospitals, schools, sensitive ecosystems.

^ Source: Environmental, Health and Safety General Guidelines, 2007. International Finance Corporation, World Bank Group.

^^ Source: Air Quality Guidelines for Europe, Second Edition, 2000; WHO Regional Office for Europe, Copenhagen

Table 4: Noise Level Standards

Receptor/ Source	National Noise Standard Guidelines, 2012* (dB)		WHO Guidelines Value For Noise Levels Measured Out of Doors** (One Hour LA <sub>q</sub> in dBA)	
	Day***	Night****	07:00 – 22:00	22:00 – 07:00
Industrial area	75	65	70	70
Mixed area	65	55		
Sensitive area	55	45	55	45

\* Taken from Environmental Standards, National Environment Commission, Royal Government of Bhutan, 2020.

\*\* Guidelines for Community Noise, WHO, 1999. Source: Environmental, Health and Safety General Guidelines, 2007. International Finance Corporation, World Bank Group.

\*\*\* Day time is from 0600 hours to 2200 hours (human activities).

\*\*\*\* Nighttime is from 2200 hours to 0600 hours (no human activities).

Table 5: National Drinking Water Quality Standards, 2016

Group	National Drinking Water Quality Standards, 2016* (for Urban Drinking Water Supply)			WHO Guidelines for Drinking- Water Quality, 4 <sup>th</sup> Edition, 2011**
	Parameter	Unit	Max. Concentration Limits	
Physical	Turbidity	NTU	5	-
	pH		6.5 – 8.5	none

	Color (TCU)	Hazen Unit	15	none
	Taste and Odor		Non- objectionable	-
<b>Chemical</b>	Iron	mg/l	0.3	-
	Manganese	mg/l	0.4	-
	Arsenic	mg/l	0.01	<b>0.01</b>
	Fluoride <sup>^</sup>	mg/l	1.5	<b>1.5</b>
	Lead	mg/l	0.01	<b>0.01</b>
	Nitrate	mg/l	50	<b>50</b>
	Calcium	mg/l	75	-
	Mercury	mg/l	0.006	<b>0.006</b>
	Residual Chlorine	mg/l	0.2 - 0.5	<b>5 ^^</b>
	Sulphate	mg/l	250	-
<b>Microbiological</b>	<b>E-coli</b>	<b>CFU/100ml</b>	<b>0</b>	<b>Must not be detectable in any 100 ml</b>

\* Taken from Bhutan Drinking Water Quality Standard, 2016, National Environment Commission, Royal Government of Bhutan, 8 March 2016.

\*\* Health-based guideline values

<sup>^</sup> To be tested for ground and spring water only.

<sup>^^</sup> From WHO (2003) Chlorine in Drinking-water, which states that this value is conservative.

Table 6: Workplace emissions standards

Parameter	Period	Unit measure of	Standard
Total suspended particulate matter TSPM	8-hour average	mg/m <sup>3</sup>	10
Respirable suspended particulate matter RSPM (PM10)	8-hour average	mg/m <sup>3</sup>	5
PM2.5 *	24-hour average	mg/m <sup>3</sup>	25
	1 Year average	mg/m <sup>3</sup>	10
Sulfur dioxide (SO <sub>2</sub> )	8-hour average	mg/m <sup>3</sup>	1
Nitrogen Oxide (NO <sub>x</sub> )	8-hour average	mg/m <sup>3</sup>	1
Carbon monoxide (CO)	1 hour average	mg/m <sup>3</sup>	5
Pb 17**	1 hour average	mg/m <sup>3</sup>	0.0005
Ozone***	8-hour average	mg/m <sup>3</sup>	0.08

Source: Environmental Standards, National Environment Commission, Royal Government of Bhutan, 2020.

PM 2.5\* Gravimetric/light-scattering/beta attenuation-based instruments

\*\* National Institute of Occupational Safety and Health (NIOSH) Method 7303

\*\*\* UV Photometric/Chemiluminescence/Chemical Method

### III. DESCRIPTION OF THE SUBPROJECT

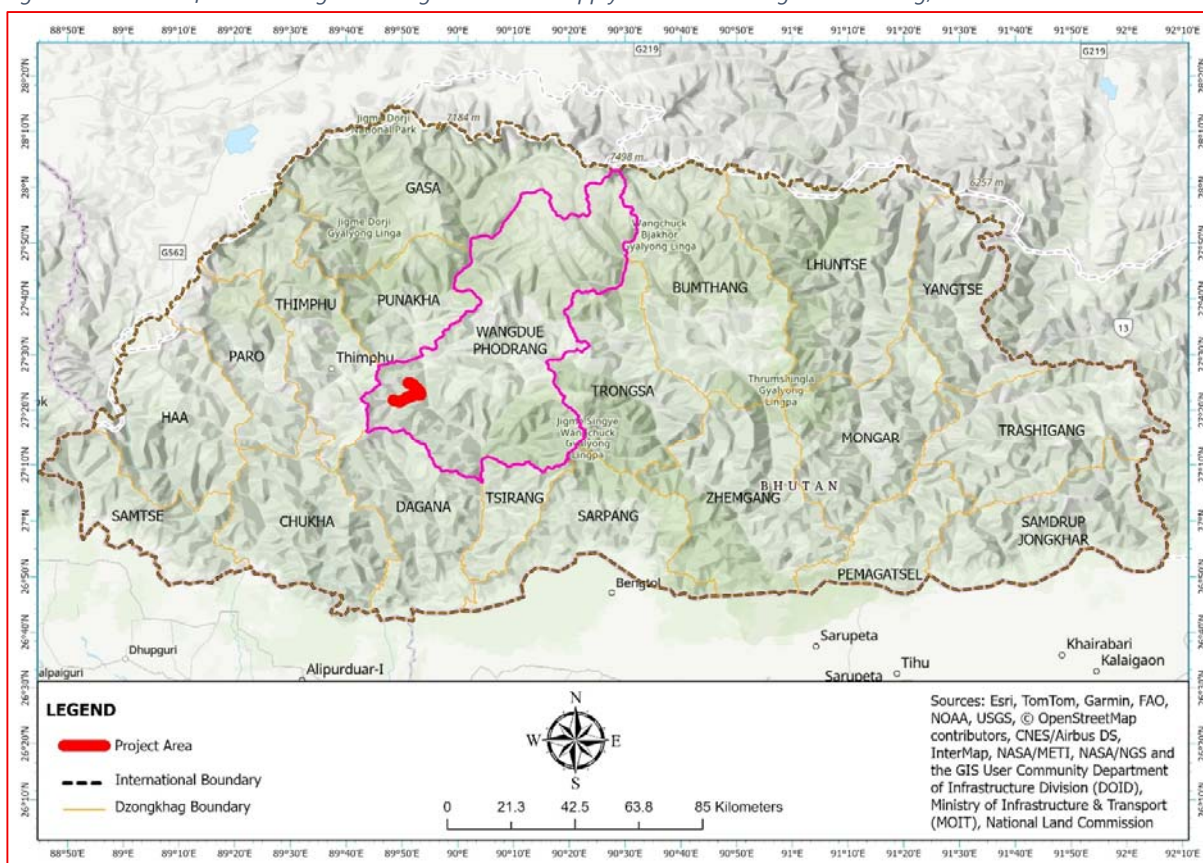
#### A. Location of the Subproject

112. The Hetshotsangchhu Integrated Water Supply Scheme subproject is situated in Wangdue Phodrang Dzongkhag, centrally located within Bhutan (Figure 1). The Dzongkhag shares its southern boundary with Dagana and Tsirang, eastern boundary with Trongsa, western boundary with Thimphu and Punakha, and northern boundary with Gasa and the international border.

113. Specifically, the project will be implemented in the Gaselo region, which comprises the Gasetsho Gom and Gasetsho Wom gewogs in the southwestern part of the Dzongkhag. This area is bordered by Nahi and Thedtsho Gewogs to the north; Ruepisa Gewog and Thimphu Dzongkhag to the west; and Daga Gewog and Dagana Dzongkhag to the south.

114. Together, these two gewogs cover an area of 254.65 km<sup>2</sup> and have a combined population of 2,278 people.<sup>7</sup>

Figure 1: Location of Hetshotsangchhu Integrated Water Supply Scheme in Wangdue Phodrang, Bhutan



115. At present, Gasetsho Gom and Gasetsho Wom gewogs experience high water availability but limited accessibility, primarily due to inadequate source management, underdeveloped infrastructure, and insufficient maintenance. Drinking water is currently sourced from multiple

<sup>7</sup> Population figure taken from actual survey of PMU and PIU during preparatory phase of the subproject.

streams located along the rolling hillsides and mountainous terrain near the villages. These sources are tapped using small-diameter HDPE pipes, typically installed by the communities themselves.

116. The reliability of these sources varies—some provide consistent supply, while others are seasonal. A summary of discharge rates from the existing sources currently utilized for drinking water in both gewogs is presented in the table below.

*Table 7: Summary of Existing Drinking Water Source Discharges in Gasetsho-Wom and Gasetsho-Gom Gewogs (Source: Survey Report by MOIT and PIU Wangdue Phodrang for the Water Flagship Program)*

<b>Gewog</b>	<b>Village</b>	<b>No. of Households</b>	<b>Existing source discharge, lps</b>
Gasetsho Wom	Tapchekha	7	0.182
	Gekha	8	0.126
	Mephuna	7	0.12
	Kilikha	1	0.08
	Zamtoe	1	0.05
	Khamaywangsina	1	0.01
	Geog office	6	0.055
	Phakha	6	0.02
	Nazhakha	2	0.071
	Singkheykhatoe	16	0.071
	Singkheykhame	13	0.03
	Dopaychusingkhay	1	0.058
	Tachekha	1	0.16
<b>Sub-total</b>			<b>1.033</b>
Gasetsho Gom	Pasakha	7	0.42
	Masikha	12	1.25
	Masikha	01	0.33
	Masikha	01	0.26
	Masikha	03	0.55
	Changchey	02	0.021
	Changchey	02	0.25
	Changchey	04	1.0
	Changchey	10	0.022
	Pangsho	02	Nil
	Pangsho	02	0.17
	Pangsho	01	0.1
	Pangsho	10	0.5
	Pangsho	01	0.025
	Changchey	02	0.33
	Changchey	02	0.33
	Changchey	01	0.21
	Changchey	03	Nil
	Changchey	03	0.21
	Pangsho	05	0.5
	Pangsho	06	0.25
	Pangsho	02	0.043
	Changchey	01	0.043
	Changchey	01	0.11
	Khatoekha	24	0.75
	Khatoekha	24	0.15
	Khatoekha	01	0.041
	Khatoekha	02	0.33
	Khatoekha	08	0.277
	Khatoekha	02	0.41

<b>Gewog</b>	<b>Village</b>	<b>No. of Households</b>	<b>Existing source discharge, lps</b>
	Khatoekha	02	No water
	Khatoekha	08	0.33
	Drapchikha	47	0.29
	Drapchikha	08	0.33
	Changkha	01	0.19
	Drapchikha	01	0.26
	Drapchikha	02	0.62
	Drapchikha	02	0.5
	Drapchikha	02	0.2
	Drapchikha	01	0.19
	Drapchikha	01	0.29
	Khamena	01	0.17
	Khamena	02	0.16
	Khamena	01	0.18
	Khamena	01	0.25
	Khamena	05	0.4
	Khamena	04	0.11
	Khamena	16	0.55
	Khamena	05	0.33
	Gaselo Higher secondary school		1.2
	Gaselo primary school		0.35
	RNR & health staff		
	<b>Sub-Total</b>		<b>16.192</b>
	<b>Total</b>		<b>17.225</b>

117. While the villages are supposedly connected by the rural water supply schemes with taps provided for most households in the villages, in reality, many of these taps are defunct, and most households tap their own water sources (from perennial streams) for drinking water. Issues in water accessibility persist due to various factors from insufficient and inequitable sharing of water, inadequate infrastructure and governance of water systems. The increase in government infrastructure and the establishment of the schools in the gewogs have also exacerbated the situation. Moreover, the areas/vicinity of these streams are now being encroached by human activities such as farming and livestock raising. Thus, this existing drinking water supply scheme in the two gewogs poses potential risk to the villages due to possible biological or chemical contamination of the surface water and requires proper planning and treatment of drinking water.

118. For irrigation purposes, there are water sharing practices that differ from village to village but this traditional water sharing system has been in operation for generations. This system requires the water to be shared on a rotation basis (based on an agreed number of days) among the villages, and within the village level again among different landholdings. This system is not equitable or efficient. Another reason for the water shortage for irrigation is the irregular rainfall due to climate change, wherein the delay in rainfall has a major impact on the paddy plantation. The lack of adequate water has resulted in much of the land being left fallow, mostly belonging to the poorer community. Water

scarcity has led to social conflicts, distrust among villagers. Without adequate water, crop yields are significantly reduced compared to other villages in Punakha and Paro.<sup>8</sup>

119. Currently, there are 22 irrigation schemes within the two gewogs, 5 in Gasetsho Gom and 17 in Gasetsho Wom. In a survey conducted by the Ministry of Agriculture in May 2022, it was determined that 23% of the wetland, 41% of the dryland, 23% of the orchards and 5% of kitchen gardens are being left fallow due to inadequate water. This results in an average of 28% of land being left fallow between the two gewogs – land that could not be utilized due to the lack of irrigation water. While the area has high water availability, bringing the water to these unused agricultural lands at higher elevations is a challenge. This results in a huge opportunity loss and foregone livelihood income for the gewogs.

Table 8: Summary of fallow land by land use type for the project area (Source: Questionnaire Survey 2022 by Gewog)

Source: Questionnaire Survey 2022 by Geowg										
SN	Gewog	NoV	NoP	NoIS	Parameter	WL	DL	OR	KG	Total
1	Gom	18	1829	5	Registered (ac)	652.39	220.52	2.71	19.01	894.64
					Fallow (ac)	127.43	71.53	0.62	0.00	199.57
					Fallow (%)	20	32	23	0	22
2	Wom	16	795	17	Registered (ac)	275.74	128.96	0.00	6.88	411.58
					Fallow (ac)	89.93	70.65	0.00	1.28	161.86
					Fallow (%)	33	55	0	19	39
3	Total	34	2624	22	Registered (a)	928.13	349.48	2.71	25.90	1306.22
					Fallow (ac)	217.36	142.18	0.62	1.28	361.44
					Fallow (%)	23	41	23	5	28

Note: NoV = No of Villages, NoP = Number of Plots, NoIS = Number of existing Irrigation Schemes, WL = W

ac = acre, DL = dryland, KG = kitchen garden, NoP = No. of Plots, NoIS – No. of Existing Irrigation Schemes, NoV = No. of Villages, OR = orchard, WL = wet land

120. Therefore, premised on the above discussions, the subproject is a critical undertaking to ensure sustainable supply of water for present and future needs of the gewogs.

## B. Subproject Components

121. In order to realize the objectives, a complete water supply infrastructure will be built in two phases. Phase 1 will cover the intake structure and the main raw water transmission systems. Phase 2 will cover the drinking water treatment components and the final irrigation distribution network. The technical specifications have been finalized in the Hydraulic Structure Design Report (August 2025), which details two primary gravity pipelines. The integrated scheme will have the following components:

### Phase 1 (Package 1): Raw Water Transmission System

122. This package, for which the detailed engineering design has been finalized, covers the construction of the primary raw water conveyance infrastructure. The system comprises two primary gravity-fed pipelines: Mainline A and the secondary Hetshokha Line B.

<sup>8</sup> Public consultation, Wangdue Phodrang Dzongkhag, June 2022

- i. Construction of the Headworks: A river-side intake structure designed for a 100-year return period flood and an adjoining 28-meter-long primary desilting tank. This serves as the initial treatment stage, designed to remove suspended particles ( $\geq 0.2$  mm) to protect the downstream pipeline.
- ii. Installation of the Primary Raw Water Transmission Main (Mainline A): Installation of a ~21.1 km main transmission line from the intake to a final delivery point. This line is designed for a total flow of 608 lps and will utilize a combination of 710mm OD High-Density Polyethylene (HDPE) pipes and a ~2.7 km section of DN700 Carbon Steel pipe for high-pressure segments.
- iii. Installation of the Secondary Raw Water Transmission Main (Hesokha Line B): Installation of a separate ~5.6 km transmission line to serve the Hetshokha area.
  - o Source: This line branches off from Mainline A at Break Pressure Tank 2 (BPT02).
  - o Design Flow: It is designed for a flow of 29 lps.
  - o Pipe Specifications: The pipeline will primarily use 180mm OD HDPE pipe with varying pressure ratings (PN6.0 to PN20.0).
- iv. Construction of Ancillary Hydraulic Structures: Construction of all necessary hydraulic structures along both transmission mains, including Break Pressure Tanks (BPTs), valve chambers for Air Release (ARV), Flushout (FOV), and Isolation (ISV), and concrete Thrust Blocks for the steel pipe sections.
- v. Construction of a 10-m Host Bridge for a major pipeline crossing.

## **Phase 2 (Package 2): Functional Completion and Distribution Networks.**

123. The scope of Package 2 comprises all subsequent works required to make the system fully operational for end-users. This work begins at the offtake structures built in Package 1 and includes:

- I. Installation of Local Treatment Units: At a subset of the offtakes designated for drinking water, Package 2 involves the installation and commissioning of the sedimentation and chlorination treatment systems.
- II. Construction of Final Distribution Pipelines: Package 2 includes the laying of the extensive network of smaller-diameter pipelines that will connect *from* all 10 offtakes to the respective irrigation command areas and community reservoirs.

## **Integrated Design of Offtakes for Irrigation and Drinking Water**

124. Total Number of Offtakes: The entire Hesotshamchu scheme is designed around a total of 10 primary offtake structures. These are the only points where water will be diverted from the main transmission line (Mainline A).

125. Package 1 Scope (Ancillary Structures): Package 1 involves the construction of the core infrastructure. This includes the physical construction of all 10 of these primary offtake chambers. At this stage, they are considered "ancillary structures" designed simply to divert raw, untreated water from the main pipeline. This is why the Package 1 scope correctly lists them "without treatment / disinfection."

- i. Package 2 Scope (Functional Completion): Package 2 completes the system for its end uses:
  - o Drinking Water: For the communities requiring potable water, a subset of the 10 offtakes built under Package 1 will be equipped with local treatment units (sedimentation and

chlorination). These treatment facilities are part of the Package 2 scope. The treated water is then piped to community reservoirs.

- o Irrigation: The final distribution pipelines that carry raw water from the 10 primary offtakes to the various farm command areas are also part of the Package 2 scope.

ii. Optimization from Feasibility Design: During the initial processing phase, the project concept aimed to replace and upgrade 22 smaller, existing irrigation schemes. The final detailed engineering design optimized this by consolidating these needs into a more efficient system managed by the 10 robust, multi-purpose primary offtakes.

126. In summary, there is no duplication. Package 1 builds the 10 physical offtake structures, and Package 2 adds the necessary final components (treatment units for drinking water, and final pipelines for irrigation) to make them functional for their designated purpose. This integrated approach is more cost-effective, hydraulically efficient, and easier to manage than building separate offtakes for each of the original 22 schemes.

127. Description and specifications of the first phase are summarized in the Table below and the locations are illustrated in subsequent figures 2 & 3 in this section.

Table 9: Summary of Subproject Components (Updated table from the draft IEE report, 2022)

Infrastructures / Components	Function	Description	Location
Common Infrastructures for Drinking Water Supply and Irrigation Water (Package 1)			
(i) Intake Structure	To abstract raw water from the Hesotsangchhu River and perform initial sediment removal.	A concrete side-intake diversion weir designed for a 100-year return period flood. The structure diverts a portion of the river flow while allowing the main flow to continue unobstructed over the weir crest, inherently ensuring the release of environmental flows downstream. The intake includes an adjoining pre-treatment unit consisting of a 28.0 m long, 3.1 m wide, and 1.5 m deep desilting tank. This tank has a calculated trap efficiency of 91% and is designed to remove coarse sediment particles ( $\geq 0.2$ mm) before water enters the transmission pipeline. The system is designed for a maximum diversion flow of 608 lps, covering future drinking water demand (13 lps) and peak seasonal irrigation requirements. The design is based on detailed hydraulic calculations and will be specified in forthcoming GFC drawings.	The intake is on the Hesotsangchhu stream in Gasetso Gom Gewog. This location is within a biological corridor that connects three protected areas.  It serves as the starting point for the ~21.1 km raw water transmission main.
(ii) Raw water transmission mains	To convey raw water from the intake to 10 offtakes along the alignment, and one final delivery point.	A ~21.1 km gravity-fed transmission main (Mainline A).  The pipeline is a combination of 710mm OD HDPE pipes with varying pressure ratings (PN 6.0 to PN 20.0) and a ~2.7 km section of DN700 Carbon Steel pipe for high-pressure segments.  The pipe will be laid in an excavated trench with an average depth of 1.0 m. A temporary construction pathway will be utilized for access.  Some sections, particularly high-pressure segments using steel pipe, may be installed above ground on plinths or bridges.	The transmission main starts at the intake in Gasetso Wom and follows the terrain to supply command areas across both Gasetso Gom and Gasetso Wom Gewogs, terminating at the final delivery point.
(ii) Raw water transmission mains (continued)		The pipe will be laid in an excavated trench with an average depth of 1.0 m over the pipe crown. The typical trench width will be ~1.21 meters (pipe OD + 250mm on each side). Backfilling will be done with approved material in compacted layers. Some sections may be installed above ground on plinths.	The entire pipeline will traverse both government-owned lands and community forest areas. The ~2.7 km Carbon Steel section is located between chainage 3.65 km and 6.34 km.
(iii) Primary Water Offtakes	To control and distribute raw water from the transmission main to the final distribution networks	10 primary take-off valve chambers are designed along the main transmission line.	The offtake locations are specified at the following chainages along the alignment: <ul style="list-style-type: none"> <li>• TO01: 3.87 km</li> <li>• TO02: 6.22 km</li> </ul>

Infrastructures / Components	Function	Description	Location
	for irrigation and drinking water treatment.		<ul style="list-style-type: none"> <li>• TO03: 7.91 km</li> <li>• TO04: 9.04 km</li> <li>• TO05: 10.79 km</li> <li>• TO06: 13.33 km</li> <li>• TO07: 14.74 km</li> <li>• TO08: 15.87 km</li> <li>• TO09: 17.79 km</li> <li>• TO10: 20.97 km (Final Delivery Point)</li> </ul>
(iv) Ancillary Valve Chambers	To ensure the safe and efficient operation of the gravity-fed pipeline.	<p>The design includes the construction of multiple valve chambers for:</p> <ul style="list-style-type: none"> <li>• Air Release Valves (ARVs) to release entrained air at high points. (15 nos.)</li> <li>• Flushout Valves (FOVs) to remove accumulated sediment at low points. (6 nos.)</li> <li>• Isolation Valves (ISVs) to allow for sectional maintenance and repair. (5 nos.)</li> </ul>	At various strategically engineered locations along the entire transmission main, as detailed in the design report (pp. 16-19).
(v) Break Pressure Tanks (BPTs)	To safely dissipate excess hydraulic pressure and break the hydraulic grade line at strategic points, preventing over-pressurization of downstream pipeline sections.	<p>Construction of 4 reinforced concrete BPTs. Each tank is designed to reduce the incoming hydraulic head to atmospheric pressure before releasing water into the next pipeline section.</p> <ul style="list-style-type: none"> <li>• BPT01 (Primary Desilting/ Sediment Tank): This is the largest tank, designed for initial sediment removal. - Dimensions (L x W): 28.0 m x 3.1 m - Effective Depth (h): 1.5 m - GL Elevation: 2203.1 m</li> <li>• BPT02, BPT03, BPT04: These are intermediate pressure-breaking tanks. Their specific dimensions are detailed in the structural drawings. <ul style="list-style-type: none"> <li>- BPT02 GL Elevation: 2171.8 m</li> <li>- BPT03 GL Elevation: 2120.0 m</li> <li>- BPT04 GL Elevation: 2088.6 m</li> </ul> </li> </ul>	<p>Located at the following strategic points along the alignment:</p> <ul style="list-style-type: none"> <li>• BPT01: At Chainage 56 m</li> <li>• BPT02: At Chainage 630 m</li> <li>• BPT03: At Chainage 7.26 km</li> <li>• BPT04: At Chainage 13.11 km</li> </ul>
(vi) Pipeline Support Crossings	To safely support and convey the pipeline where trenching is unfeasible due to crossing streams, rivers, deep gullies, or unstable terrain.	<p>The design specifies 12 specialized pipeline support crossings constructed as part of the main transmission line (Mainline A). These structures are engineered to provide a stable, above-ground alignment for the pipeline. They fall into two main categories:</p> <ul style="list-style-type: none"> <li>• Aqueduct–Bridge-Support (3 nos.): These are structures where the pipeline is supported by dedicated piers or small bridges.</li> <li>• Aqueduct–Self-Support (9 nos.): These are sections where the rigid Carbon Steel pipe itself spans a short distance between supports, acting as its own structural member.</li> </ul> <p>Additionally, the project includes the construction of one major 10-meter host bridge to carry the pipeline over a significant crossing. The final structural designs and exact dimensions for each crossing are detailed in the project's civil works and structural drawing packages.</p>	These 12 crossings are located at various points along the ~21.1 km pipeline alignment where it intersects with natural drainage channels and gullies, as identified during the detailed design survey.
(vi) Final Delivery Point	To serve as the terminus of the main transmission line and the primary distribution point for raw water.	<p>The final delivery point is a reinforced concrete chamber designated as Take-off Valve Chamber TO10. It is the largest distribution structure in the system.</p> <ul style="list-style-type: none"> <li>• Technical Designation: TO10 (Take-off 10)</li> <li>• Structure Type: Valve Chamber / Delivery Chamber</li> <li>• Design Discharge Capacity: 370 lps (representing ~61% of the total design flow)</li> <li>• Function: It receives the full remaining flow from the main pipeline and distributes it to the extensive irrigation networks in the lower command areas of Gasetsho Gom Gewog.</li> </ul>	Located at the end of the ~21.1 km transmission main at 89.85194°E, 27.41531°N at an elevation of 2045.975 m, above Tingna Village in Gasetsho Gom.
<b>Drinking Water Infrastructure (Package 2)</b>			
(i) Drinking Water Offtakes and Local Treatment Units	To provide final clarification and disinfection of raw water to ensure it complies with National Drinking Water Quality Standards before distribution.	<p>A subset of the 10 primary offtakes will be designated for drinking water supply. At each of these locations, a local treatment unit will be constructed.</p> <ul style="list-style-type: none"> <li>• Treatment Process: A two-stage process will be used: <ol style="list-style-type: none"> <li>1. Sedimentation: Water will first pass through a sedimentation tank for final clarification and turbidity reduction.</li> </ol> </li> </ul>	The local treatment units will be constructed at the designated drinking water offtake locations along the main transmission line.

Infrastructures / Components	Function	Description	Location
		<p>2. Disinfection: Following sedimentation, the water will be disinfected using a chlorination unit to eliminate pathogens.</p> <ul style="list-style-type: none"> <li>● Compliance Standard: The system is designed to ensure the final water quality meets or exceeds the Bhutan National Drinking Water Quality Standards (NDWQS).</li> <li>● Design Status: The exact number, capacity, and detailed engineering design of these units will be finalized under Package 2.</li> </ul>	
(ii) Treated water pipeline	To convey treated drinking water from the local chlorination tanks to the different village storage tanks in the two gewogs.	<p>A network of new pipelines will be installed to distribute the treated water.</p> <ul style="list-style-type: none"> <li>● Pipe Material: High-Density Polyethylene (HDPE)</li> <li>● Pipe Diameters (Indicative): 50 mm – 110 mm</li> <li>● Aggregate Length (Indicative): ~13 km</li> <li>● System End Point: The project's scope for the drinking water supply concludes at the inlet of the existing community storage tanks. The final distribution network from these tanks to individual households is already in place.</li> <li>● Hydraulic Management: While primarily gravity-fed, break pressure tanks will be installed where necessary along these distribution lines to manage hydraulic pressure and prevent damage to the pipelines.</li> </ul>	<p>These pipelines will connect the new local treatment units to the various community drinking water storage tanks located throughout the Gasetsho Gom and Gasetsho Wom gewogs.</p> <p>The pipeline alignments are expected to follow existing road and path rights-of-way to minimize environmental and social impacts.</p>
<b>Irrigation Infrastructure (Package 2)</b>			
(i) Irrigation Distribution Pipelines	<p>To distribute raw water from the 10 primary offtakes on the main transmission line to the irrigation command areas across Gasetsho Gom and Gasetsho Wom gewogs.</p> <p>This modern pipeline network will replace and consolidate numerous smaller, less reliable existing schemes, reducing water loss from seepage and evaporation.</p>	<p>(A network of new pipelines will be installed to supply irrigation water.</p> <ul style="list-style-type: none"> <li>● Pipe Material: High-Density Polyethylene (HDPE)</li> <li>● Pipe Diameters (Indicative): 50 mm – 110 mm</li> <li>● Aggregate Length (Indicative): ~17 km</li> <li>● Technical Advantages: This modern, fully enclosed system is designed to virtually eliminate water losses from seepage and evaporation, which are major issues in the current open channels. This ensures higher water delivery efficiency.</li> <li>● Water Management &amp; Environmental Benefits: The piped system allows for a highly controlled and regulated flow of water to the farm level. This prevents over-irrigation, reduces the risk of soil erosion and waterlogging, and minimizes the runoff of agricultural inputs like fertilizers and pesticides into nearby watercourses.</li> </ul>	<p>The distribution network will supply the designated irrigation command area, which encompasses the areas currently served by 22 smaller, existing irrigation schemes (5 in Gasetsho Gom and 17 in Gasetsho Wom).</p> <p>The pipelines will be installed underground, primarily following existing canal alignments, footpaths, and farm roads</p>

Figure 2: Location of intake structure and alignment of the primary raw water transmission pipeline (Source: Final Detailed Design Report, IWSS, Wangdue Phodrang, August 2025)

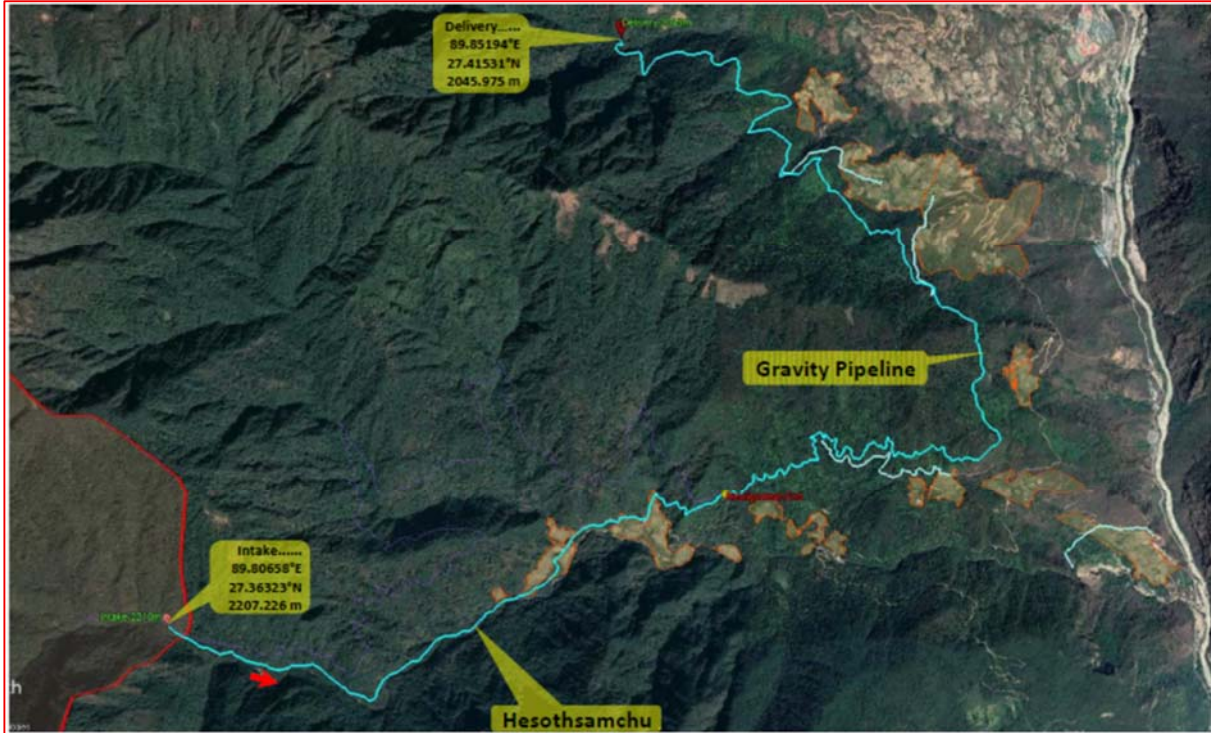


Figure 3: Pipeline Alignment Plan Main Transmission Line 0.00 - 21.09km (Source: Hydraulic Structure Design Report, August 2025)

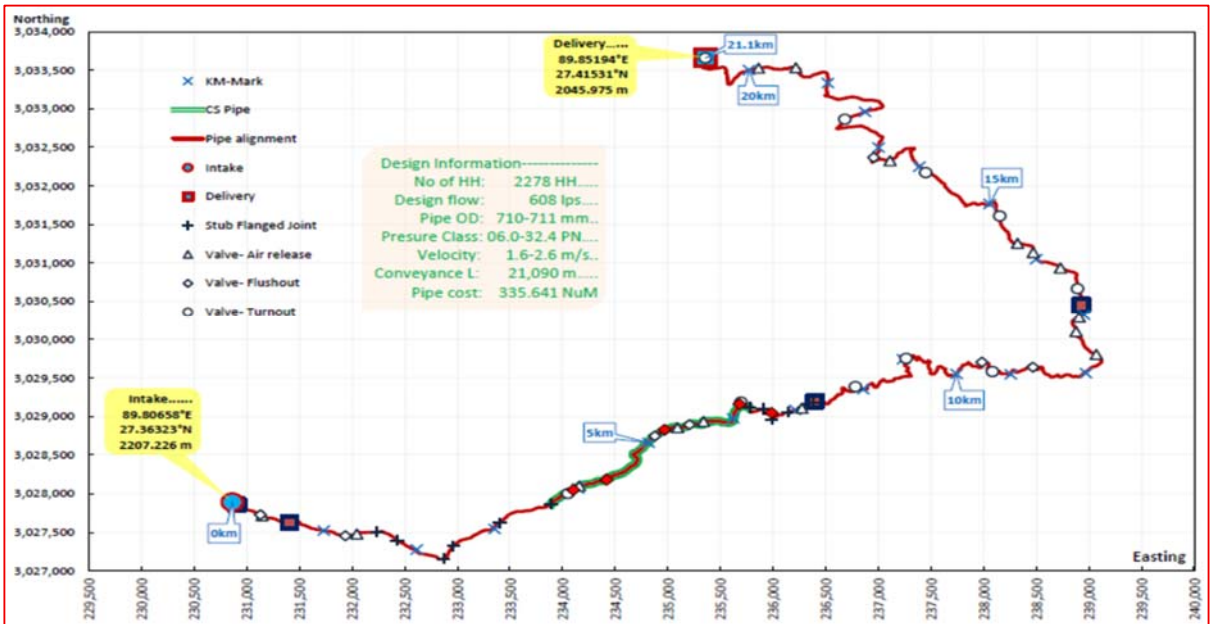
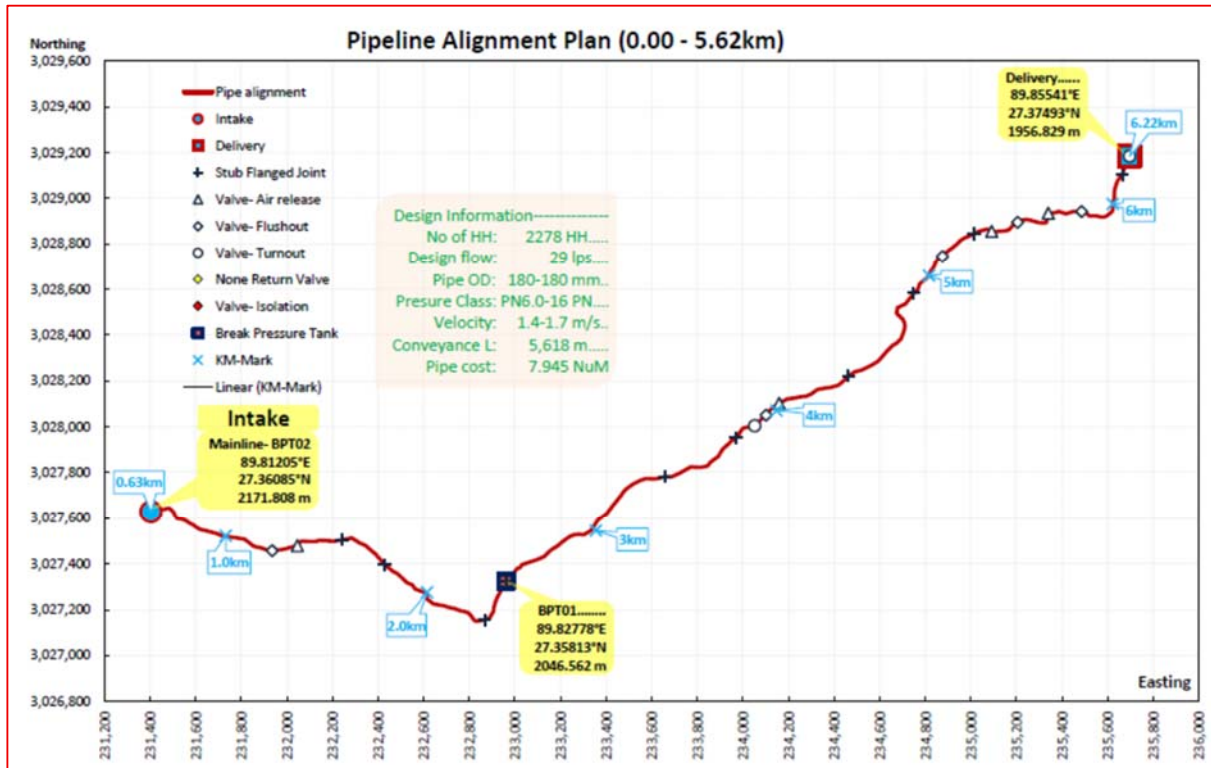


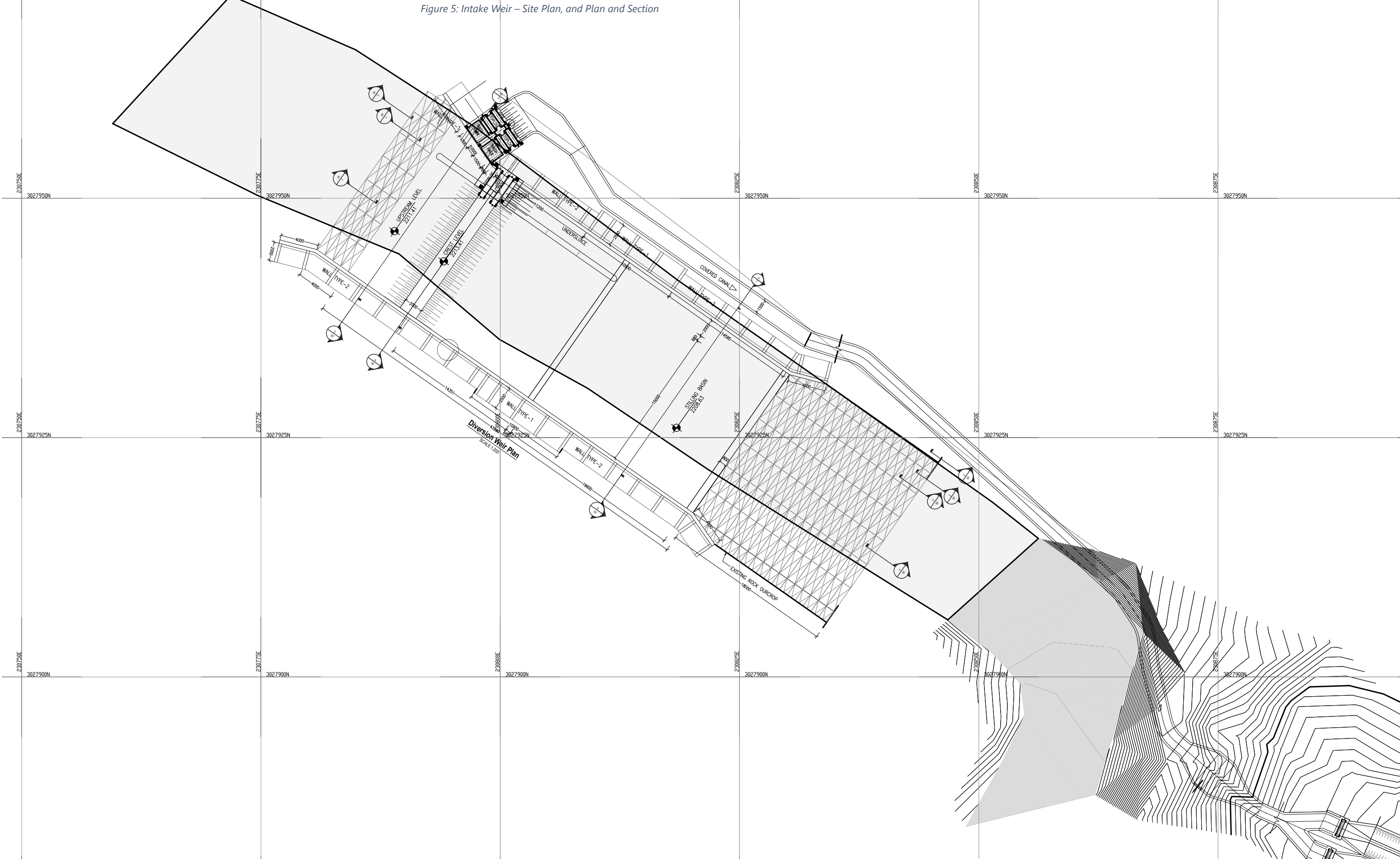
Figure 4: Hetshokha Pipeline Alignment 0.00 – 5.62 km (Source: Hydraulic Structure Design Report, August 2025)



128. Intake. There will be one primary intake structure constructed for the scheme. The headworks will consist of a weir and an adjoining desilting tank, along with associated protection works. The location of the intake is on the Hesotsangchhu River with a Weir Crest Level at an elevation of 2213.41 meters above sea level (masl) and an upstream bed level of 2211.41 masl, at coordinates 27.36323°N; 89.80658°E.

129. Weir and Desilting Tank. At the intake site, a diversion weir with an 11.2-meter clear crest length and an adjoining 1.5-meter wide undersluice will be constructed. This structure is engineered to withstand a 100-year return period flood, ensuring its resilience during peak flow events. Energy dissipation is managed via a 15-meter-long reinforced concrete stilling basin downstream, protected by 1000mm thick gabion boxes and stone filling. The upstream section includes 300mm hard stone lining for scour protection. Water diverted by the weir will immediately flow into a 28-meter long, 3.1-meter wide, and 1.5-meter-deep desilting tank. This tank is the first stage of water treatment, designed to remove sand and silt particles ( $\geq 0.2$  mm) to protect the downstream pipeline.

Figure 5: Intake Weir – Site Plan, and Plan and Section



**NOTES**  
 -ALL DIMENSIONS IN MILLIMETERS UNLESS SPECIFIED  
 -WRITTEN DIMENSIONS TO BE READ AND NOT TO BE SCALED  
 -ALL DIMENSIONS ARE MEASURED FROM UNFINISHED SURFACE UNLESS OTHERWISE MENTIONED  
 -ANY DISCREPANCY IN THE DRAWINGS IS TO BE BROUGHT TO THE IMMEDIATE NOTICE OF THE SUPERVISION TEAM

**HESOTSHAMCHHU INTEGRATED WATER SUPPLY SCHEME**  
 Wangdue Phodrang Dzongkhag Administration

DESIGN BY: \_\_\_\_\_ DRAWING BY: \_\_\_\_\_ CHECKED BY: Khando Tshering, PE, Irrigation Division, DOID APPROVED BY: Kinley Dorji, CE, Irrigation Division, DOID

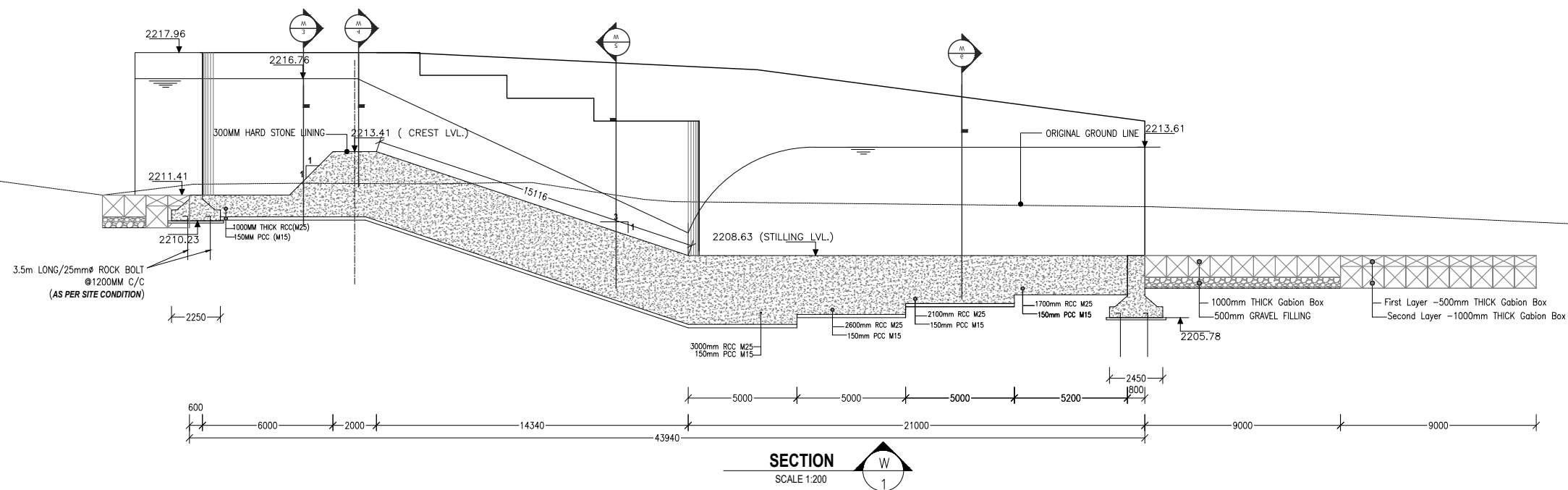
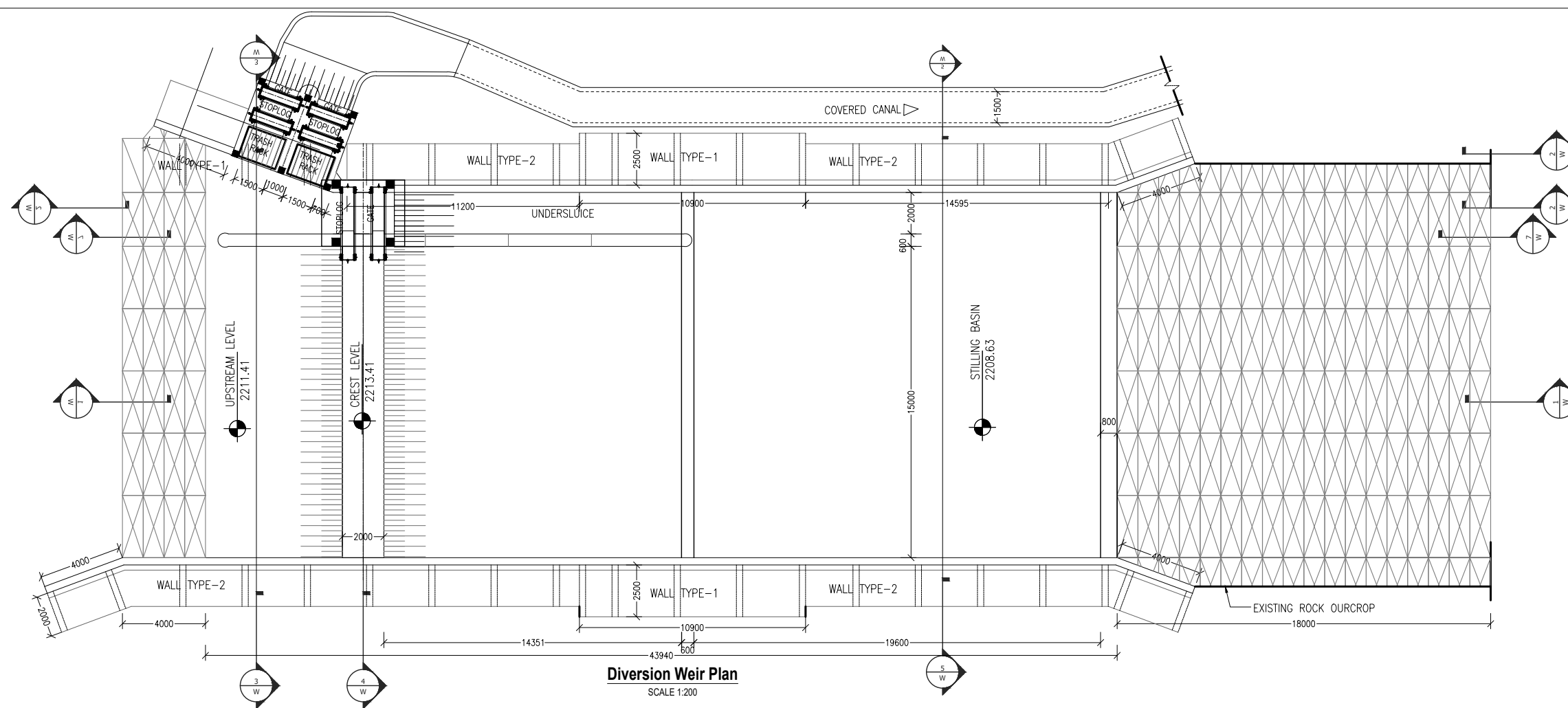
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 Intake Weir- SIDE

**SHEET TITLE:**  
 SITE PLAN

**DATE:**  
 NOV 2025

**DRAWING NO.:** HIWSS-07 **PAGE NO.:** 1 of 6 **SCALE:** As indicated **UNIT:** MILLIMETERS

No.	Description	Issued by	Date



**NOTES**

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Intake Weir- SIDE

**SHEET TITLE:**

PLAN & SECTION

**DATE:**

NOV 2025

**DRAWING NO.:**

HIWSS-07

**PAGE NO.:**

2 of 6

**SCALE**

As indicated

**UNIT:**

MILLIMETERS

No.	Description	Issued by	Date



130. Transmission Main. The primary raw water transmission main (Mainline A) will have a total length of approximately 21.1 km. The pipeline is a combination of High-Density Polyethylene (HDPE) pipe (approx. 18.4 km) and Carbon Steel pipe (approx. 2.7 km). The steel sections are specified for high-pressure segments of the alignment. The nominal outside diameter of the HDPE pipe is 710 mm, with varying pressure ratings (PN 6.0 to PN 20.0) determined by the hydraulic grade line, while the steel pipe is specified as DN700 (PN 32.4).

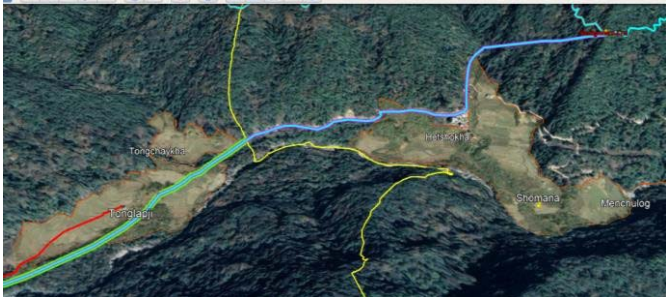
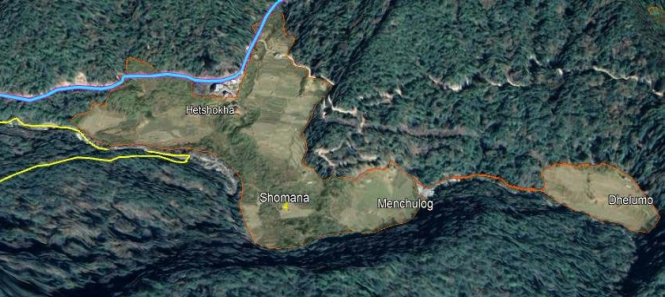
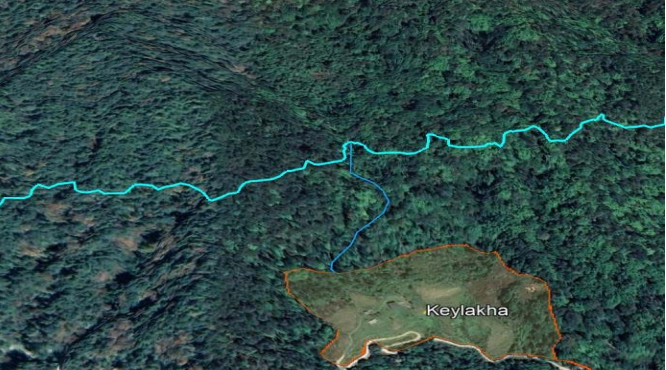

131. Hesokha Transmission Main (Line B). The secondary raw water transmission main for the Hetsokha area (Line B) will have a total length of approximately 5.6 km. This pipeline branches off from Mainline A at Break Pressure Tank 2 (BPT02). The pipeline is designed primarily using High-Density Polyethylene (HDPE) pipe. The nominal outside diameter of the HDPE pipe is 180 mm, with varying pressure ratings (PN 6.0 to PN 20.0) determined by the hydraulic grade line to manage the pressure along its alignment. The system is designed for a dedicated flow of 29 lps to serve the Hesokha command area.




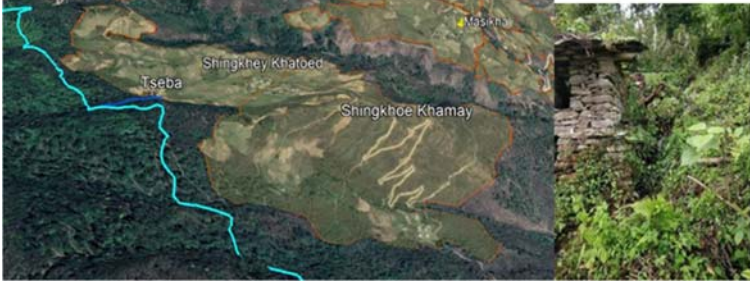
132. Alignment and Terrain. The transmission main alignment from the intake (2207.2 m masl) to the final delivery point (2045.9 m masl) traverses challenging, mountainous terrain along the steep hillsides of the river valley. The final alignment was determined through reconnaissance surveys and detailed topographical and geotechnical analysis to identify the most feasible and stable route. The selected route minimizes environmental impact by utilizing existing pathways where possible and avoiding areas with a high risk of landslides, while optimizing the hydraulic profile for gravity flow.



133. Installation. The installation of the pipeline will primarily be underground. The design specifies an average trenching depth of 1.0 m. The pipe will be laid on a prepared bedding of smooth soil, and then backfilled. The typical width of the construction corridor to be cleared will be approximately 3.5 meters. In certain sections, such as at stream crossings or on unstable terrain, the pipeline may be installed above ground on plinths or dedicated support structures.

134. Offtakes. There will be a total of 10 primary offtakes constructed along the main transmission line, as specified in the Hydraulic Structure Design Report. These offtakes will distribute raw water for two main purposes: irrigation and drinking water supply. The system is designed to provide irrigation water to command areas in 34 villages across the two gewogs, consolidating and improving the reliability of the 22 existing, smaller irrigation schemes in the project area. Drinking water will be tapped from a subset of these same 10 offtakes, with no additional primary offtakes planned for the main transmission line. The detailed design of the final distribution networks, which will carry water from these 10 offtakes to the specific irrigation fields and drinking water treatment units, will be completed under Package 2.

Table 10: Recipient Villages of Irrigation Water Supply (Field survey, June 2022)

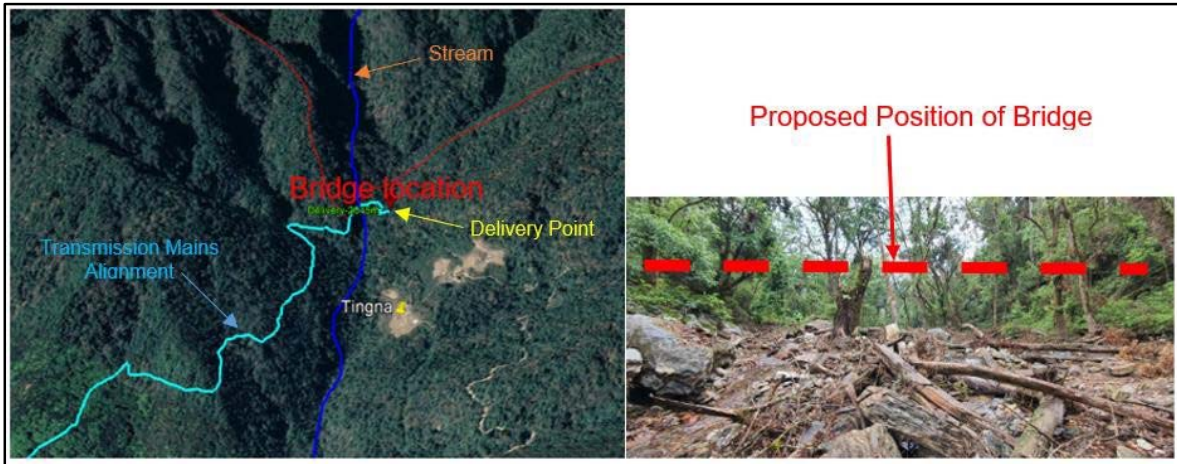
#	Details on the irrigation scheme Number and name of villages	Maps Showing Locations
1	<p><b>Number of villages: 2</b>  <b>Name of Villages:</b> Tonglobjee and Tongchaykha  <b>Name of irrigation schemes:</b> Tonglobjee Yuwa</p>	
2	<p><b>Number of villages: 4</b>  <b>Name of villages:</b> Hesotshokha,  <b>Name of irrigation schemes:</b> Mehza IS, Thapchu IS, Zakha</p>	
3	<p><b>Number of villages: 1</b>  <b>Name of villages:</b> Keylakha  <b>Name of irrigation schemes:</b> Keylakha Yuwa</p>	
4	<p><b>Number of villages: 3</b>  <b>Name of villages:</b> Shasokha, Zamtok, Palom  <b>Name of irrigation schemes:</b> Chukulum IS</p>	

#	Details on the irrigation scheme Number and name of villages	Maps Showing Locations
5	<p><b>Number of villages: 4</b>  <b>Name of villages:</b>            Tenchekha, Gekha, Mebisa, Mephuna  <b>Name of irrigation schemes:</b> Chukulum IS</p>	
6	<p><b>Number of villages: 1</b>  <b>Name of villages:</b>            Tabchekha  <b>Name of irrigation schemes:</b> Menza IS, Tabchezakha IS</p>	
7	<p><b>Number of villages: 1</b>  <b>Name of villages:</b> Shingkhey Khamey  <b>Name of irrigation schemes:</b> Janglu Tashi Gyem Khechu IS</p>	
8	<p><b>Number of villages: 1</b>  <b>Name of villages:</b>            Shingkhey Khatoed  <b>Name of irrigation schemes:</b> Chuzomsa IS, Jangluma Yuwa IS, Khay chu IS, Langtachu IS, Lumphu IS</p>	

#	Details on the irrigation scheme Number and name of villages	Maps Showing Locations
9	<b>Number of villages: 1</b> <b>Name of villages:</b> Phakha <b>Name of irrigation schemes:</b> Bjanglo Yuwa, Jangluma Yuwa- Phakha	
10	<b>Number of villages: 18</b> <b>Name of villages:</b> Gasetshogom <b>Name of irrigation schemes:</b> Rest of Gasetsho Gom Villages	

135. Pipeline Crossings. The pipeline alignment will require the construction of multiple specialized crossings to safely span streams, rivers, and deep gullies. The design report specifies several "aqueduct-bridge-support crossings" and "self-support aqueduct" sections distributed along the route where the terrain makes underground installation unfeasible. The specific structural design and dimensions for these crossings are a component of the detailed civil engineering works for the project.

Figure 6: Bridge/Crossing Location for Transmission Mains (Field Survey, June 2022)



136. Delivery Chamber. At the terminus of the ~21.1 km main transmission line, a major delivery structure will be constructed above Tingna village at an elevation of 2045.9 m masl. As per the Hydraulic Structure Design Report, this final delivery point is designated as Take-off Valve Chamber TO10. It is engineered to discharge 370 lps, representing over 60% of the main pipeline's total design flow, serving as the primary distribution point for the extensive irrigation networks in the lower command areas.

Figure 7: Delivery Chamber Design

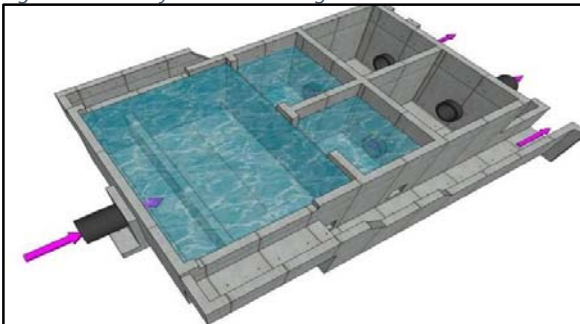


Figure 8: Site for Delivery Chamber



Figure 9: Existing Irrigation Channels (Field Survey, June 2022)



Figure 10: An Existing Source of Irrigation Water (Field Survey, June 2022)



137. Drinking Water Supply System: The subproject will provide a reliable drinking water source for the Gasetsho Wom and Gasetsho Gom gewogs, designed to serve the current population of 2,278 and a projected population of 5,200 by the year 2055. The design duty for the future drinking water supply is 13 liters per second (lps), which is calculated based on a per capita consumption of 200 liters per day (lpcd).

138. Water Treatment Infrastructure: Raw water for drinking will be tapped from a subset of the 10 primary offtakes located along the main transmission line. At each designated drinking water offtake, a local treatment unit will be constructed. This unit will consist of a sedimentation tank for final clarification to reduce turbidity, followed by a chlorination tank for disinfection. This two-stage process is designed to ensure the water is safe for consumption and complies with the National Drinking Water Quality Standards (NDWQS), particularly by ensuring the effectiveness of chlorine against pathogens like coliform. The detailed engineering design for these treatment units will be finalized under Package 2.

139. Treated Water Distribution: The drinking water infrastructure will include the construction of an aggregate network of HDPE pipelines to convey treated water from the chlorination tanks to the existing community storage tanks. While this network will primarily utilize gravity flow, break pressure tanks will be installed where necessary to manage hydraulic pressure. The indicative pipe sizes range from 50mm to 110mm. The subproject's scope concludes at the community storage tanks and does not cover the final distribution network to individual households, which is already in place. The existing household distribution network does not contain any asbestos cement pipes.

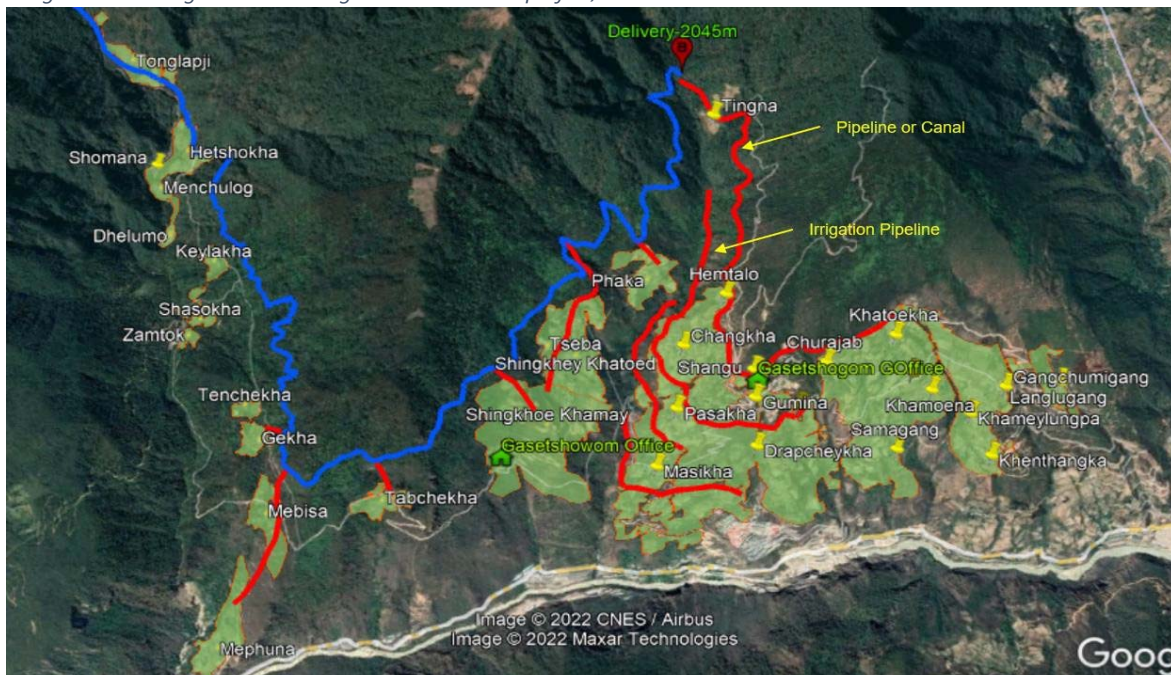
140. Environmental and Social Considerations for Distribution: In contrast to the main transmission alignment, the areas for the drinking water distribution infrastructure (pipelines from offtakes to villages) are typically within community boundaries. These alignments are expected to follow existing road and path rights-of-way and are not anticipated to impact environmentally sensitive sites or require significant tree felling. Therefore, potential impacts from the construction of this distribution network are regarded as site-specific and short-term, manageable through standard, environmentally responsible construction practices implemented by the contractor.

141. Irrigation Distribution Network. Under Package 2, an irrigation distribution network will be constructed to convey raw water from the 10 primary offtakes to the various irrigation command areas. This modern, enclosed pipeline system is designed to consolidate and replace the 22 smaller, existing, and often inefficient open-channel irrigation schemes currently operating in the two gewogs. The indicative specifications for this network include approximately 17 km of HDPE pipes with diameters ranging from 50mm to 110mm. The final alignments and detailed engineering designs will be completed as part of Package 2.

142. Advantages of a Piped System. The use of a fully piped irrigation network offers significant advantages over the existing open channels. It is designed to virtually eliminate water losses from ground seepage and evaporation, ensuring more efficient water delivery to the fields. Furthermore, an enclosed system prevents the overtopping of canals and localized flooding, providing a more reliable and manageable water supply for farmers. The preliminary layout for this distribution network is shown in the figure 11.

143. Water Management and Environmental Benefits. The new system provides a high degree of control over water distribution. The volume of water released at each of the 10 offtakes can be regulated, allowing for efficient management based on seasonal and crop-specific needs. This controlled flow, combined with the cascading (terraced) arrangement of the agricultural fields, mitigates risks such as soil waterlogging and salinization. More importantly, this precise water management prevents over-irrigation, thereby reducing soil erosion and minimizing the runoff of agricultural inputs like fertilizers and pesticides into nearby watercourses.

Figure 11: Approximate Locations of Offtakes and Irrigation Pipelines/Canals (Draft IEE Report, Oct 2022, Hetshotsangchhu Integrated Drinking Water and Irrigation Scheme Subproject).



## **C. Construction Method for the Transmission Pipeline including Temporary Access Road**

144. Construction and Service Road: To facilitate the construction of the pipeline, a temporary access road will be established along the alignment. During the construction phase, this route will provide essential access for equipment, materials, and personnel.

145. In accordance with the agreements made during the project processing phase, this access road is for construction purposes only and will not be retained as a permanent service road.

146. Upon completion of all construction, testing, and commissioning activities, the temporary access road will be fully decommissioned and the area will be restored. The restoration process will include:

- I. Road Closure: The access route will be made impassable to vehicles.
- II. Rehabilitation: The compacted road surface will be ripped and the land re-contoured to match the natural surrounding topography as closely as possible.
- III. Revegetation: The entire disturbed corridor will be revegetated with native species, including the planting of trees, to stabilize the soil, prevent erosion, and facilitate the natural regeneration of the forest ecosystem.

147. This approach ensures that the long-term impact on the landscape and forest habitat is minimized, and the area is returned to its pre-project condition as agreed.

148. Geotechnical Considerations and Hazard Mitigation. The final pipeline alignment is based on a geological walkover survey that confirmed the absence of major, deep-seated landslides. However, the survey did identify localized hazards that require specific attention during construction. The route was selected to avoid these major risks where possible, but the contractor must implement mitigation measures for site-specific hazards. This includes managing the risk of rolling boulders, minor soil slips, and rockfalls, particularly in steeper sections. The construction corridor's width will be kept to a minimum (typically 3.5 meters) to reduce the environmental footprint.

### **Trenching and Pipelaying:**

- Excavation Method: The primary method will be trench excavation using mechanical equipment. The authorized trench width for measurement will be the external pipe diameter (710 mm) plus a minimum of 250 mm of working space on each side, resulting in a typical trench width of ~1.21 meters.
- Excavation Depth: The trench will be excavated to a depth that ensures a minimum cover of 1.0 meter over the crown of the laid pipe, unless otherwise specified.
- Spoil Management: Suitable excavated material will be temporarily stockpiled at least one meter clear of the trench edge for later use as backfill. Unsuitable and surplus material will be collected and disposed of at pre-approved, engineered disposal sites as per the Spoil Management Plan (SMP). Indiscriminate side-casting is strictly prohibited.
- Excavation in Rock: Where hard rock is encountered, excavation will be carried out by mechanical means (e.g., pneumatic drills) or controlled blasting, with prior approval from the

Project Manager. All blasting operations must adhere to RGOB blasting regulations to ensure safety and minimize vibration.

**Pipe Bedding and Laying:**

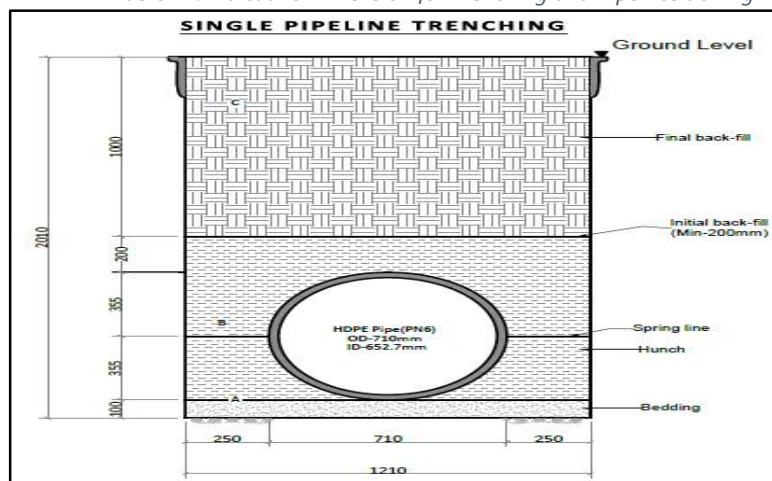
- Pipe Bedding: In sections with hard or ordinary rock, a pipe bedding layer of approved sand or fine gravel will be prepared at the bottom of the trench to provide a uniform, stable foundation and protect the pipe from damage.
- Pipe Laying: Before laying, each pipe section will be thoroughly inspected and cleaned of all debris. Pipes will be laid true to the specified alignment and gradient. The trench will be kept dry during laying operations, with dewatering systems employed as necessary. Open pipe ends will be plugged at the end of each day's work.

**Bedding and Backfill Materials:**

149. Backfilling will commence after the pipe joints have been successfully tested. The process will be conducted in three distinct zones:

- Zone 1 (Pipe Haunching): The space from the bottom of the trench to the centerline of the pipe will be filled with selected fine material (earth, sand) in 150 mm layers, compacted carefully with hand tampers to achieve 90-95% proctor density.
- Zone 2 (Pipe Crown): From the centerline to 300 mm above the top of the pipe, backfilling will continue with selected material in 150 mm layers. This zone will be compacted by hand to avoid damaging the pipe.
- Zone 3 (Upper Trench): The remainder of the trench will be backfilled with suitable excavated material in layers not exceeding 200 mm, mechanically compacted to achieve 90% proctor density. Boulders or stones larger than 200 mm will be removed.

Table 11: Indicative Dimension for Trenching and Pipe Positioning



Note: The maximum cover above the pipeline will be 1.2 m. However, this will vary depending on the site conditions and terrain. In some sections, the pipeline may be laid above the ground, and in some section the cover may range from 200 mm to 1200mm.

**1. Other Considerations for Clearing, Trenching, and Excavation**

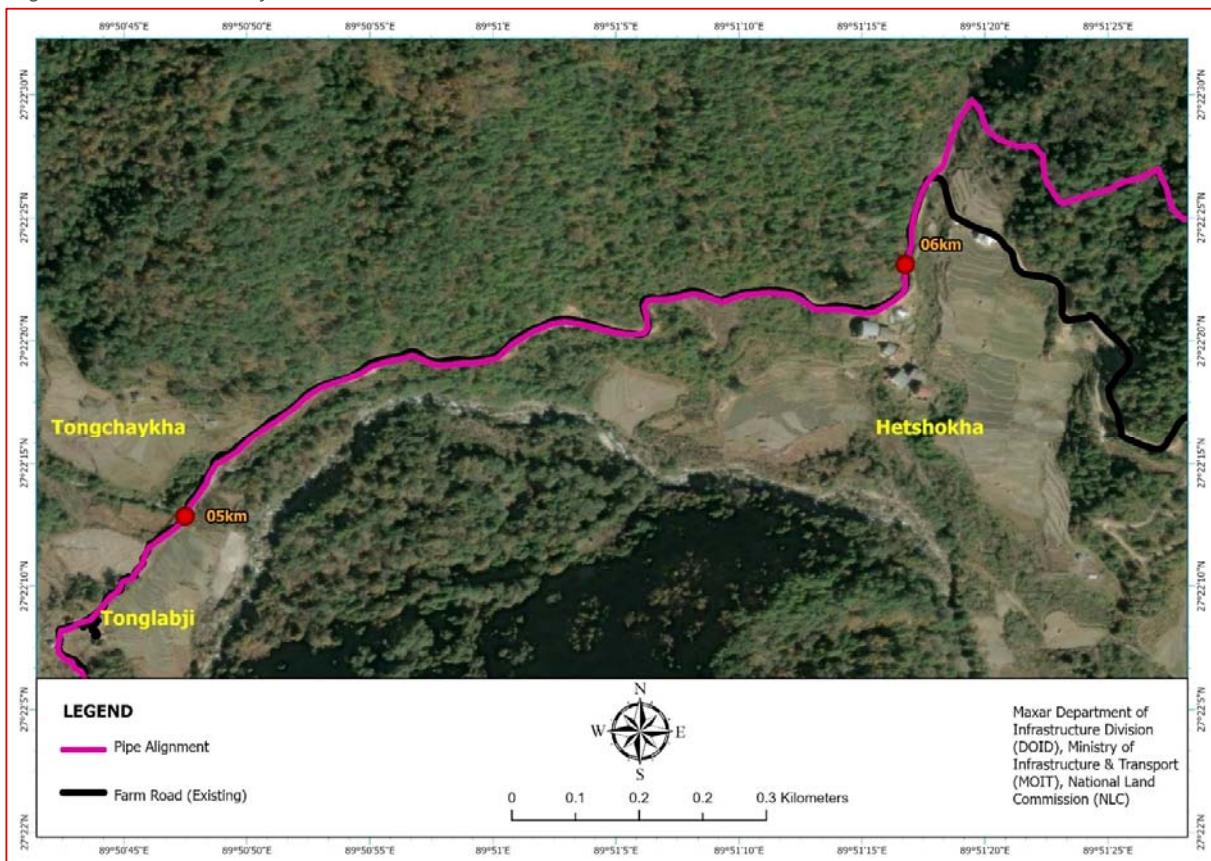
150. Pre-Construction Survey and Marking. In accordance with environmental due diligence and forestry regulations, a pre-construction tree enumeration has been finalized and done for the

pipeline alignment. The survey was conducted by the Wangdue Territorial Division, Department of Forest & Park Service (DOFPS), which has officially marked all trees identified for removal. This enumeration forms the basis for the felling permits that the project must secure prior to commencing any site clearing. The contractor is also bound to manage all felled timber as directed by and in full compliance with DOFPS regulations.

151. Clearing and Earthworks. Following DOFPS approval, clearing and grubbing of vegetation will be confined strictly within the staked construction corridor. All earthworks, including excavation and any necessary formation cutting for the service road, must adhere to the mitigation measures outlined in the project's Environmental Management Plan (EMP). This approach will ensure that the clearing footprint is minimized and that environmental impacts are properly managed.

152. Construction Access and Phasing. The project is designed to avoid the need for constructing new approach roads. Initial access for machinery and materials will be via an existing community road in Gasetsho Wom Gewog, which intersects the pipeline alignment. From this access point, construction will proceed bi-directionally: upstream towards the intake and downstream towards the final delivery point. This phased approach will allow the newly constructed service road to be used progressively for access as work continues.

Figure 12: Alignment Coinciding/Overlapping Existing Community Road (Source: Final Hydraulic Structure Design Report, August 2025 & Field Survey, October 2025).



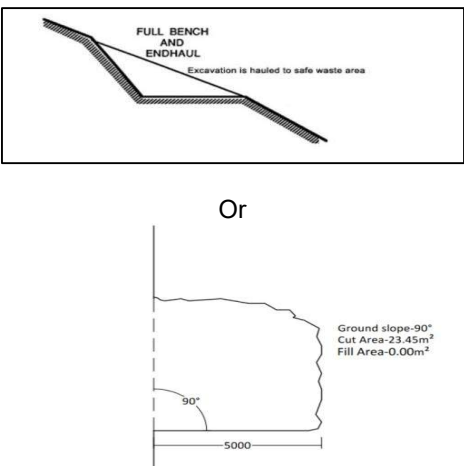
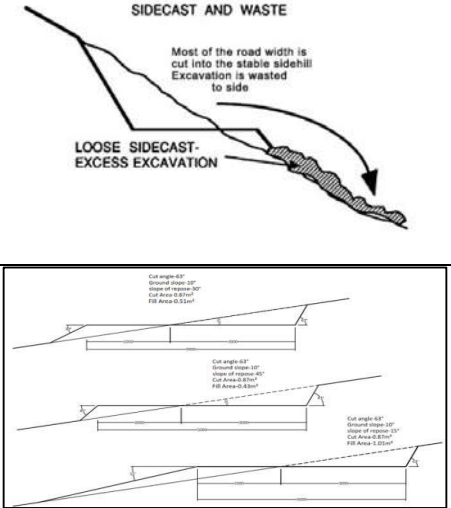
153. Formation Cutting and Earthworks. Given the predominantly steep and mountainous terrain along the pipeline alignment, the primary construction method for the service road and trench will

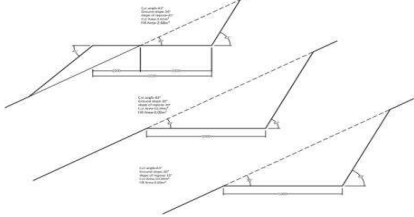
be bench cutting wherever possible. This method involves creating a stable, flat platform entirely on solid ground by cutting into the hillside.

154. All excavated material (spoil) from these cuts will be collected and transported (end-hauled) to pre-approved, safe disposal sites. This approach is essential to prevent the uncontrolled side-casting of spoil, which could trigger soil slips or landslides on the steep lower slopes.

155. The "cut and fill" method will be strictly limited to short sections with gentle slopes and stable ground conditions, as determined by the supervising engineer. Land grading in flatter areas will only be undertaken where absolutely necessary to achieve the required pipeline gradient. All earthworks will be executed in accordance with the project's Environmental Management Plan (EMP) to ensure long-term slope stability and minimize the construction footprint.

Table 12: Summary of Excavation Methods (Draft IEE Report, Integrated Drinking Water and Irrigation Scheme Subproject, Oct 2022).

Method	Illustration <sup>a</sup>	Determining Factors
Full bench and end haul		<ul style="list-style-type: none"> <li>- Steep slopes along the alignment or when downslope is too steep to hold a fill.</li> <li>- Where residential structure or community or agricultural area exists on the downslope.</li> <li>- Where river or stream exists on the downslope.</li> <li>- Requires approved disposal site for excavated materials.</li> </ul>
Cut and Fill		<ul style="list-style-type: none"> <li>- Only on moderate downslopes along the alignment.</li> <li>- Strictly no structures such as houses or communities on the downslope.</li> <li>- Strictly no river or stream on the downslope</li> </ul>

Method	Illustration <sup>a</sup>	Determining Factors
		

<sup>a</sup> Sample illustration taken from Watershed Management Field Manual (Road design and construction in sensitive watersheds). Food and Agriculture Organization. 1998; and Integrated Water Supply Project for Wangdue Phodrang

156. **Excavation and Blasting.** Excavation for the service road and pipeline trench will be carried out using mechanical equipment. In sections where hard rock formations such as Granitic Gneiss are encountered, controlled blasting will be necessary. All blasting activities must be conducted in strict accordance with a Blasting Management Plan prepared by the contractor and approved by the relevant authorities. This plan will include protocols for safety, community notification, and vibration control to prevent damage to the surrounding environment and structures.

157. **Equipment and Spoil Management.** The primary equipment for earthworks will include hydraulic excavators for trenching and cutting, and dump trucks for transporting material. All excavated material (spoil) not suitable for backfill will be end-hauled to pre-approved, geotechnically stable disposal sites. Spoil will be managed to prevent accumulation on steep slopes, and the contractor must ensure that disposal sites are properly stabilized and revegetated upon completion of the work.

158. **Service Road Compaction.** As the service road is a permanent project asset, proper compaction is critical for its long-term stability and to prevent erosion. The road subgrade and surface layers will be compacted in layers using appropriate machinery, such as a vibrating steel drum compactor, to achieve a durable, all-weather surface capable of safely supporting maintenance vehicles.

159. **Material Sourcing and Disposal.** The contractor will prioritize the reuse of suitable excavated soil for backfilling the pipeline trench. Any additional fill material required will be sourced from approved suppliers. All excess spoil, including blasted rock and other debris, will be transported and disposed of only at sites approved by the Project Management Unit (PMU) and relevant environmental authorities, as outlined in the project's Spoil Management Plan.

#### **D. Subproject Phase and Schedule**

160. **Project Timeline.** The subproject is scheduled for implementation over a three-year construction period, commencing in January 2026 and expected to be completed by December 2028. Following the completion of construction, there will be a subsequent period for defects liability and initial operational support before the full responsibility for Operation and Maintenance (O&M) is handed over to the designated operator.

161. **Workforce Requirements.** The final number of personnel required for construction will be determined by the appointed contractor and documented in their Site-Specific Environmental Management Plan (SEMP). However, based on similar projects in Bhutan, it is estimated that the construction phase will require a workforce of approximately 75 to 100 individuals at its peak. For

the long-term operational phase, a smaller, dedicated team of approximately 5 to 10 personnel is anticipated to be required for routine maintenance and system management.

## IV. DESCRIPTION OF THE ENVIRONMENT

162. This chapter establishes the baseline environmental conditions of the project's area of influence. This baseline serves two primary purposes: (i) to provide a benchmark against which potential environmental and social impacts of the project can be predicted and evaluated, and (ii) to inform the final design, construction methodology, and operational plans to ensure environmental safeguards are effectively integrated.

163. The assessment covers the physical, biological, and socio-economic environment. Data was gathered using a multi-faceted approach, including a review of secondary sources, primary data collection through on-site surveys, and extensive consultations with relevant stakeholders.

### A. Subproject Location and Area of Influence

164. The subproject is located in Wangdue Phodrang Dzongkhag, a district situated in central Bhutan. The Dzongkhag covers an area of 4,029 km<sup>2</sup> and has a population of 42,186 people, the majority of whom reside in rural areas. It is bordered by the Dzongkhags of Dagana and Tsirang to the south, Trongsa to the east, Thimphu and Punakha to the west, and Gasa to the north.

165. Specifically, the project is situated within the Gasetsho Gom and Gasetsho Wom gewogs, located in the southwestern part of the Dzongkhag. These two gewogs have a combined area of 254.65 km<sup>2</sup> and a total population of 2,278 people, who are the primary beneficiaries of the scheme.

166. The subproject's primary area of influence is therefore defined by: (i) the intake site at the Hesotshamchu stream; (ii) the ~21.1 km corridor required for the main transmission pipeline and its permanent service road; and (iii) the associated irrigation command areas and villages within Gasetsho Gom and Gasetsho Wom gewogs that will receive water from the scheme.

Figure 13: Map showing Gasetsho-Gom and Gasetsho-Wom Gewog under Wangdue Phodrang Dzongkhag (Source: Final Hydraulic Structure Design Report, August 2025 and National Land Commission)

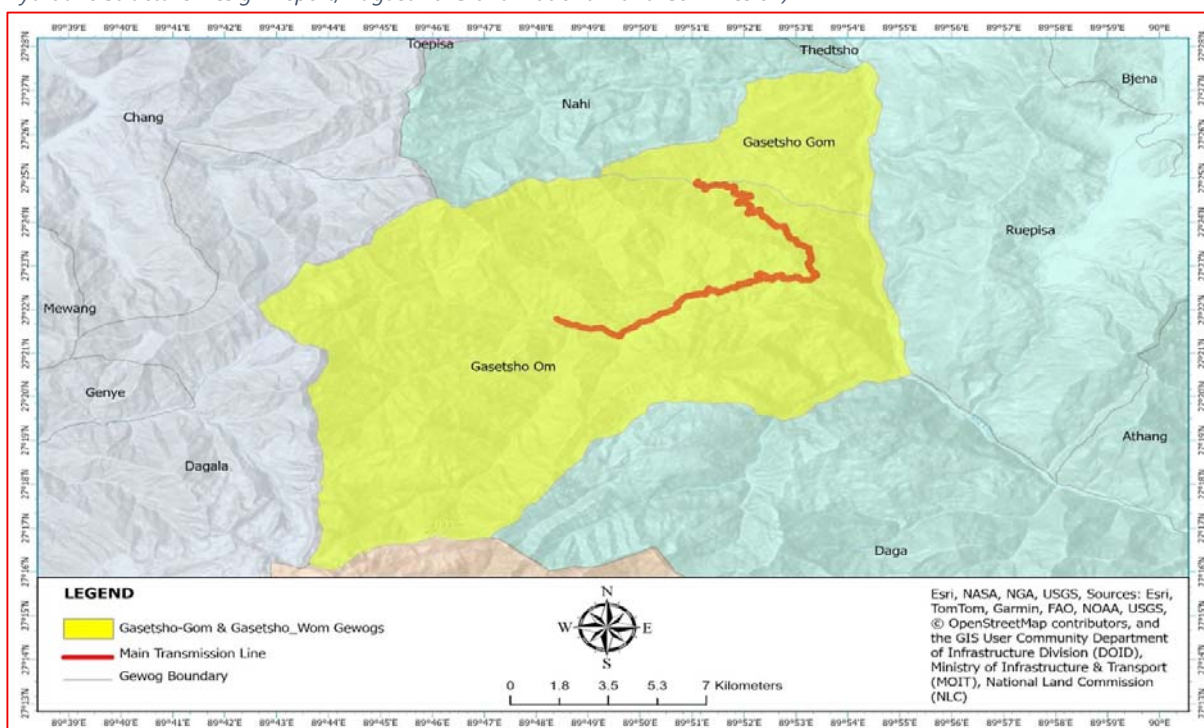


Figure 14: Location of the Irrigation Command Areas (Gasetsho Wom and Gasetsho Gom). (Draft IEE Report, Integrated Drinking Water and Irrigation Scheme Subproject, Oct 2022).

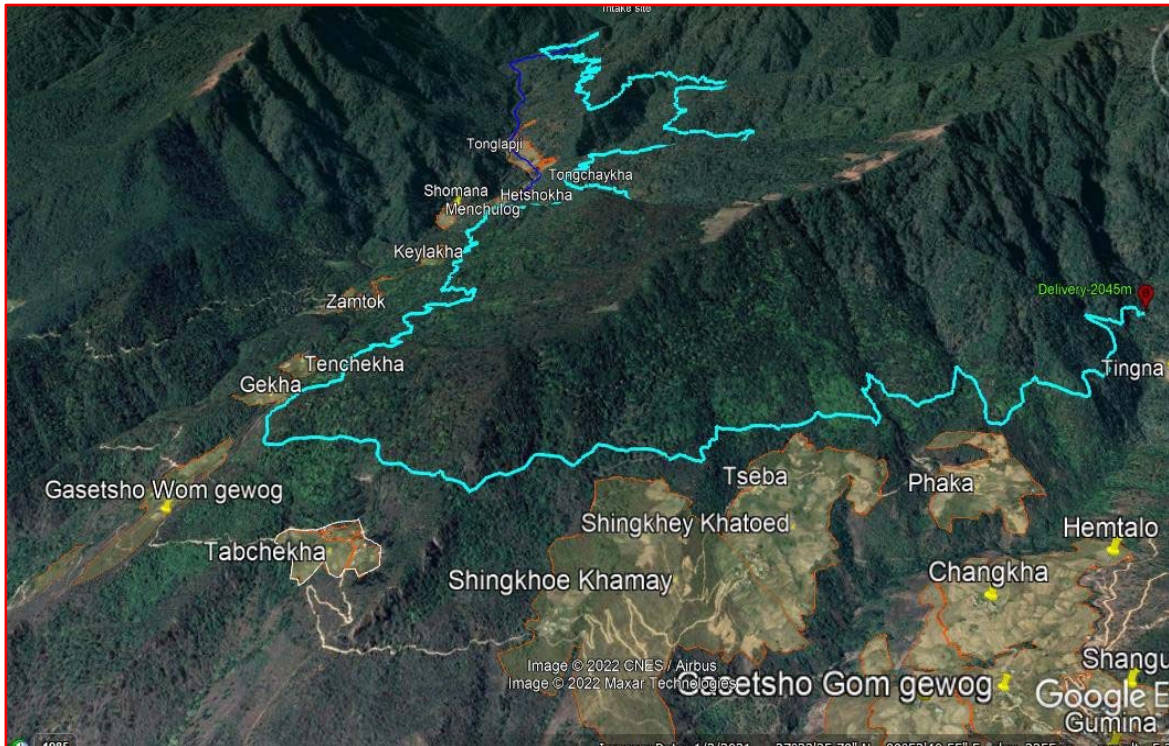


Figure 15: Location of Irrigation Areas in Gasetsho Gom Gewog (Draft IEE Report, Integrated Drinking Water and Irrigation Scheme Subproject, Oct 2022).

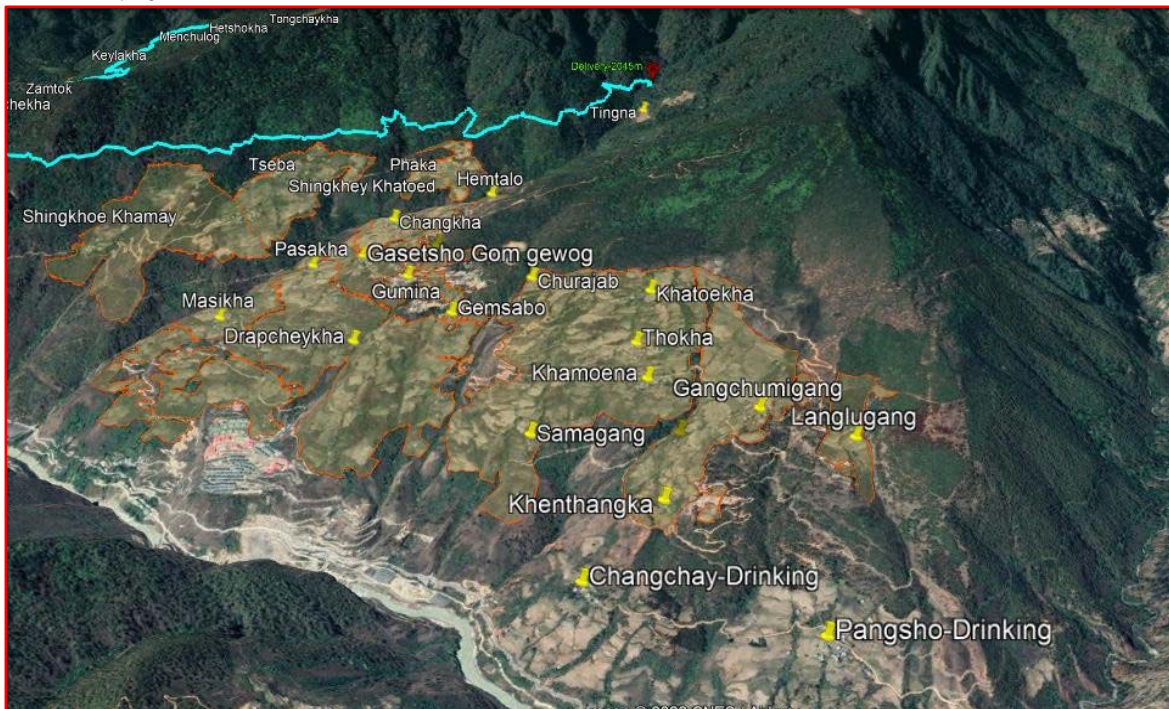










Figure 16: Beneficiary villages (Field Survey, June 2022 & August 2025)



Table 13: On-Ground Baseline Conditions of Subproject Component Locations and Vicinities (Field Survey, June 2022 & August 2025)

Component	Location Details & Baseline Description	On-Ground Photograph of Baseline Conditions
<b>Intake Headworks Site</b>	<b>Chainage: 0+000 km</b> Elevation: 2208.2 m Located directly on the Hesotsangchhu River within Biological Corridor No. 2. The site is characterized by a rocky riverbed with large boulders and steep, densely forested banks. The area shows signs of high-energy flows, such as deposited logs and scoured banks.	

Component	Location Details & Baseline Description	On-Ground Photograph of Baseline Conditions
<b>Break Pressure Tank 1 (BPT01) / Sedimentation Tank Site</b>	<p>Chainage: 0+056 km (56 m)  Elevation: 2203.1 m  Functional Role: This is a dual-function structure. It serves as the primary desilting (sedimentation) tank for the entire 608 lps flow, providing initial treatment by removing coarse suspended solids (<math>\geq 0.2</math> mm). Simultaneously, it functions as Break Pressure Tank 1 (BPT01), dissipating the initial hydraulic energy from the intake before the water enters the main gravity pipeline.</p> <p>The site is located on a small, relatively flat terrace immediately adjacent to and slightly above the main river intake site. The area is characterized by dense, mixed broadleaf forest and is situated entirely within the sensitive Biological Corridor No. 2. Construction will require careful clearing of this forested area to accommodate the large footprint of the 28-meter-long concrete tank</p>	
<b>Break Pressure Tank 2 (BPT02) Site</b>	<p>Chainage: 0+630 km  Elevation: 2171.8 m  This site is located in the upper reaches of the alignment, within a forested area inside the Biological Corridor. The terrain is gentle, and the location is chosen to manage the significant hydraulic head generated from the initial drop in elevation from the intake.</p> <p>This structure is also a key bifurcation point in the system. From BPT02, the separate Hesokha Line (Line B) branches off to supply irrigation and drinking water to the Hesokha area, while the main transmission line (Mainline A) continues onward to serve the remaining command areas.</p>	
<b>Typical Pipeline Alignment (Upper Reaches)</b>	<p><b>Chainage: 0 km - 5 km</b>  Alignment &amp; Terrain: The pipeline follows a contour alignment along a steep valley side, traversing terrain with highly variable slopes. Analysis of the slope map indicates:</p> <ul style="list-style-type: none"> <li>● Very Steep Sections: The alignment crosses several sections with slopes of 30-50% (orange and red zones), particularly between chainage 1.5 km and 2.5 km.</li> <li>● Gentler Sections: A significant portion, notably between 2.5 km and 4.5 km, follows a broader, more stable part of the hillside with gentler slopes in the 0-20% range (green zones).</li> </ul> <p>This entire 5 km section is located within the Biological Corridor. The alignment follows existing footpaths through what is described as dense, mixed conifer and broadleaf forest. It also crosses multiple small, steep tributary streams flowing down to the main river. The steep and variable nature of the terrain confirms that bench cutting will be the required construction method for much of this section to create a safe and stable working corridor.</p>	
<b>Break Pressure Tank 3 (BPT03) Site</b>	<p><b>Chainage: 7+255 km</b>  Located on a steep, open hillside characterized by shrubland and scattered trees outside the main forested area. The site offers a natural elevation drop suitable for pressure breaking.</p>	

Component	Location Details & Baseline Description	On-Ground Photograph of Baseline Conditions
<b>Break Pressure Tank 4 (BPT04)</b>	<b>Chainage: 13+110 km</b> Elevation: 2088.6 m Located in the mid-section of the pipeline, this site is situated on a steep, rugged mountainside. The surrounding vegetation is likely a mix of broadleaf forest and dense shrubland. The location is strategically placed after a significant elevation drop to regulate pressure before the pipeline continues its descent.	
<b>Typical Pipeline Alignment (Mid to Lower Reaches)</b>	<b>Chainage: 5 km - 21.1 km</b> Alignment & Terrain: In this section, the pipeline alignment transitions from the deep forested valley to more open, rugged mountainsides and eventually into areas with human settlement. The slope analysis shows a highly varied profile: <ul style="list-style-type: none"> <li>● <b>Extremely Steep Sections:</b> The alignment negotiates several sections with slopes of 40-60% (orange and red zones), most notably between chainage 12 km and 14 km and again near chainage 17 km. These are the most challenging sections for construction.</li> <li>● <b>Moderate Sections:</b> Significant portions, especially between 8 km - 12 km and 18 km - 20 km, traverse moderately sloped ground of 10-30% (yellow-green zones).</li> <li>● <b>Final Approach:</b> The final kilometer to the delivery point (from 20 km to 21.1 km) passes through gentler terrain with slopes predominantly in the 0-20% range.</li> </ul> <p>This section of the alignment is located outside the main Biological Corridor. It traverses a mix of Government Reserve Forest, community forests, and areas of shrubland. The final section (after 20 km) enters the periphery of agricultural lands and settlements near Tingna Village.</p>	
<b>Final Delivery Point (TO10) Site</b>	<b>Chainage: 21+090 km</b> The site is located on a moderately sloping hillside above Tingna Village, transitioning from forest to agricultural land. The area is characterized by grasses, shrubs, and nearby terraced fields.	

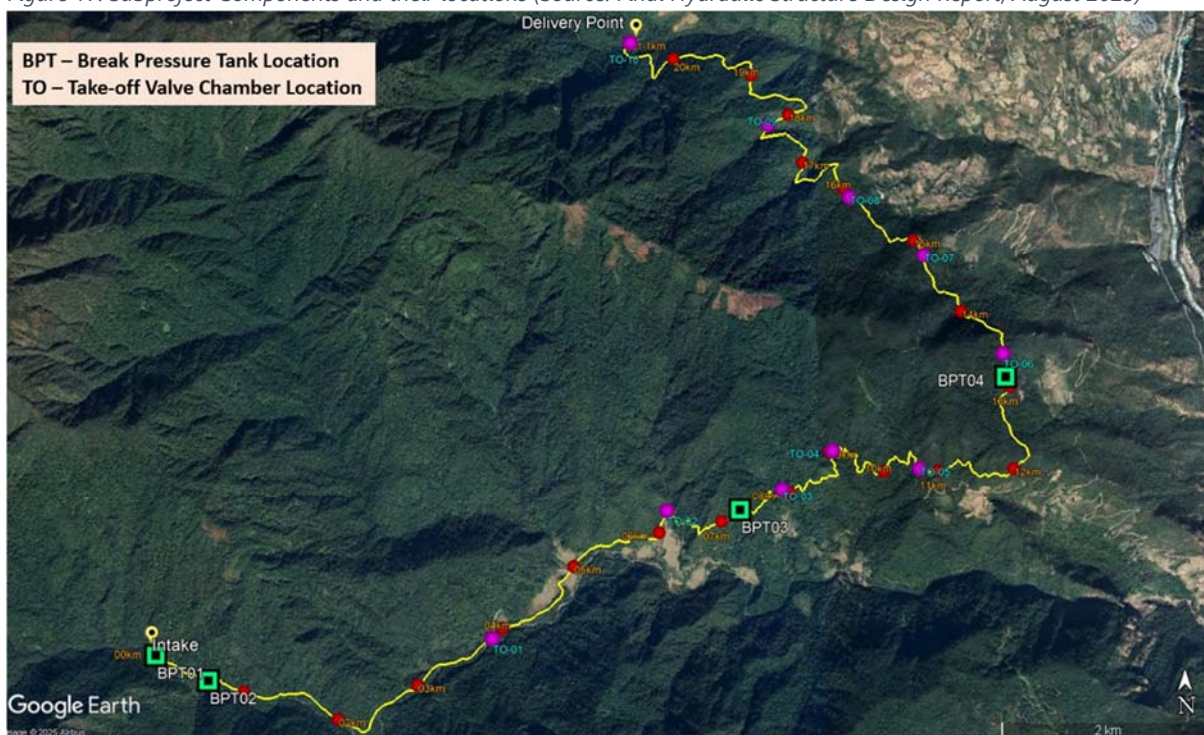
## B. Physical Environment

167. Topography. While Wangdue Phodrang Dzongkhag is characterized by rugged, mountainous terrain, the project alignment itself is located in a particularly challenging environment. The ~21.1 km pipeline traverses steep valley sides, starting at an intake elevation of 2207 m masl and descending to a final delivery point at 2045 m masl. The Natural Hazard Assessment Report confirms that the terrain along the alignment is predominantly steep, with slope angles frequently ranging between 20° and 45°. Some sections are classified as "Very Steep," with slope gradients exceeding 50%, necessitating careful engineering and construction methods. While the project operates within this specific elevation band, the broader topography of the Dzongkhag is illustrated in Table 14.

Table 14: The area of the district under various altitudes (Source: Wangdue Phodrang Dzongkhag)

Altitude (meters)	sq.km
<600	2.8
600-1200	122.71
1200-1800	355.8
1800-2400	538
2400-3000	729.95
3000-3600	783.88
3600-4200	500.32
4200-4800	492.98
4800-5400	455.97
5400-6000	49.71
6000-6600	4.41
>6600	0.42
	4036.95

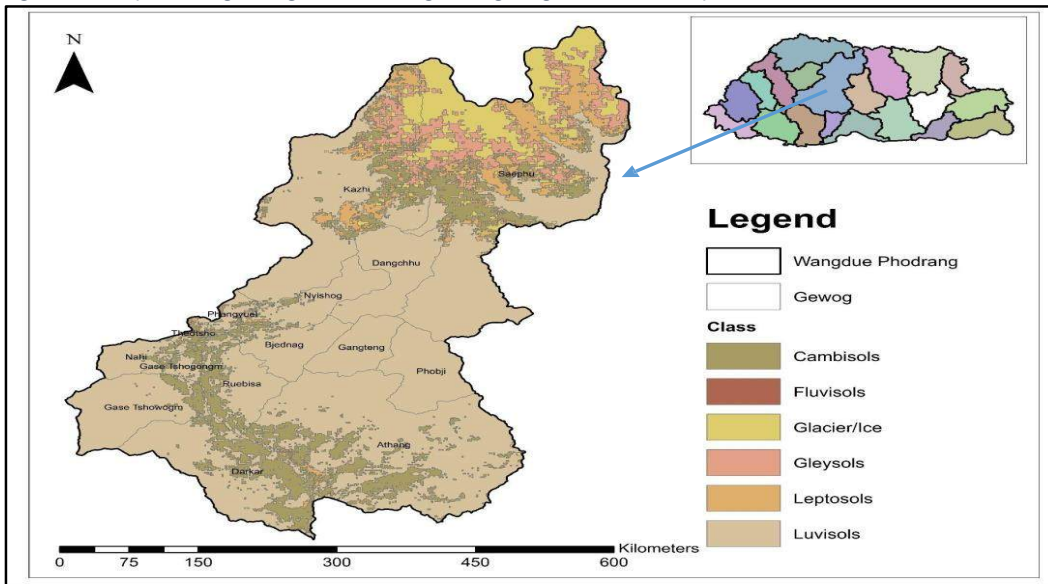
Figure 17: Subproject Components and their locations (Source: Final Hydraulic Structure Design Report, August 2025)



168. Soil Conditions. The soil map of the world prepared by FAO and International Soil Reference and Information Centre (ISRIC) is used to extract the soil information for the project area. The scale of the latest available soil map is of 250 meters grid; therefore, it is the best available data to extract the soil information for the project areas. There are four different types of soil in Wangdue Phodrang Dzongkhag. These being yellow soils (weakly acidic; low humus content, Phosphorus retention, cation-exchange capacity and base saturation) till 1000 meters, yellow brown forest soils (slightly acidic; medium humus content; high CEC) till 2000 meters, brown forest soils (thin, porous, brown-coloured, strongly acidic; high humus content; high P retention; low base saturation) till 3000 meters,

and podzols (acidic soil, low CEC; high humus content and P retention) till the 4000 meters level. The Figure below shows the soil map of Wangdue Phodrang Dzongkhag.

Figure 18: Map showing Wangdue Phodrang Dzongkhag and its soil map (Source: MoAL)

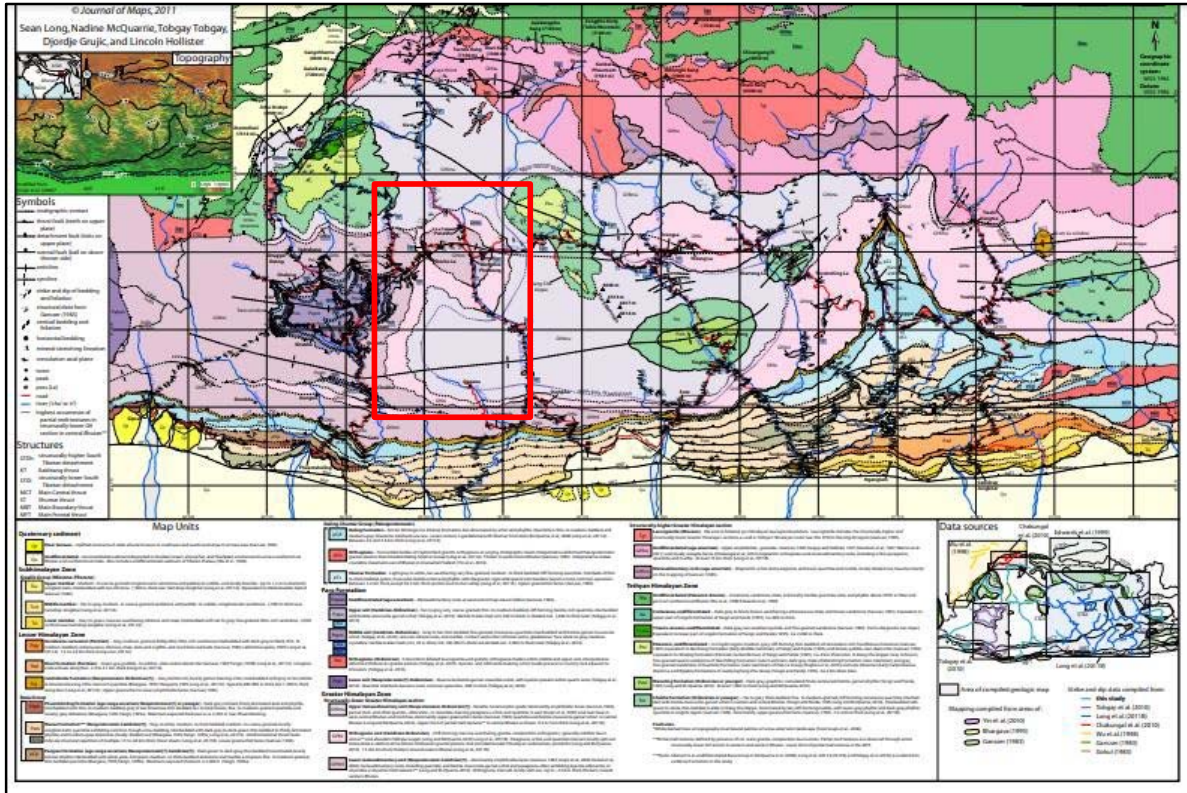


169. Regional and Local Geology. The project area is situated within the Upper Higher Himalayas of the Bhutanese geological structure. According to the Geological Map of Bhutan, the project alignment falls entirely within the Greater Himalayan Zone, specifically within the Upper Metasedimentary Unit, which is of Neoproterozoic-Ordovician age.

170. Rock Types along the Alignment. The geological walkover survey conducted for this project confirmed the specific rock types present along the pipeline corridor. The alignment is predominantly underlain by Granitic Gneiss, a high-grade, foliated metamorphic rock. This is the most dominant rock unit observed. A minor band of Mica Schist was also identified, particularly in the road-cut slope above Hesokha village. Megascopic observation of the Granitic Gneiss revealed the presence of quartz, biotite, feldspar, and tourmaline minerals, with weathering grades ranging from fresh to highly weathered depending on the location and exposure.

171. Structural Geology. The general trend of the rock formations in the project area is from northwest to southeast, with gentle to moderate north-easterly dips ranging from 8° to 65°. A detailed analysis of the rock mass identified three primary discontinuity sets (foliation and two joint sets) that control the stability of rock slopes. The interaction of these discontinuities with the steep terrain, particularly at two identified escarpments (near chainage 6+000 and 13+500), creates a potential for localized rockfalls and wedge failures, which has been considered in the construction planning.

Figure 19: Bhutan Geological Formation (Source: [https://sites.pitt.edu/~nmcq/Long\\_etal\\_2011\\_JOM\\_Bhutan\\_Map\\_1-500k.pdf](https://sites.pitt.edu/~nmcq/Long_etal_2011_JOM_Bhutan_Map_1-500k.pdf))



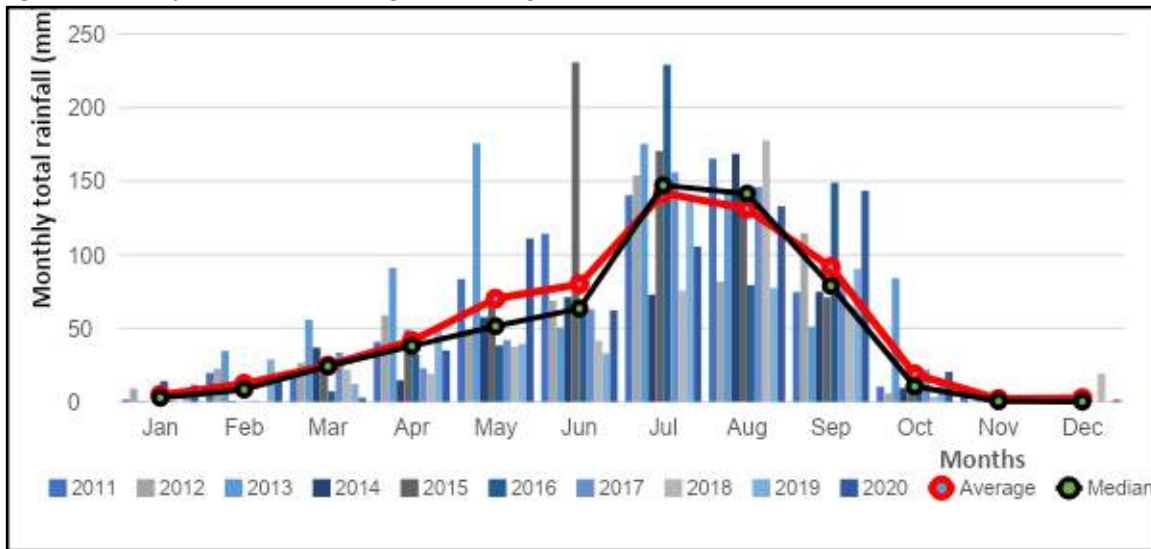
172. **Climate.** The project area experiences four distinct seasons: Winter (December-February), Spring (March-May), Summer (June-September), and Autumn (October-November). The climate is dominated by the summer monsoon, with the vast majority of annual precipitation occurring between June and September.

173. **Rainfall and Project Implications.** The project's design is directly influenced by the region's monsoonal rainfall pattern, as detailed in the water sufficiency analysis (Hydraulic Structure Design Report, p. 13). Precipitation is highly seasonal, with monthly rainfall peaking in July at approximately 144 mm and dropping to as low as 3.6 mm in December. While the total annual rainfall of approximately 675 mm is not considered extreme for the region, this seasonal variation has two critical impacts on the project:

- Operational Design: It dictates the seasonal availability of water, meaning the scheme's full design capacity of 608 lps can only be met during the wet summer months.
- Geotechnical Risk: The Natural Hazard Assessment Report identifies prolonged or intense rainfall during the monsoon as the primary triggering factor for soil saturation, which can lead to localized landslides and soil slips along the steep pipeline alignment.

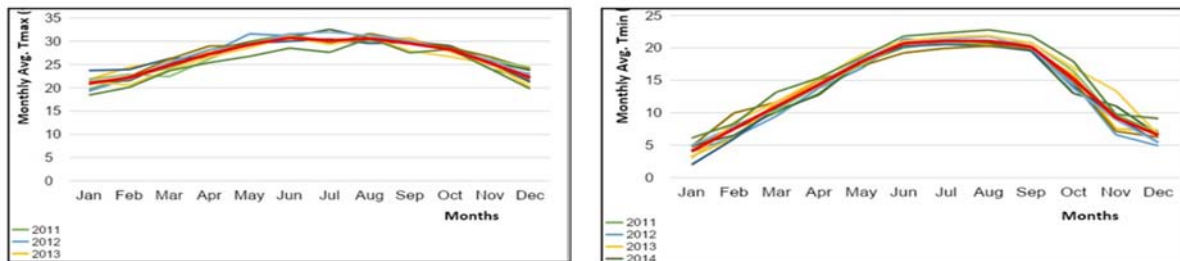
<sup>9</sup> NCHM 2018 National Center for Hydrology and Meteorology <https://www.nchm.gov.bt/>

Figure 20: Monthly total rainfall in Wangdue Phodrang 2011 – 2020. (Source: NCHM, 2022)



174. **Temperature.** Temperature data from the Wangdue Phodrang meteorological station indicates significant seasonal variation. The hottest months are typically June, July, and August, with average maximum temperatures reaching approximately 30.8°C. Conversely, the coldest months are December and January, with average minimum temperatures dropping to around 4.1°C and daily minimums occasionally falling below freezing.

Figure 21: Monthly average maximum and minimum temperature in Wangdue Phodrang (Source: NCHM, 2022).



175. **Wind Speed and Direction.** To understand the potential for air pollutant dispersion within the project area, baseline meteorological data was collected at the Tonglobji monitoring station. The findings, presented in the Wind Class Frequency Distribution chart and the Wind Rose Plot, reveal a low-energy atmospheric environment with very specific characteristics.

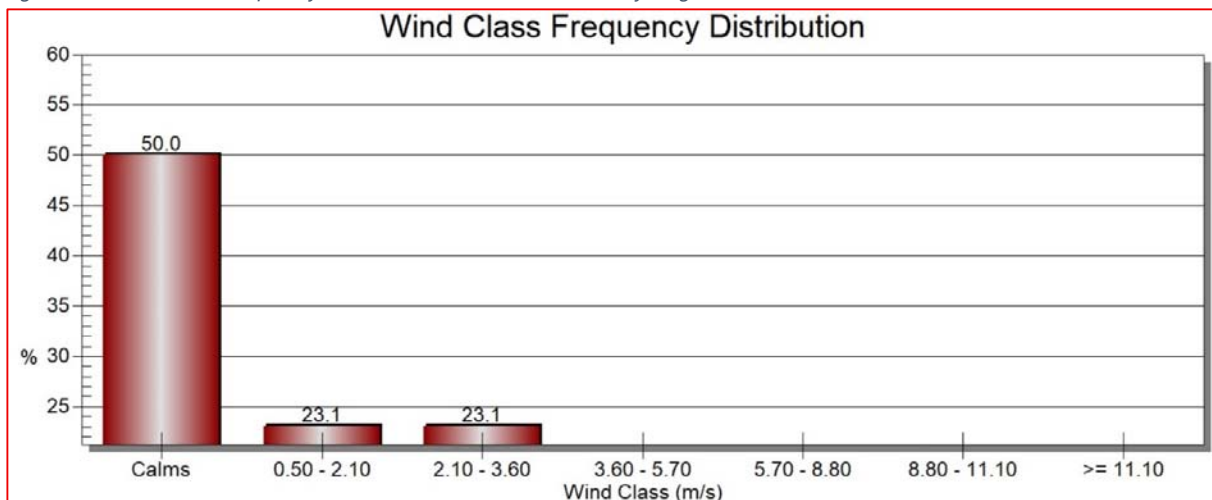
- **Predominantly Calm Conditions:** The most significant finding is that the area experiences calm conditions (wind speeds below 0.5 m/s) for 50% of the time. This indicates that for half of the monitoring period, the air is largely stagnant with very little movement.
- **Low Wind Speeds:** During the remaining 50% of the time when wind is present, it is of low velocity. Wind speeds in the range of 0.5 m/s to 3.6 m/s (light to gentle breeze) account for nearly all non-calm periods (a combined 46.2%). Wind speeds exceeding 3.6 m/s are negligible.
- **Dominant Wind Direction:** The wind rose plot clearly shows that when the wind does blow, it is overwhelmingly from the south, blowing towards the north and north-northeast.

176. **Connection and Implications for Air Quality.** These meteorological conditions have direct and significant implications for how air pollutants will behave during the construction phase.

- **Poor Pollutant Dispersion:** The high frequency of calm conditions is the most critical factor. Stagnant air leads to very poor dispersion, meaning that any pollutants released—such as dust from excavation or exhaust fumes (NO<sub>x</sub>, SO<sub>x</sub>, CO) from machinery—will not be readily diluted or carried away. Instead, they will tend to linger and accumulate near their source, potentially leading to higher localized concentrations and increased exposure for workers and nearby sensitive receptors.
- **Explanation for Elevated Baseline NO<sub>2</sub>:** This finding provides a strong scientific explanation for the elevated baseline Nitrogen Dioxide (NO<sub>2</sub>) levels recorded in the area. The frequent calm conditions likely trap emissions from existing local sources (e.g., vehicles), preventing their dispersal and causing them to accumulate, resulting in a higher measured concentration than would be expected in such a remote area.
- **Defined Pollutant Pathway:** During non-calm periods, the consistent southerly wind creates a predictable pathway for pollutant transport. Any sensitive receptors—including sections of the Biological Corridor, community areas, or worker sites—located to the north of active construction zones will be directly downwind and therefore at the highest risk of being impacted by airborne dust and emissions.

177. The baseline meteorological data confirms that the project site has a very low capacity for atmospheric dispersion. This elevates the risk of air quality degradation during construction. Therefore, the implementation of stringent, proactive, and consistent on-site mitigation measures for dust suppression and emission control is not merely a recommendation but an essential requirement to prevent the accumulation of pollutants and protect the sensitive environment of the Biological Corridor and the health of all nearby receptors.

Figure 22: Wind Class Frequency Distribution (Source: Field Survey August 2025)



### Baseline Air Quality.

178. While the establishment of a full environmental baseline is typically the responsibility of the appointed contractor prior to the commencement of civil works, the sensitive nature of the project area, particularly its proximity to a Biological Corridor, necessitated a proactive approach. To establish pre-project conditions in this pristine environment, the Project Management Supervision Consultant (PMSC) requested ENGEO Consultancy to conduct an advance baseline survey. ENGEO Consultancy

generously consented and carried out the ambient air, noise, and surface water quality monitoring on August 17–18, 2025, at no cost to the project.

179. This early monitoring was conducted at Tonglobji (near Hetshokha), a location selected as being representative of the sensitive environment within the Biological Corridor. The 24-hour ambient air quality monitoring results are summarized in Table 15 and compared against Bhutan's National Environment Commission Environmental Standards (NEC ES 2020) and the more stringent World Health Organization Air Quality Guidelines (WHO AQG, 2021).

Table 15: Baseline 24-Hour Ambient Air Quality Results at Tonglobji, Hetshokha within the Biological Corridor (Source: Field Survey August 2025)

Parameters	Results	NEC ES 2020 (for Mixed Area)	WHO AQG, 2021
TSP (ug/m3)	8.24 (24 hr)	200 (24 hr)	NA
PM10 (ug/m3)	7.42 (24 hr)	100 (24 hr)	45 (24 hr)
PM2.5 (ug/m3)	5.83 (24 hr)	60 (24 hr)	15 (24 hr)
O3 (ug/m3)	7.27 (8 hr)	100 (8 hr)	100 (8 hr)
CO (mg/m3)	0.00 (24 hr)	2000 (24 hr)	4 (24 hr)
SO2 (ug/m3)	0.00 (24 hr)	80 (24 hr)	40 (24 hr)
NO2 (ug/m3)	56.53 (24 hr)	80 (24 hr)	25 (24 hr)

### Analysis of Baseline Findings and Required Validation

180. The baseline data indicates that the ambient air quality in the project area is largely characteristic of a remote, rural environment. The measured concentrations of Total Suspended Particulates (TSP), Particulate Matter (PM<sub>10</sub> and PM<sub>2.5</sub>), Ozone (O<sub>3</sub>), Carbon Monoxide (CO), and Sulphur Dioxide (SO<sub>2</sub>) are all well below both the national standards and the stringent WHO guidelines, confirming the generally pristine nature of the airshed.

181. However, a notable finding is the measured 24-hour average concentration for Nitrogen Dioxide (NO<sub>2</sub>), which was 56.53 µg/m<sup>3</sup>. While compliant with the national standard (80 µg/m<sup>3</sup>), this value is more than double the WHO's health-based guideline of 25 µg/m<sup>3</sup>.

182. This unexpectedly high NO<sub>2</sub> reading, in an area with no significant local emission sources, requires careful consideration. Without a more detailed analytical study, it is not appropriate to draw a firm conclusion. The reading may be attributed to a possible error in sampling. Alternatively, it could be a valid reading influenced by a combination of regional pollutant transport and local topographical effects that trap air in the valley.

183. To resolve this uncertainty and establish a definitive baseline, the project commits to the following actions:

- Validation Monitoring: The contractor will be required to conduct a comprehensive pre-construction baseline survey to validate the air quality readings, with a specific focus on NO<sub>2</sub>. This validation monitoring will be a mandatory prerequisite before the commencement of major civil works and is designed to ensure the correctness of the data.

- Local Corroboration: The validation process will be supported by consultations with local communities and relevant public health agencies to determine if there is any anecdotal or recorded evidence of air quality issues (e.g., haze, respiratory complaints) in the area.
- Update of Safeguard Documents: The results of this validation monitoring will be used to update this IEE and the corresponding Environmental Management Plan (EMP) to reflect the confirmed baseline conditions. This ensures that all mitigation measures are based on accurate and verified data.

184. Noise Environment. To establish the pre-project acoustic environment, 24-hour baseline noise monitoring was conducted at Tonglobji, a location representative of the quiet, rural setting of the project area and the sensitive Biological Corridor. The results, presented as the equivalent continuous sound level (Leq), are summarized in Table 15 and compared against Bhutan's National Environment Commission Environmental Standards (NEC ES 2020) for a "Mixed Area" and the World Health Organization (WHO) Environmental Noise Guidelines.

Table 16: Baseline Noise Monitoring Result at Tonglobji (Source: Field Survey August 2025)

Site ID	Location Name	Daytime Leq (06:00–22:00)	Night-time Leq (22:00–06:00)
I	Tonglobji	48.33 dBA	46.14 dBA
	NEC ES 2020 Limit (Mixed Area)	65 dBA	55 dBA
	WHO Guideline (Residential)	< 53 dBA (Lden)	< 45 dBA (Lnight)

**(i) Assessment of Baseline Conditions:**

185. The data confirms that the project area is a very quiet environment. The measured daytime (48.33 dBA) and night-time (46.14 dBA) noise levels are well below the permissible limits set by Bhutan's NEC ES 2020.

186. However, when compared to the stricter, health-based WHO guidelines, a key finding emerges. The night-time noise level of 46.14 dBA is slightly above the WHO's strong recommendation of < 45 dBA for preventing adverse health effects, primarily sleep disturbance. This indicates that the existing acoustic environment, while very quiet, has no additional capacity to absorb night-time noise without potentially impacting human health and causing significant disturbance to nocturnal wildlife. The low baseline means any noise introduced by the project will be highly perceptible and intrusive.

187. **Hydrology.** There are five main river basins in Bhutan: Amochu, Wangchhu, Punatsangchhu, Mangdechhu, and the Drangmechhu. The project site falls under the Punatsangchhu basin that is fed by 466 glaciers. The river forms the border between Gasetshog Wom and Ruebesa Gewog. Currently, construction of the 1,200 MW Punatsangchhu phase I, the 1,020 MW Punatsangchhu phase II.

188. Within the District, the Punatsangchhu is joined below the Dzong by the Dangchu, and this continues to flow to India. This basin contributes the highest average net monthly outflow (27%).

189. The project site is located at an elevation of more than 720m meters above the Punatsangchhu river.

Figure 23: Hydrological basins in Bhutan (Source: NLC & NCHM)

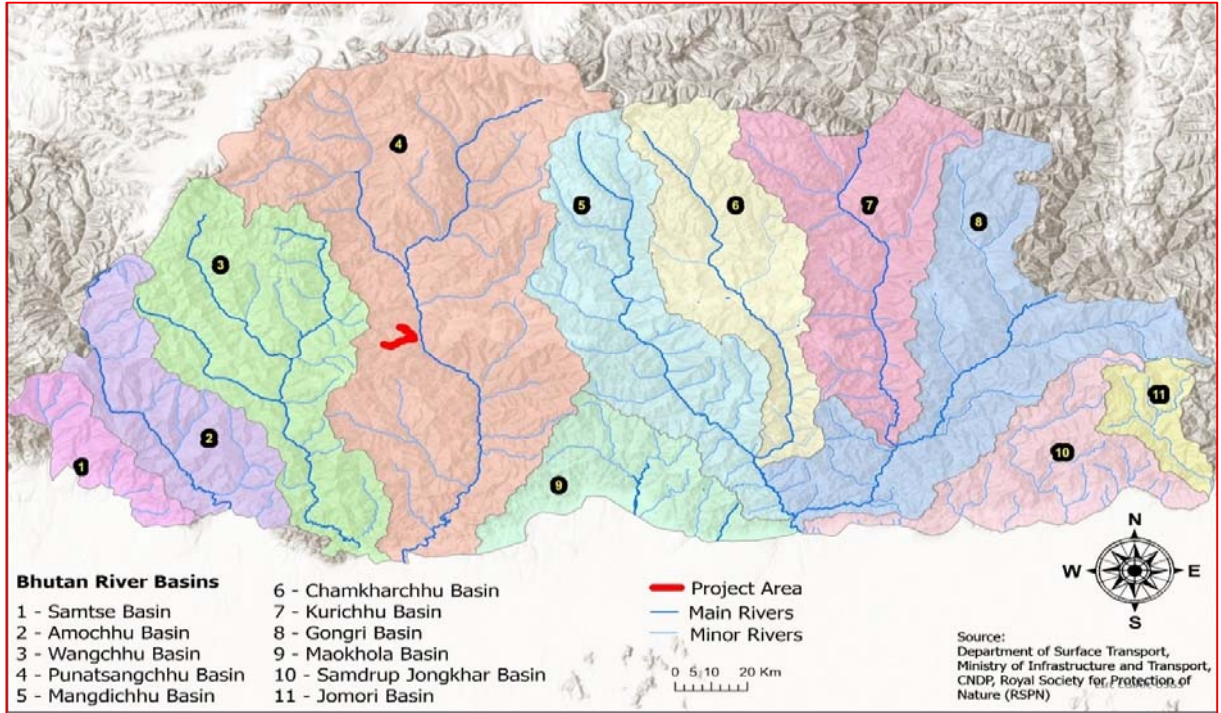


Figure 24: Streams and Rivers in the project site (Draft IEE Report, Oct 2022, Hetshotsangchhu Integrated Drinking Water and Irrigation Supply Scheme Subproject)

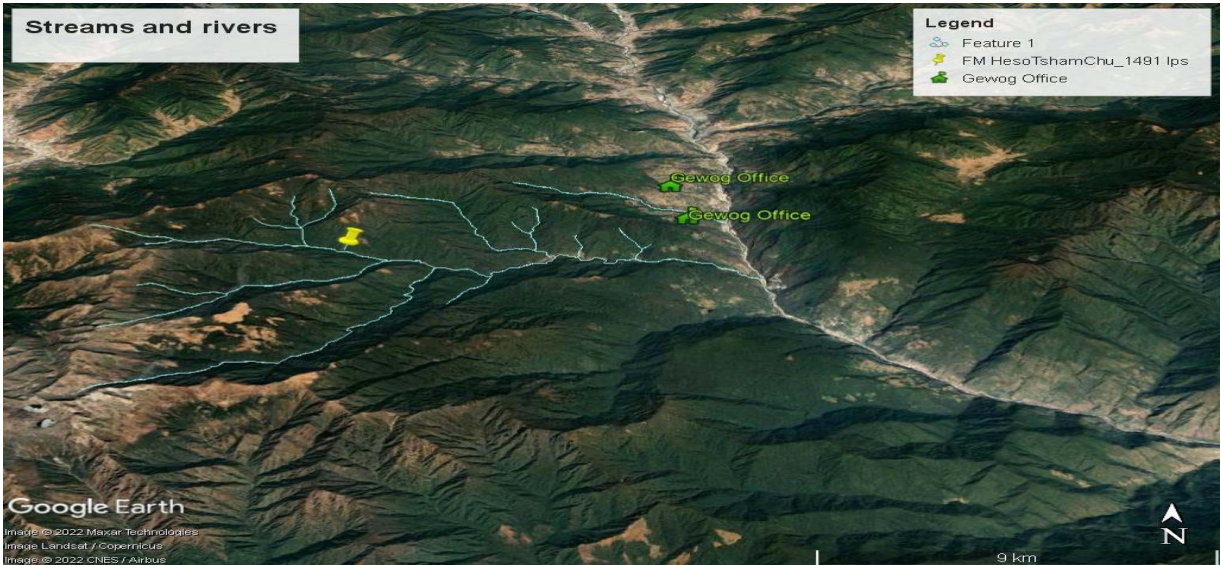


Table 17: Water Availability at the Intake (Source: Summary Report on the Description of the Proposed Hetshotsangchhu Integrated Drinking Water and Irrigation Scheme (Appendix 15))

Month	Rainfall, mm	Flow, m <sup>3</sup> /s	Flow, Ips
Jan	8.4	0.791	791
Feb	9.7	0.674	674
Mar	16.7	0.595	595
Apr	42.6	0.581	581
May	62.8	0.743	743
Jun	106.6	1.388	1,388
Jul	144.1	4.708	4,708

<b>Aug</b>	136.1	5.537	<b>5,537</b>
<b>Sep</b>	92.0	3.593	<b>3,593</b>
<b>Oct</b>	45.7	1.470	<b>1,470</b>
<b>Nov</b>	6.8	0.190	<b>190</b>
<b>Dec</b>	3.6	0.117	<b>117</b>
<b>Total</b>	675		
<b>Mean</b>	56	1.699	<b>1,699</b>
<b>Max</b>	144.1	5.537	<b>5,537</b>
<b>Min</b>	<b>3.6</b>	<b>0.117</b>	<b>117</b>

### Surface Water Quality.

190. As part of a proactive environmental assessment, baseline surface water quality monitoring of the Hetshotsangchhu was conducted on August 17–18, 2025, to establish reference conditions for the proposed intake site. ENGEO Consultancy, at the request of the PMSC Environmental Specialist, generously performed the sampling and analysis free of charge. Samples collected upstream and downstream of the intake location were assessed against Bhutan’s 2016 Drinking Water Quality Standards (NDWQS), revealing pristine conditions typical of a high-altitude forested catchment—characterized by soft water with zero hardness, high dissolved oxygen, low BOD, neutral pH, and no detectable E. coli or fecal coliform. Iron levels were measured at 0.28 mg/L upstream and 0.25 mg/L downstream, both well below NDWQS thresholds, negating the need for iron-specific treatment. Consistent chemical and physical results across both sites confirmed the absence of localized pollution and validated the stream’s suitability as a public water source. Accordingly, the proposed two-stage treatment—sedimentation at the intake followed by chlorination—is considered sufficient to meet national standards. Nevertheless, the Environmental Management Plan (EMP) requires the contractor to carry out independent water quality testing through an accredited third-party laboratory at multiple stages - before construction begins, during construction, prior to commissioning, and throughout operational phases - to ensure sustained compliance with national standards and to protect public health, underscoring the critical role of continuous monitoring.

## C. Climate Change Context and Implications

191. The planning, design, and long-term sustainability of the Hetshotsangchhu Integrated Water Supply Scheme must be contextualized within the broader impacts of climate change. The "Bhutan State of the Climate 2020" report by the National Center for Hydrology and Meteorology (NCHM) confirms that Bhutan is experiencing climatic shifts consistent with global trends. These shifts, combined with recent local events, highlight the direct and immediate implications for water resources in the project area of Gasetsho Gom and Gasetsho Wom Gewogs.

### 1. National and Regional Climate Trends

192. The NCHM report highlights several key trends relevant to the Wangdue Phodrang Dzongkhag:

- **Rising Temperatures:** Globally, 2020 was one of the three warmest years on record, and Bhutan's climate reflects this warming trend. The project area in Wangdue Phodrang is

located in one of the nation's warmer agro-ecological zones. Data from nearby meteorological stations in 2020 underscores this:

- The Punakha station recorded an annual average maximum temperature of 28.3°C, with 167 days where the maximum temperature exceeded 30°C.
  - The Bajo station recorded an annual average maximum of 25.1°C.
  - The spatial temperature maps (Figure 6 in the report) clearly show the Punakha-Wangdue valley system as a zone with higher annual average maximum temperatures compared to other parts of the country.
- **Variable and Intense Rainfall:** While the country as a whole received near-normal rainfall in 2020, the defining characteristic of climate change is increased variability and intensity. Bhutan's heavy reliance on the summer monsoon (June to September) for its annual rainfall makes it particularly vulnerable to shifts in monsoon patterns. The NCHM foreword identifies "erratic rainfall," "flash floods," and "drought" as significant national hazards. This means the region can expect more extreme weather events, including intense downpours that cause flooding and erosion, as well as prolonged dry spells that strain water sources.

## 2. Implications for the Hetshotsangchhu Water Supply Scheme

193. These climatic trends, validated by recent local experience, present direct challenges and risks to the water supply scheme and amplify the existing water scarcity issues in the region.

- **Increased Water Stress and Demand:** Higher average temperatures will increase evaporation from the Hetshotsangchhu source and lead to greater water demand for domestic use, sanitation, and agriculture, placing significant strain on the system.
- **Source Water Vulnerability and Extreme Weather:** The reliability of the Hetshotsangchhu as a water source is highly susceptible to climate change impacts. The theoretical risks of erratic and intense rainfall were starkly demonstrated by a recent local event.
  - **Recent Flash Flood Event:** According to villagers from Hetshokha, the Hetshotsangchhu experienced a severe flash flood in November 2024. This unseasonal event, occurring well after the typical monsoon period, underscores the increasing unpredictability of the local climate. The flood was reportedly powerful enough to cause a massive fish kill, indicating a sudden and extreme influx of sediment, debris, and runoff into the river.
  - **Impact on Water Quality:** An event like the November 2024 flood would introduce extreme turbidity (sediment load) into the water source. This can overwhelm the project's water treatment and filtration systems, leading to service disruptions, increased operational and maintenance costs, and potential damage to equipment.
- **Risk to Infrastructure:** Extreme weather events pose a direct physical threat to the scheme's infrastructure. The aforementioned flash flood serves as a practical warning. Such events can trigger localized landslides and generate debris flows capable of damaging or destroying the intake structure, pumping stations, and the water transmission pipeline, leading to costly repairs and prolonged service outages for the communities.

## Conclusion

194. The evidence from the NCHM's climate report, powerfully reinforced by the community-reported flash flood in the Hetshotsangchhu in November 2024, confirms that climate change impacts are not a future possibility but a current reality for the project area. The design of the Hetshotsangchhu Integrated Water Supply Scheme must therefore incorporate climate resilience as a core principle. This includes ensuring the intake and pipelines are robustly designed and protected from extreme weather events, accounting for both low-flow periods and sudden, high-sediment flood events, and promoting efficient water use within the community. Addressing these documented, climate-related risks is essential for the long-term success and sustainability of the project and the well-being of the communities in Gasetsho Gom and Gasetsho Wom.

*Figure 25: Site reconnaissance (August 2025) at a Proposed intake location for Hetshotsangchhu IWS Project. The image captures conditions along Hetshotsangchhu riverbed, where large boulders and uprooted logs – deposited during the November 2024 flash flood – indicate high-energy flow and sediment transport.*



## D. Ecological Environment

195. **Forests.** According to the National Forest Inventory (2023), 69.71% of Bhutan's land area (2,676,545 ha) is covered by forest<sup>16</sup>. Wangdue Phodrang district has the largest forest area of any district (258,969 ha), which constitutes 65.14% of its total area. The primary forest types in the district range from Fir Forest at the higher altitudes, to Mixed Conifer, Blue pine, Chirpine and Broadleaf forests.

196. The primary forest types in Wangdue Phodrang are Broadleaf Forest, Chirpine, Mixed Conifer and Fir Forests. Within the project area, the two project gewogs because of the size of the gewogs, the area under cultivation and the altitudes, Gasetsho Gom has only 67% forest cover, while Gasetsho Wom, which has less arable land, has 90.6% forest cover. Both gewogs are dominated by Broadleaf Forest, but Gasetsho Gom has extensive Chirpine forests (18.7%) while Gasetsho Wom has more Mixed Conifers (27%) and Fir Forest.

Table 18: Forest types in the district and its gewogs<sup>10</sup> (Source: LULC 2020, NLC).

	Area (Ha)	Area (%)	Area (Ha)	Area (%)	Area (Ha)	Area (%)
	Wangdue	Wangdue	G 1	G1	G2	G2
<b>Forests</b>	264059.57	66.07%	1925.29	67.02%	18610.24	<b>90.26%</b>
<b>Bluepine</b>	3425.30	0.86%				
<b>Broadleaf</b>	109145.78	27.31%	1354.75	47.16%	10111.48	<b>49.04%</b>
<b>Chirpine</b>	28085.92	7.03%	537.85	18.72%	339.36	<b>1.65%</b>
<b>Fir</b>	28508.62	7.13%			2592.20	<b>12.57%</b>
<b>Mixed conifer</b>	94893.94	23.74%	32.69	1.14%	5567.21	<b>27.00%</b>
<b>shrubs</b>			<b>124.90</b>	<b>4.35%</b>	<b>877.91</b>	<b>4.26%</b>

197. The forest is very rich due to its altitudinal range with a dense cover of vegetation, including evergreen and deciduous trees, and a rich under-story of shrubs, herbs and grasses, plus fungi, epiphytes, ferns, etc. During the site visits, a total of 139 species of flora was recorded (20 trees, 44 shrubs, 11 orchids and 47 herbs, 13 climbers and 4 ferns as well as a few varieties of mushrooms). See Appendix 3 for the tabulation of these species. The common trees are oak (*Quercus griffithii*, *Quercus glauca*), beech (*Castanopsis hystrix*), *Acer oblongum*, *Acer Sterculiaceum*, *Betula alnoides*, *Juglans regia*, *Michelia velutina* and *Prunus nepalensis*. Almost 25 species of shrubs were recorded in the area. The common ones include *Ardisia macrocarpa*, *Brassaiopsis mitis*, *Ilex crenata*, *Mahonia nepalensis*, *Viburnum cylindricum*, *Viburnum foetidum*, *Berberis aristata* and *Elaeagnus parvifolia*. The ground cover comprises of over 35 species of herbs, with the more common ones being *Elatostema acuminata*, *Galium elegans*, *Girardinia diversifolia*, *Impatiens spp*, *Pilea scripta*, *Pouzolzia hirta* or *Rubia manjith* among others. There are also ferns, climbers and even orchids such as *Calanthe spp*, *Eria graminifolia*, *Otochilus fuscus* and *Phalaenopsis manni*.

<sup>10</sup> LULC 2016. FRMD, 2016. Land Use and Land Cover of Bhutan 2016. Forest Resource Management Division, Department of Forest & Park Services, Ministry of Energy and Natural Resources, Thimphu, Bhutan

Figure 26: Land Use Land Cover Map of Gasetsho-Gom and Gasetsho-Wom Gewogs (LULC 2020, NLC).

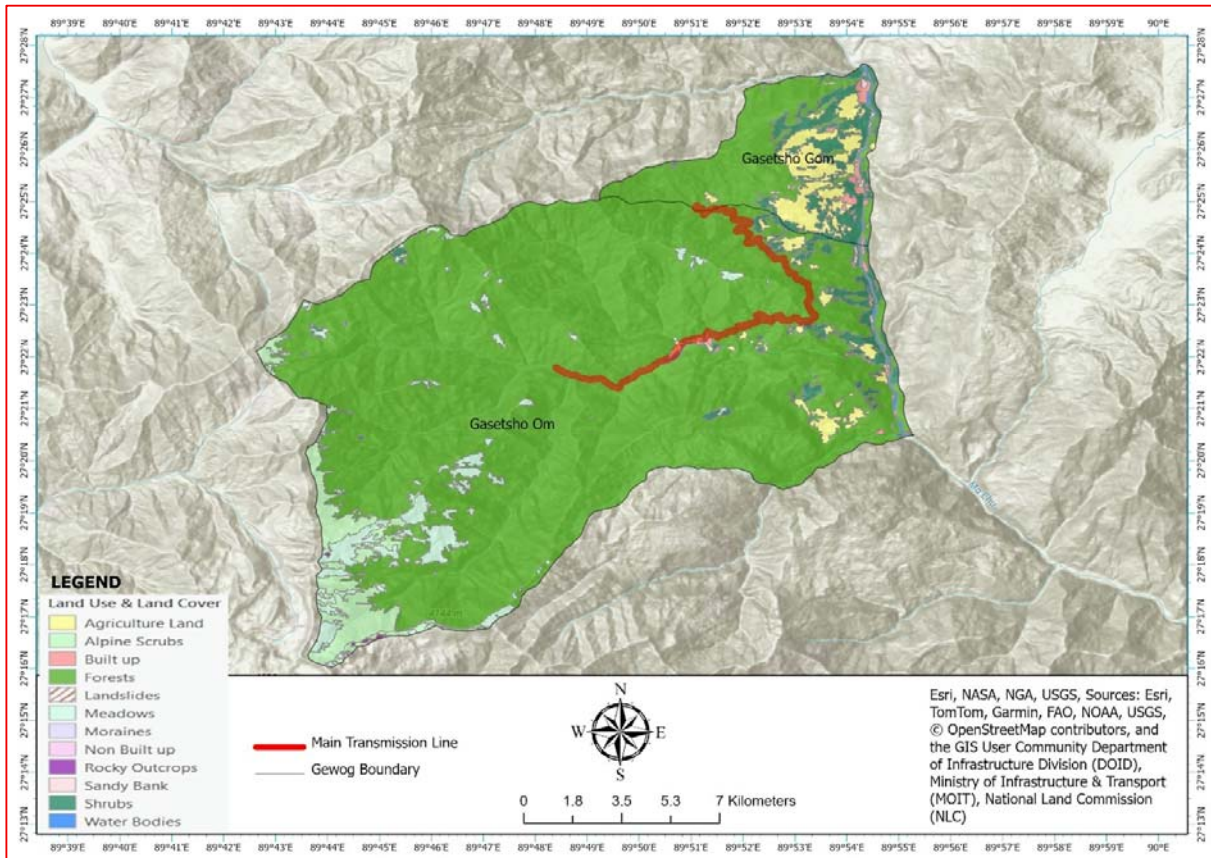


Figure 27: Forest type within the Project Area (Source: Field verification survey August 2025)



198. Towards the intake site, the common tree species include *Acer sikkimensis*, *Betula alnoides*, *Bucklandia populnea*, *Carpinus spp*, *Castanopsis hystrix*, *Cinnamomum glanduliferum*, *Cinnamomum impressinerrium*, *Fraxinus floribunda*, *Gamblea ciliata*, *Ilex depriyana*, *Juglans regia*, *Michelia velutina*, *Quercus glauca*, *Quercus lamellosa* and *Quercus oxyodon*. The middle canopy comprises mostly of *Ardisia macrocarpa*, *Berberis aristata*, *Brassaiopsis mitis*, *Colquhounia coccinea*, *Daphniphyllum chartaceus*, *Daphne bholua*, *Elsholtzia spp.*, *Eurya acuminata*, *Gaultheria*, *Ilex*, *Myrica esculenta*, *Rhododendron*, *Smilax*, *Viburnum*, *Symplocos species*. The ground cover includes species such as *Tupistra nutans*, *Thalictrum spp.*, *Swertia chirata*, *Rubus spp.* *Rubia manjith*, *Piper spp.*, *Girardiana diversifolia*, *Elatostema acuminata*, *Hedychium spp.*, *Leucas ciliata*, *Duhalde cappa*, *Cyanotis vaga*, *Ophiopogon intermedius*, *Pilea scripta*, *Piper spp.*, *Artemisia*, *Arisaema flavum*, *Anaphalis adnata*, *Boehmeria*, *Begonia spp.*, *Jasminium dispernum*, *Aconogonum molle*, *Aconitum ferox*, *Hedera nepalensis* and many more. There are also ferns (*Diplazium esculentum*, *Pyrrosia spp*, *Drynaria spp*, *Polystricum spp*), Climbers (*Cissus elongata*, *Dioscorea alata*, *Ficus hederacea*, *Hedera nepalensis*, *Heterosmilax japonica* etc) and Orchids (*Bulbophyllum spp.*, *Calanthe spp*, *Coelogyne corymbosa*, *Epigenium spp*, *Eria graminifolia*, *Otochilus fuscus* and *Vandopsis undulata*).

Figure 28: Forest along the Main Transmission Line towards the Intake Site (Draft IEE Report, Oct 2022, Hesotsamchhu Integrated Drinking Water and Irrigation Scheme Subproject).



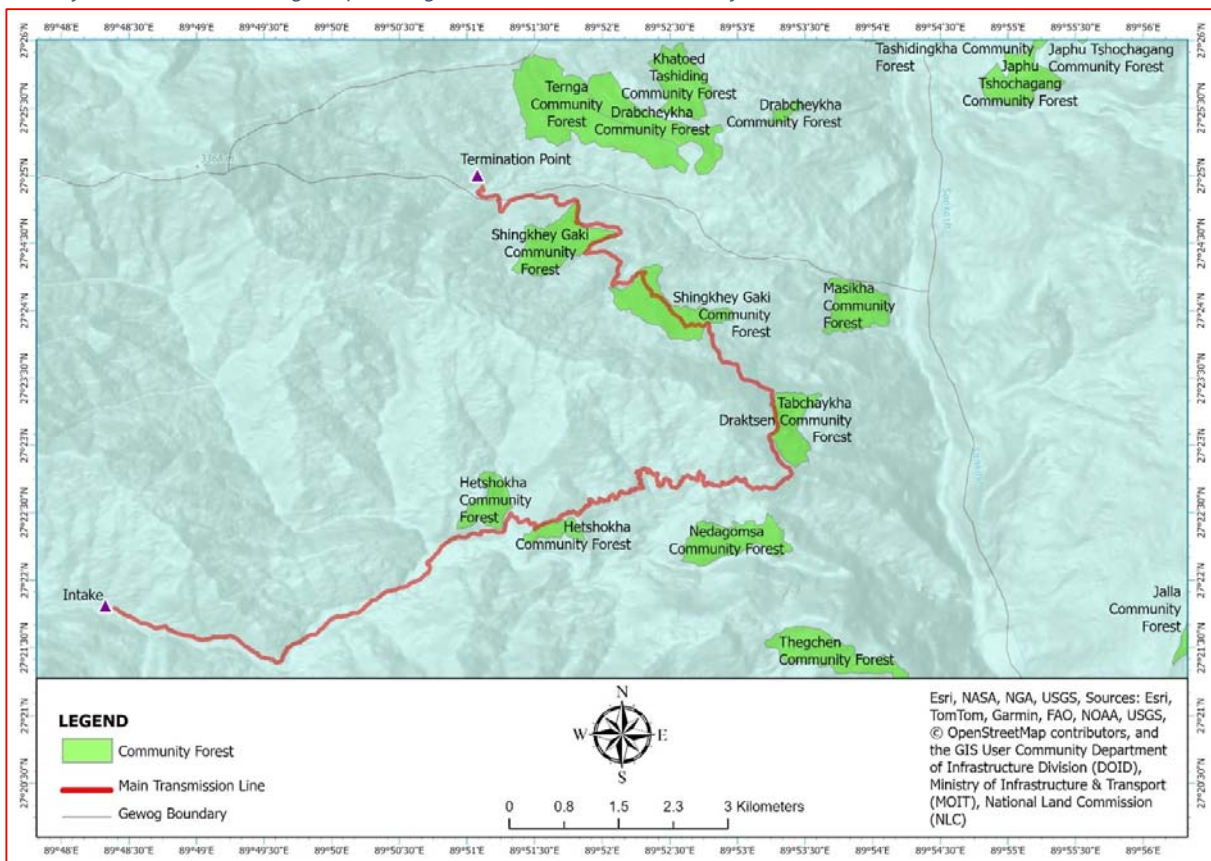
199. **Community Forests.** The proposed alignment of the main water transmission line, as illustrated in the map above, directly interfaces with several gazetted Community Forests (CFs). Community Forests in Bhutan are state-owned forest areas managed by local communities under a formal agreement with the government, providing them with rights to use and manage forest resources sustainably. The pipeline route begins at the intake and extends to the termination point, traversing a significant portion of this community-managed landscape.

200. Based on the final transmission alignment map, the pipeline alignment will:

- **Directly Traverse:** Pass through the designated boundaries of at least three Community Forests:
  - Hetshokha Community Forest
  - Shingkhey Gaki Community Forest
  - Tabchaykha Draktsen Community Forest
- **Pass in Close Proximity:** Run adjacent to or near several other CFs, including Nedagomsa Community Forest and Masikha Community Forest.

201. This direct interaction necessitates a careful assessment of potential impacts and the implementation of robust mitigation measures, developed in close consultation with the respective Community Forest Management Groups (CFMGs).

Figure 29: Community Forests along the Main Transmission line of Hetshotsangchhu Integrated Water Supply Scheme, (Source: Final Hydraulic Structure Design Report, August 2025 & DoFPS, Field Survey October 2025).



202. **Invasive Alien Species (IAS) within the Project Area.** A survey of the flora within and adjacent to the project area identified the presence of two globally recognized Invasive Alien Species (IAS): *Ageratina adenophora* (Mexican Devil/Crofton Weed) and *Solanum viarum* (Tropical Soda Apple). The presence of these species poses a significant environmental risk to the local ecosystem and requires a dedicated management strategy to prevent their proliferation as a direct result of project activities.

### I. Species-Specific Findings

#### a) *Ageratina adenophora* (Mexican Devil)

- **Location and Abundance:** *Ageratina adenophora* was observed growing in abundance along the roadside beyond Hetshokha village. Its presence in dense stands indicates that it is well-established in the wider area, using the disturbed roadside as a primary corridor for colonization.
- **Threat Profile:** This species is a highly aggressive invader. It spreads rapidly via vast quantities of wind-dispersed seeds, allowing it to easily colonize disturbed and bare soil. It forms dense, monotypic thickets that actively outcompete and displace native ground cover and understory vegetation. Furthermore, it is known to be toxic to livestock, particularly horses, and its presence degrades the quality of grazing land and forest ecosystems.

#### b) *Solanum viarum* (Tropical Soda Apple)

- **Location and Abundance:** A single specimen of *Solanum viarum* was identified in close proximity to the proposed intake area of the Hetshotsangchhu.
- **Threat Profile:** Despite the presence of only one plant, this finding is of high concern. *Solanum viarum* is an extremely noxious weed, notorious for forming impenetrable, thorny thickets that displace all native flora and render areas inaccessible to wildlife and humans. A single plant can produce tens of thousands of seeds in a year. Its fruit is readily consumed by wildlife and livestock, which then spread the seeds over long distances. The discovery of this plant near the intake represents a critical opportunity for Early Detection and Rapid Response (EDRR) to prevent the establishment of a new, highly damaging infestation.

### II. Implications for the Hetshotsangchhu Water Supply Scheme

203. The construction and operation of the water supply scheme can inadvertently exacerbate the spread of these invasive species.

- **Risk of Proliferation from Soil Disturbance:** Project activities, including clearing vegetation for the pipeline alignment, establishing access tracks, and constructing the intake, will create significant soil disturbance. These areas of bare earth are ideal seedbeds for opportunistic invaders like *A. adenophora* and *S. viarum*.
- **Vectors of Spread:** Construction vehicles and machinery moving from the main road (infested with *A. adenophora*) to the more remote intake site can easily transport seeds and plant fragments in soil attached to tires and undercarriages. This is a primary pathway for introducing IAS into previously un-infested areas.

- **Long-Term Management Burden:** If not managed proactively, these invasive species will colonize the project footprint, leading to increased long-term maintenance costs, degradation of the surrounding habitat, and potential interference with project infrastructure.

Figure 30: *Solanum viarum* (left) and *Ageratina adenophora* (right) – Invasive species recorded in the Project Area (Source: Field Survey, August 2025).



### III. Recommendations for Management and Mitigation

204. A proactive Invasive Species Management Plan must be integrated into the project's Environmental Management Plan (EMP). The following measures are recommended:

- **Immediate Eradication of *Solanum viarum*:** The single Tropical Soda Apple plant must be carefully uprooted immediately, before it has a chance to fruit. The entire plant, including its root system, should be bagged on-site and disposed of safely (e.g., through controlled burning), not composted, to prevent any possibility of regrowth or seed dispersal. The immediate area should be monitored for any new seedlings.
- **Prevention of Spread (Vector Control):** Implement a strict "Clean-in, Clean-out" protocol. All vehicles and heavy machinery must be thoroughly washed down at a designated location to remove soil and seeds before entering the project site, especially the area around the intake.
- **Containment of *Ageratina adenophora*:** While full eradication along the road may be beyond the project's scope, a control program should be implemented along the project's access tracks and around the construction footprint to create a buffer zone and reduce the seed source.
- **Worker Awareness:** All project personnel and contractors should be trained to identify these two invasive species to prevent accidental transport and to report any new sightings.
- **Post-Construction Revegetation:** Following construction, all disturbed areas must be promptly revegetated with fast-growing, native grass and plant species to provide ground cover and outcompete any potential invasive seedlings. Leaving soil bare should be strictly avoided.
- **Long-Term Monitoring:** The project area, particularly the pipeline right-of-way and intake site, should be monitored for at least three years post-construction to detect and manage any new invasive species outbreaks.

205. **Protected Areas.** Bhutan is one of the top 10% of countries with the highest species density in the world (number of species per unit area). It has the highest proportion of forest cover and protected areas in Asia<sup>11</sup>. Bhutan consists of 3 major eco-floristic zones and 9 forest types, that provides home to 5,603 species of vascular plants, over 200 mammals, 678 birds, 23 reptiles and amphibians, and 50 fish species<sup>12</sup>. The rich biodiversity is due to the remote nature, geographical relief and climatic heterogeneity of the country, and its location between temperate Eurasia in the north and the tropical Indian subcontinent in the south.

206. Bhutan has 10 protected areas covering more than half of the total area of the country, these parks are connected by biological corridors which provide free mobility to wild animals (Figure 32). The biological corridors are also given special protection under the Forest and Nature Conservation Act (1995).

207. The northern half of the district (the gewogs of Kazhi, Dangchu and Sephu) falls within Wangchuck Centennial Park, the northwestern part of Kazi gewog falls within Jigme Dorji National Park, and the gewogs of Athang and Phobji are part of the Jigme Singye Wangchuck National Park. The subproject area is next to the Biological Corridor #2, which connects the Jigme Dorji National Park to the Jigme Singye Wangchuck National Park. Biological Corridor (BC) # 2 has 2769.32 hectares (60 km length by 4 km minimum width). More than 90% of the BC 2 falls under the jurisdiction of Wangdue Territorial Division<sup>13</sup>.

208. The intake point and a length of about 5 kilometers of the raw water transmission pipeline falls in the biological corridor. Figure 27 shows the protected areas around the subproject area (intake and raw water transmission pipeline alignment), and the biological corridor. The nearest protected area (Jigme Dorji National Part) is already at about 50km from the subproject location.

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<sup>11</sup> MOA (2002): Biodiversity Action Plan for Bhutan, Ministry of Agriculture and Forests, RGOB

<sup>12</sup> MoAF (2015): Conservation Management Plan of Jigme Dorji National Park

<sup>13</sup> Bhutan for Life 2020. Environmental and Social Management Plan for Biological Corridor 2 (2020)  
<https://www.bfl.org.bt/>

Figure 31: Protected Area System and Wildlife Corridors in Bhutan (Source: RSPN, NLC & DoFPS)

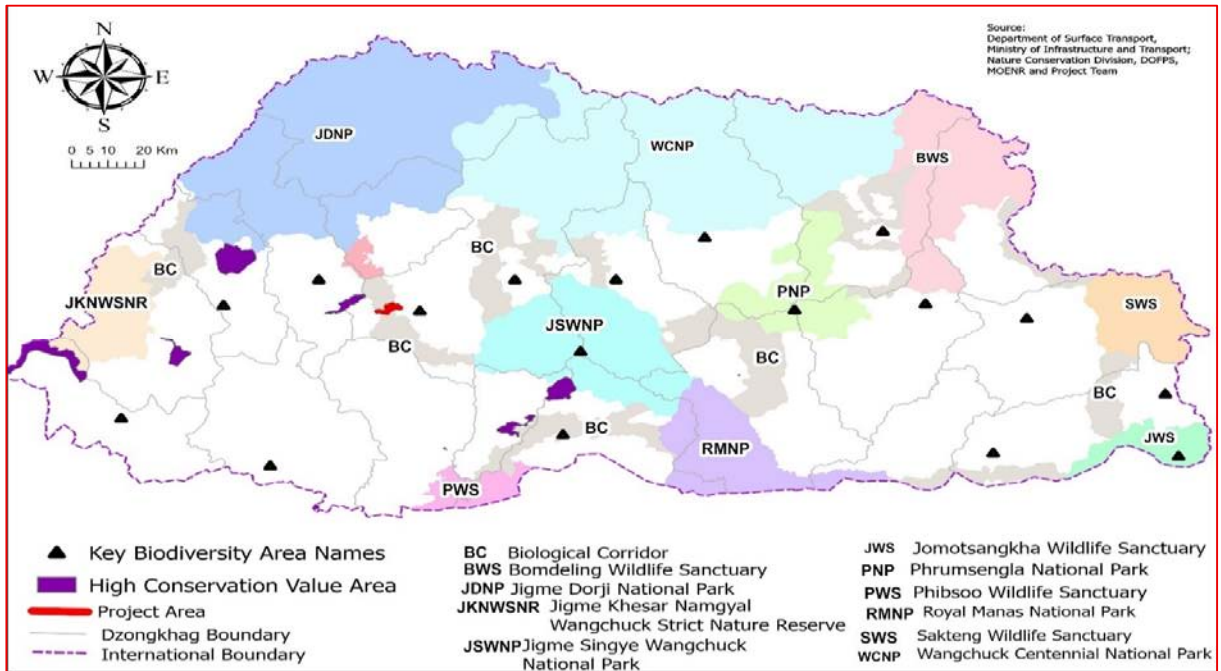
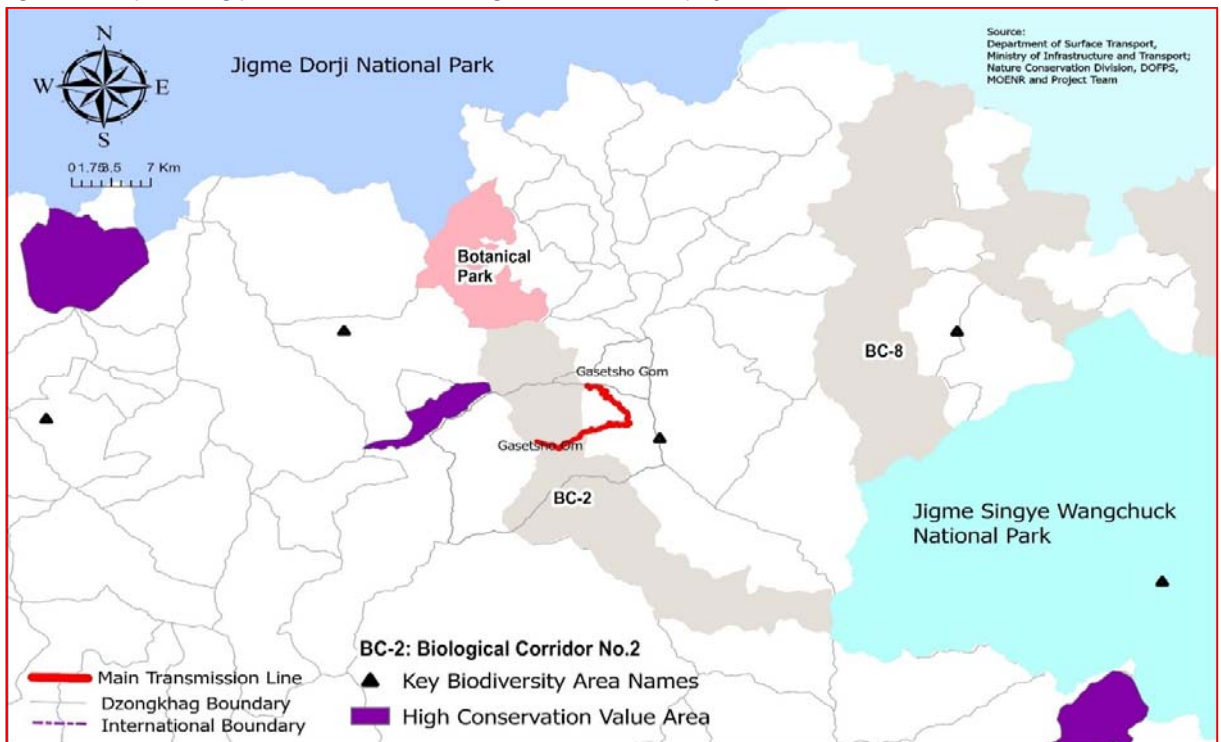


Figure 32: Map showing protected areas, and biological corridor in subproject area (Source: RSPN, NLC & DoFPS)



209. **Rare or Endangered Species and Critical Habitat.** The Integrated Biodiversity Assessment Tool (IBAT) was used to screen and assess potential risks on critical habitat that may exist around the subproject site (default area of analysis of 50 km radius). Initial screening results show there are 9 protected areas and 8 key biodiversity areas within this 50-km radius and likely to be a critical habitat due to the identified 24 IUCN Red List species of concern. See Appendix 2 for the complete IBAT screening results.

210. The same IBAT screening also provided a proximity analysis on the relative distance of the protected areas and KBAs. Results show that there is no KBA within the 10-km radius. Results also show that the nearest protected area (Jigme Dorji National Park) is about 35 km away from the subproject site. However, a biological corridor (lesser degree of classification than a protected area) exists within the 1-km radius as discussed above and shown on Figure 27.

211. Separately, the IUCN Red List species of concern identified through the IBAT screening and other locally identified species of concern were assessed to determine the likelihood of them being found at the subproject site. In consultation and discussions with the Department of Forests and Park Services (DOFPS), through its Divisional Forest Office, the presence of each of these species were identified. Table 16 shows a summary and a copy of the confirmation note by the DOFPS is attached as Appendix 4.

Table 19: Assessed Presence of Species of Concern at the Subproject Site (Field Survey, June 2022)

	Species Name	Common Name	Taxonomic Group	IUCN Category	Yes/No
1	<i>Ardea insignis</i>	White-bellied Heron	Aves	Critically endangered	No
2	<i>Aythya baeri</i>	Baer's Pochard	Aves	Critically endangered	No
3	<i>Gyps bengalensis</i>	White- rumped Vulture	Aves	Critically endangered	No
4	<i>Aquila nipalensis</i>	Steppe Eagle	Aves	Endangered	No
5	<i>Haliaeetus leucoryphus</i>	Pallas's Fish- eagle	Aves	Endangered	No
6	<i>Trochalopteron imbricatum</i>	Bhutan Laughingthrush	Aves	Least concern	Yes
7	<i>Zoothera salimalii</i>	Himalayan Forest Thrush	Aves	Least concern	No
8	<i>Sarcogyps calvus</i>	Red-headed Vulture	AVES	Critically endangered	No
9	<i>Ailurus fulgens</i>	Red Panda	Mammalia	Endangered	No
10	<i>Cuon alpinus</i>	Dhole	Mammalia	Endangered	Yes
11	<i>Moschus leucogaster</i>	Himalayan Musk Deer	MAMMALIA	Endangered	No
12	<i>Moschus chrysogaster</i>	Alpine Musk Deer	Mammalia	Endangered	No
13	<i>Moschus fuscus</i>	Black Musk Deer	Mammalia	Endangered	No
14	<i>Panthera tigris</i>	Tiger	Mammalia	Endangered	No
15	<i>Trachypithecus geei</i>	Gee's Golden Langur	Mammalia	Endangered	No
16	<i>Manis pentadactyla</i>	Chinese Pangolin	Mammalia	Critically endangered	No
17	<i>Anourosorex schmidi</i>	Giant Mole Shrew	Mammalia	Data deficient	No
18	<i>Carex nigra subsp. drukyulensis</i>		Liliopsida	Endangered	No
19	<i>Trillium govianianum</i>	Himalayan Trillium	Liliopsida	Endangered	No
20	<i>Cheirostylis sherriffii</i>		Liliopsida	Critically endangered	No
21	<i>Oreorchis sanguinea</i>		Liliopsida	Critically endangered	No
22	<i>Onosma griersonii</i>		Magnoliopsida	Critically endangered	No
23	<i>Ceropegia bhutanica</i>		Magnoliopsida	Endangered	No
24	<i>Strobilanthes accrescens subsp. accrescens</i>		Magnoliopsida	Endangered	No
25	<i>Isodon atroruber</i>		Magnoliopsida	Endangered	No
26	<b>Tor putitora</b>		<b>Actinopterygii</b>	<b>Endangered</b>	<b>No</b>

CR = Critically Endangered, EN = Endangered, V = Vulnerable, NT = Nearly Threatened, LC = Least Concern, DD = Data Deficient

212. **Biodiversity Survey and Assessment.** In addition to stakeholder consultations, a comprehensive biodiversity survey and assessment was conducted for the subproject's area of influence by a multidisciplinary team of experts (refer to Appendix 5 for the full report). This

assessment included field surveys to identify flora and fauna and a specific evaluation of the project's proximity to sensitive habitats and species of conservation concern.

213. As part of this assessment, a critical habitat screening was conducted. This screening followed the criteria outlined in the International Finance Corporation's (IFC) Guidance Note 6, which is consistent with ADB's requirements, to determine if the project area would qualify as Critical Habitat due to the presence of endangered species.

214. The screening focused on three key species of concern known to be in the wider region:

- Dhole (*Cuon alpinus*): An Endangered mammal known to have a wide distribution across Bhutan, including the project area.
- Snow trout (*Schizothorax richardsonii*): A Vulnerable fish species common in the Himalayan River systems.
- Star Anise (*Illicium griffithii*): An Endangered medicinal plant found in cool broadleaved forests in the region.

215. The assessment concluded that while these species are present in the broader landscape, the project's specific area of influence does not meet the quantitative thresholds required to be classified as Critical Habitat for any of them. The area represents a small part of their much wider range and is not a core or unique habitat essential for their survival.

216. Therefore, based on the results of the biodiversity assessment and the critical habitat screening, the subproject area of influence is not considered to be Critical Habitat. However, as it is located within an important and sensitive ecosystem (the Biological Corridor), robust, species-specific mitigation measures are required and have been integrated into the project's Environmental Management Plan (EMP).

## **E. Socio-economic Environment<sup>14</sup>**

217. Demography. As of 2017, the total population of Wangdue in 2017 was 42,186. Of this, 9,880 (5,217 M and 4,663 F) were urban dwellers while the remaining 32,306 (19,085 M and 13,221 F) were from the 558 villages in 77 chiwogs. Wangdue has 15 Gewogs.

218. Gasetshog Gom and Gasetsho Wom Gewogs, where the subproject components will be located, comprise 5 Chiwogs (Changchey- Matsipokto, Khamena, Khataykha, Changkha and Dabcheykha-Matsikha) and 5 Chiwogs (Haetshokha, Shingkhey Khatoe, Shingkhey Khamoe, Maedpisa Tabchikha and Haebisa), respectively. Gasetsho Gom has 185 households, while Gasetsho Wom has 106 households. Unlike in Gasetshog Gom, settlements in Gasetsho Wom are widely scattered. The two gewogs together have a total population of 4,949 (3960 in Gasetshog Gom and 959 in Gasetshog Wom)<sup>15</sup>. The majority of the population in the two gewogs speak Dzongkha.

219. Administration. For both Gasetsho Gom and Gasetsho Wom gewogs, each has the Gewog Tshogde (Elected Representative to Dzongkhag Tshogdu) as the highest decision- making body. Meeting is conducted quarterly and chaired by Gup with Mangmi as the Vice Chairman. Once

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<sup>14</sup> Population and Housing Census of Bhutan, National Statistics Bureau, RGOB, Thimphu

<sup>15</sup> Public consultation with the community in Wangdue June 2022

endorsed by the Gewog Tshogde, important discussions are taken forward to the Dzongkhag Tshogdu for further discussion and deliberation.

220. **Livelihood.** Majority of the rural population, including those in Gasetsho Gom and Gasetsho Wom, depend on agriculture and livestock as the main form of livelihood. Various types of cereals, maize, millet, vegetables and fruits such as oranges, persimmon is grown here and the principal crops being paddy, potato and chili. In 2013, the district was the highest producer of Wheat, potato and the third highest producer of paddy. The farmers sell vegetables and wild forest products to Punatshangchu project staff and workers and at the farmers markets in Bajo.

Figure 33: Wetland (Chuzhing) in the Command Areas (Source: Field Survey, August 2025)



221. **Infrastructure.** Wangdue Phodrang is well connected with road, electricity and mobile networks. The district has the basic District Administration structure, Army establishments, Corporate Offices such as Banks, Bhutan Power Corporation (Electricity supply), the Road Safety Authority Office and other private establishments. The district town is located at Bajo. The district is well connected, 99% electricity and has mobile and internet connectivity.

222. The Gasetshogom Gewog Centre is located just above the Punatshangchu Hydropower Project Authority (PHPA) colony and is well known for the biggest power projects in the country, Punatshangchu Hydropower Project Phase 1 and phase 2. The two projects have supported the Gasetshogom gewog through funds or by constructing farm roads and irrigation channels.

223. **Transportation.** Wangdue Phodrang is located close (approximately 70km) to the capital city and therefore easily reachable within 2 hours by road. It is also quite well connected with 1,188.30km of road. There are limited public transportation.

224. Gasetsho Gom is connected by a 25km road from the Wangdue-Tsirang Highway. This highway also passes through Gasetshog Wom gewog, which has an internal feeder road that connects it to the Basochu power site at Haebisa. There are limited public transportation in the area, but private taxis are available.

225. **Health, education and other facilities.** Within the District there are 2 Hospitals, 4 Indigenous Units, 11 Basic Health Units, 24 Outreach Clinics, 3 Central Schools, 3 Higher Secondary Schools, 1 Middle Secondary Schools, 1 Lower Secondary School and 23 Primary Schools. In addition to this, there are also 22 Non-Formal Education Centres and 16 Early Child Care and Development Centres and 2 Vocational Training Institutes.<sup>16</sup>

<sup>16</sup> NSB, 2021. Dzongkhag at a Glance, Wangdue Phodrang Dzongkhag, 2021.

For both Gasetsho Gom and Gasetsho Wom Gewogs, there are the local government officials like the Gup, Mangmi, Gaydrung and the Tshogpas. Apart from the locally elected members, there are Government officials such as the Gewog Administrative Officer, Livestock Extension Office, Agriculture Extension Officer and Forest Extension Officer. The Gewog Office and the RNR center are located together. Details on the two gewogs are provided in the table below.

Table 20: Brief information on the 2 sub-project gewogs (Source: Gasetsho-Gom & Gasetsho Wom Gewog Administrations, June 2022).

Gewog	Gasetshog Gom	Gasetshog Wom
<b>Area</b>	46.8 sq km	207 sq km
<b>Altitude/elevation</b>	1200 to 1500 masl	1540-1848m
<b>Chiwogs</b>	5 Chiwogs (Changchey-Matsipokto, Khamena, Khataykha, Changkha and Dabcheykha-Matsikha)	5 Chiwogs (Haetshokha, Shingkey Khatoe, Shingkey Khamoe, Maedpisa Tabchikha and Haebisa)
<b>Villages<sup>17</sup></b>	18	16
<b>Households</b>	187 (resident households- 296)	106
<b>Population</b>	959 (in 2017)	863 (in 2017)
<b>Current population</b>	662 (315 M, 347F)	616 (294 M, 322 F)
<b>Gewog Office</b>	1 (Gumina)	1
<b>Community Primary School</b>	1	(1 (Haebisa)
<b>Lower Secondary School</b>	1	
<b>Middle Secondary School</b>	1	
<b>Central School</b>	1	
<b>Basic Health Unit</b>	1	
<b>Outreach Clinic</b>	1	2
<b>Non-Formal Education Centre</b>	1	5
<b>RNR Centre</b>	1	1
<b>PWD Regional Workshop</b>	1	
<b>Power generating station</b>	1	
<b>Agriculture</b>	The main cash crop is paddy, but other fruits and vegetables are also grown	Main cash crop is paddy. Mustard, wheat and buckwheat and vegetables are also grown
<b>Forest range office</b>	1	

<sup>17</sup> PIU, MOWHS

Figure 34: Basic Health Infrastructure, Schools, Early Learning Center, Gasetsho Gom and Gasetsho Wom Gewog offices. (Source: Field Survey, August 2025)



## F. Physical Cultural Resources

226. The project area lies within the Wangdue Phodrang Dzongkhag, a region of significant historical and cultural importance. The most prominent landmark is the Wangdue Phodrang Dzong, built in 1638 by the country's founder, Zhabdrung Ngawang Namgyal. The Dzong is strategically located on a ridge above the confluence of the Punatsangchu and Dangchu Rivers, approximately 30km from the project site.

227. The project area specifically encompasses the Gasetsho Gom and Gasetsho Wom Gewogs, both of which possess a rich tapestry of local cultural and religious heritage.

228. Gasetsho Gom Gewog is noted for its strong cultural heritage, featuring numerous religious structures such as monasteries and stupas. Annual religious ceremonies, including the mani-dungdrup at Matshipogto Lhakhang and rituals at Shalipangkha Lhakhang, are significant events that unite the community and reinforce its spiritual heritage. This deep-rooted cultural life coexists with significant challenges, notably water scarcity, which impacts the community's agriculture, livelihoods, and overall well-being.

229. Gasetsho Wom Gewog is home to several important Lhakhangs (temples), each with its own unique history and significance:

- Thegchen Ugyen Dra Lhakhang: Founded in the 18th century by Je Chejey Jamtsho, its main relics include a statue of Jowo Jamba and a protected statue of the goddess Zhenchey Om. The site is also known for a sacred Nye where an image of Guru Rinpoche has naturally appeared on a large stone cave. The Lhakhang is cared for by the public with support from the state monastic body.
- Haetsokha Community Lhakhang: Founded in the 20th century, this temple is managed by the community, with caretakers serving in turns. Its chief relic is a statue of Chugche Zhey, brought from Paro Kurje Lhakhang.

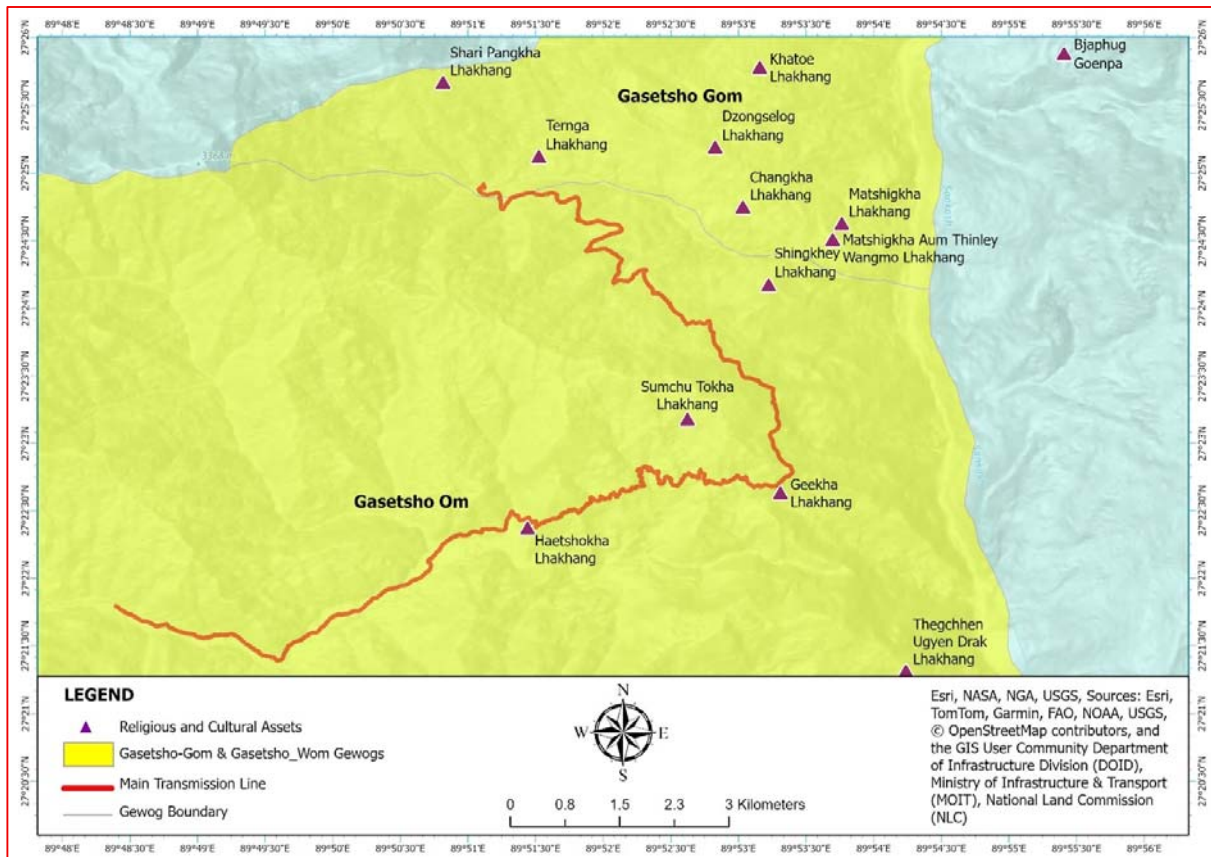
- Gikha Community Lhakhang: Built in the 17th century by Wangzop Dalu Tashi Tobgay, this two-storey temple's main relic is a statue of Lham. It is considered a very sacred Lhakhang and is managed on a rotational basis by villagers.
- Shin Nyen Lhakhang: A community-built, two-storey Lhakhang with a chief relic of a Tempa statue. It underwent a major renovation in 2012 and is looked after by the communities of two chiwogs.
- Simchutokha Lhakhang (Private): A private temple founded 400 years ago by Lam Tenzin Jamtsho. It is now cared for by the fourth generation of his descendants. Its sacred relic, a *Phub*, is kept in a secret custodian and is not available for public view.

### Proximity of Cultural Sites to Project Infrastructure

230. Based on project mapping, the majority of these revered religious sites are located at a safe distance from the proposed water transmission line. Simchutokha Lhakhang, Shin Nyen Lhakhang, and Gikha Lhakhang are all situated more than 300 meters from the alignment.

231. However, one site, the Haetsokha Community Lhakhang, is located within a village that is approximately 40-50 meters from the nearest point of the proposed alignment. This proximity will require careful planning and mitigation measures during construction to avoid any physical or ambient disturbance to the cultural site and the community.

Figure 35: Religious and Cultural Assets in Gasetsho Gom and Gasetsho Wom Gewogs (Source: NLC and Department of Culture and Dzongkha Development, August 2025)



## V. ANTICIPATED ENVIRONMENTAL IMPACT AND MITIGATION MEASURES

### A. Anticipated Impacts and Mitigation Measures during Design and Pre-construction Phase

#### 1. Impact Due to Climate Change

232. Impact Due to Extreme Weather Events. Future climate changes can result in more intensified extreme weather events, can also potentially damage the usability or affect the efficient functioning of the subproject components such as pipelines, pumps, and other related infrastructures of the subproject. These are not theoretical risks; the project area is already experiencing such events. For instance, a community-reported flash flood in the Hetshotsangchhu in November 2024—well outside the typical monsoon season—demonstrates the increasing unpredictability and intensity of local weather. Such events pose a direct threat of physical damage to the intake structure and pipelines from debris flow and landslides, and can cause operational shutdowns due to extreme water turbidity.

233. Mitigation. Integrate in the subproject design appropriate climate change adaptation measures, such as, but not limited to, use of structural arrangements, construction methods, and/or materials designed to withstand future climate-related changes such as flooding due to extended monsoon seasons and increased level of precipitation, droughts, and increased global temperature, among others. Specifically, the design will incorporate:

- The resilience of the intake design is demonstrated through key engineering specifications outlined in the Peak Runoff Estimation and Weir Design Report, which confirm its capacity to withstand extreme hydrological events and manage sediment and debris effectively. The diversion weir and associated headworks are engineered to endure a 1-in-100-year flood, with a peak discharge of 214 m<sup>3</sup>/s calculated using the Mononobe Method and adjusted for climate change. A 15-meter concrete weir is designed to resist high-velocity flows and impacts from boulders and debris. To manage sediment and protect downstream infrastructure, the headworks incorporate a 28-meter-long reinforced concrete desilting tank that slows flow to below 0.3 m/s, enabling settlement of particles ≥0.2 mm, alongside a heavy-duty trash rack with 100 mm spacing to block large debris and a flushing gallery to maintain tank efficiency. These integrated features collectively affirm the intake's flood resilience and its robust capacity for sediment and debris management.
- Strategic routing of the transmission pipeline to avoid known landslide-prone areas and geohazards.
- Use of bioengineering measures (e.g., planting of deep-rooted native grasses and shrubs) for slope stabilization along the pipeline corridor

234. The subproject design will also integrate a user-friendly climate smart water management (digital) system envisaged under Output 3 of the project, which will (i) harmonize existing water MIS data into a single platform and integrate it with climate information and smart devices connected to water infrastructure to strengthen climate adaptation capacity, and (ii) will enable early warning of extreme climate events (floods and droughts), fast response and adaptation to climate change

through remote and automatic control, improved planning, and monitoring capacity for relatively large water infrastructure.

## 2. Impact Due to Source Sustainability and Seasonal Water Availability

235. **Impact.** Currently, the demand in the two gewogs is about 17.225 lps or about 1.5MLD for drinking water (see Table 6 in Section III discussions) and about 50 lps or about 4.32 MLD for irrigation water during lean season. The table below shows the source availability and projected water demand for design year 2052.

Table 21: Projected Water Supply and Demand Discharge for Design Year 2052 (Source: Final Hydraulic Structure Design Report, August 2025).

Supply/ Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>Source Discharge Flow, lps</b>	<b>791</b>	<b>674</b>	<b>595</b>	<b>581</b>	<b>743</b>	<b>1,388</b>	<b>4,708</b>	<b>5,537</b>	<b>3,593</b>	<b>1,470</b>	<b>190</b>	<b>117</b>
<b>Irrigation, lps</b>	59	94	149	114	362	595	489	382	369	263	74	<b>50</b>
<b>Drinking Water, lps</b>	13	13	13	13	13	13	13	13	13	13	13	<b>13</b>
<b>Total Demand, lps</b>	<b>72</b>	<b>107</b>	<b>162</b>	<b>127</b>	<b>375</b>	<b>608</b>	<b>502</b>	<b>395</b>	<b>382</b>	<b>276</b>	<b>87</b>	<b>63</b>

236. While the annual average flow of the Hetshotsangchhu is sufficient to meet projected 2052 demand, the data reveals a critical vulnerability in its extreme seasonal variability. The river flow drops dramatically to 190 lps in November and a low of 117 lps in December. Although these flows still exceed the projected demand for those months, they indicate that the river system is already highly stressed during the dry season. Future climate change impacts, including lower precipitation and higher evapotranspiration rates, are expected to exacerbate this trend, leading to more severe and prolonged low-flow periods that could threaten the long-term sustainability of the source.

237. **Mitigation.** To ensure the long-term sustainability of the water source and build resilience against climate-induced low flows, a multi-faceted mitigation strategy will be incorporated during the design phase:

- **Catchment Management Plan:** In collaboration with the Department of Forests and Park Services and local communities, a basic catchment protection plan for the area upstream of the intake will be developed. This will include measures to manage grazing, prevent deforestation, and control invasive species, thereby enhancing the watershed's natural capacity to regulate flow and maintain water quality.
- **Demand-Side Management:** The project will promote water-use efficiency through the installation of water meters for all connections and the implementation of a public awareness campaign on water conservation for both domestic and agricultural users.
- **Monitoring and Response Protocol:** A long-term flow monitoring protocol will be established at the intake site. This will include defining critical low-flow thresholds that would trigger water-use restrictions or other pre-planned drought response actions to manage the available resource effectively.

### 3. Potential for Competing Use of Water Resources

238. **Impact.** The primary potential impact of water abstraction from the Hetshotsangchhu is on downstream users. While there are no direct community abstractions downstream of the proposed intake, the river is a major tributary for the Basochhu Hydropower Plant (BHP), operated by the Druk Green Power Corporation (DGPC). Therefore, the project presents a significant resource-sharing and water-use competition issue, particularly during the dry season.

239. Hydrological modeling indicates a high seasonal variability in river flow, with a peak discharge of 5,537 lps in August and a critical minimum flow of 117 lps to 190 lps during the lean months of November and December. This confirms that the potential for adverse impacts on hydropower generation is highest during these low-flow periods.

240. **Mitigation.** To address this competing water use and ensure the project does not adversely affect hydropower generation or the downstream riverine ecology, two primary mitigation measures have been established:

241. **Guaranteed Environmental Flow (E-flow):** The intake structure will be designed and operated to release a minimum of 30% of the river's instantaneous flow downstream at all times. This ensures that a sufficient volume of water is always available for both ecological needs and for the BHP.

242. **Formal Water Sharing Agreement:** A Memorandum of Understanding (MoU) has been executed between the Project Implementation Unit (PIU) and the Druk Green Power Corporation. This agreement formally outlines the terms of water resource sharing from the Hetshotsangchhu, providing a clear framework for cooperative management.

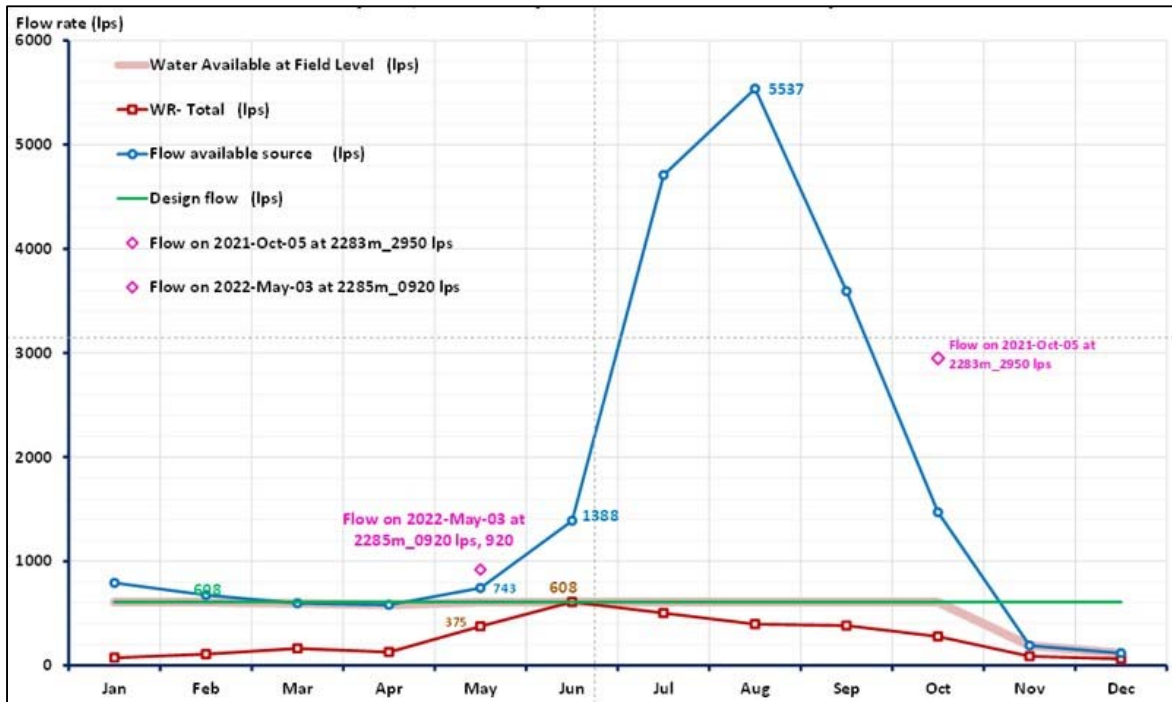
243. **Verification of Mitigation.** An analysis was conducted to verify that even under the full projected demand for the design year 2052, the 30% E-flow commitment is met. The results, summarized in Table 19, show that the remaining downstream flow will be 54% in November and 46% in December—the months with the lowest natural discharge. This is significantly above the required 30% minimum, demonstrating that the project's water abstraction is sustainable and will not compromise downstream users. Figure 36 provides a graphical representation of this supply-demand profile.

Table 22: Raw Water Supply, Demand Discharge and Downstream Flow Profile for the Hetshotsangchhu Subproject, (Source: Final Hydraulic Structure Design Report, August 2025).

Supply/ Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Source Discharge Flow, lps	791	674	595	581	743	1,388	4,708	5,537	3,593	1,470	190	117
Irrigation, lps	59	94	149	114	362	595	489	382	369	263	74	50
Drinking Water, lps	13	13	13	13	13	13	13	13	13	13	13	13
Total Demand, lps	72	107	162	127	375	608	502	395	382	276	87	63
Balance (downstream flow), lps	719	567	433	454	368	780	4,206	5,142	3,211	1,194	103	54
<b>Balance (downstream flow), in %</b>	<b>91</b>	<b>84</b>	<b>73</b>	<b>78</b>	<b>50</b>	<b>56</b>	<b>89</b>	<b>93</b>	<b>89</b>	<b>81</b>	<b>54</b>	<b>46</b>

lps = liters per second

Figure 36: Water Supply-Demand Profile for Hetshotsangchhu Intake (Source: Final Hydraulic Structure Design Report, August 2025).



#### 4. Impacts from Pipeline Installation Method on Wildlife Movement

244. **Impact:** The long-term environmental integrity of the Biological Corridor relies on maintaining habitat connectivity and free movement for wildlife. An above-ground pipeline creates a linear physical barrier, fragmenting habitat and impeding the passage of terrestrial fauna. This potential barrier impact is a primary concern for the ~5 km section of the alignment traversing the Biological Corridor.

##### Design Requirements and Mitigation Strategy:

245. To prevent the pipeline from becoming a long-term impediment to wildlife movement, the core design philosophy mandates the following, which must be fully integrated into the final engineering drawings and specifications:

1. Design Priority: Fully Underground Installation (Default Method):
  - o The project design prioritizes the burial of the pipe in an excavated trench with a minimum cover of 1.0 meter across the vast majority of the ~21.1 km alignment. This design choice is the principal measure to eliminate any long-term physical barrier and maintain natural terrain continuity for wildlife movement.
2. Mandated Design for Above-Ground Exceptions:
  - o Above-ground installation is strictly limited to sections where trenching is demonstrably unfeasible or geotechnically unsafe. The design must specify supports for these exceptions:
    - Stream and Gully Crossings: The pipeline must be supported above ground on dedicated aqueduct-bridge support structures (as specified in the detailed design).

- Unstable or Very Steep Rocky Terrain: In short, unavoidable sections with highly unstable slopes or rock outcrops, the pipe will be placed on low-lying concrete supports (plinths).
3. Design Integration of Wildlife Passage Features:
- Elevated Crossings for Wildlife Passage: The design for all stream and gully crossings (aqueduct-bridge supports) must ensure the pipeline is sufficiently elevated above the ground and bank level to maintain a clear and open corridor underneath. This ensures these structures do not create bottlenecks and allow for the unimpeded passage of both wildlife and water flow.
  - Minimization of Plinth-Supported Lengths: The design shall minimize the total length of the pipeline supported on plinths.
  - Wildlife Overpasses (Earthen Ramps): In areas where the terrain is particularly steep or difficult, making underpasses technically unfeasible, simple wildlife overpasses will be constructed. These will consist of stable, compacted earthen ramps or "land bridges" built up and over the low-lying pipeline, covered with native soil and vegetation to blend in with the surrounding environment and provide a natural-feeling pathway for animals.

246. Contractual Requirement: This strategy ensures that these critical mitigation measures are integrated into the final design package. The construction contractor will be contractually required to implement this pre-approved, wildlife-sensitive design.

## 5. Loss of Trees and Impacts on Biological Corridor and Government Reserve Forest

247. The final detailed design of the pipeline alignment has resulted in a significant reduction in the project's environmental footprint compared to the estimates made during the preliminary, processing-phase IEE. The required forest area for clearance has been reduced from 31.2 hectares to 7.4 hectares, and the total number of trees to be felled has been officially confirmed by the Department of Forest and Park Services (DoFPS) as 774, a substantial decrease from the initial estimate of 5,653 trees.

248. This significant reduction was achieved by narrowing of the Construction Right-of-Way (RoW). The preliminary estimate was based on a conservative and wider RoW assumption. The final detailed design, based on geotechnical assessments and the planned use of appropriately sized machinery, confirmed that a narrower construction corridor is feasible. The official RoW width required for the forestry clearance was finalized at 3.5 meters, significantly less than the initial assumption.

249. This design change - a technical refinement of the required construction width - is the basis for the confirmed reduction in environmental impact.

250. **Impact.** The construction of the water supply scheme will still necessitate the felling of trees within the project's Right-of-Way (RoW). A detailed tree enumeration survey along the final 21.1 km pipeline alignment has been completed by the Divisional Forest Office of Wangdue Phodrang, Department of Forest and Park Services (DoFPS). The survey has confirmed that a total of 774 trees will be felled. The RoW, calculated at a width of 3.5 meters, will temporarily impact an area of approximately 7.4 hectares passing through forest, shrubland, and rocky terrain.

251. A significant portion of this impact will occur within sensitive ecological zones. The intake site and an initial 5 km section of the water transmission line are located inside a designated Biological Corridor that connects Jigme Dorji National Park and Jigme Singye Wangchuk National Park. Construction activities within this corridor and the adjoining Government Reserve Forests (GRF) will cause unavoidable impacts, including loss of forest resources and localized changes to the natural terrain.

252. **Mitigation.** A comprehensive mitigation strategy has been developed to avoid, minimize, and compensate for these impacts. The strategy is centered on careful alignment, controlled construction practices, and robust restoration and compensation measures.

1. Alignment and Design to Minimize Impact:
  - The pipeline alignment within the biological corridor has been strategically routed to follow an existing traditional footpath. This area already shows signs of disturbance from historical use (livestock grazing, fuelwood collection) and has a less dense tree cover. Utilizing this existing trail significantly reduces the number of trees to be felled and minimizes new fragmentation of the forest.
2. Controlled Construction and Tree Felling Practices: The Contractor will be contractually obligated to implement the following measures:
  - (i) Footprint Minimization: The construction RoW will be strictly limited to the width essential for safe passage of equipment and installation of the pipe. All temporary access paths will be closed and rehabilitated immediately after construction.
  - (ii) Prohibited Activities: The establishment of worker camps, storage depots, or equipment yards within the biological corridor and GRF is strictly prohibited. All such temporary facilities will be located in pre-approved areas outside of sensitive forest ecosystems where no tree felling is required.
  - (iii) Spoil Management: A contractor-prepared Spoil Management Plan (SMP) will be submitted to the PIU for approval. The plan will detail procedures for the proper handling and disposal of all excess excavated materials and construction waste at pre-identified and approved disposal sites to prevent indiscriminate dumping.
  - (iv) Worker Briefings: All construction workers will receive mandatory briefings on the ecological sensitivity of the area and the legal penalties associated with illegal tree felling or poaching.
  - (v) Pre-Felling Fauna Survey Protocol: To minimize direct harm to resident wildlife, the following protocol must be implemented before any tree felling:
    - Timing: To the extent possible, bulk tree felling shall be scheduled outside the primary bird breeding season (March to June).
    - Survey: No more than 48 hours prior to felling any tree, the Contractor's EHS Officer will conduct a visual inspection to check for the presence of active bird nests, active beehives, or other inhabiting fauna.
    - Action: If an active nest or other resident fauna is found, a "No-Cut" buffer zone of at least 10 meters will be established around the tree. Felling will be postponed until the young have fledged or the animal has vacated the tree, as confirmed by a follow-up inspection.

- Documentation: The results of all pre-felling surveys will be documented in a logbook by the EHS Officer.
3. **Compensation and Restoration:**
- i. *Status of Forestry and Tree Felling Clearance:* The project requires a formal Forestry Clearance from the Department of Forest and Park Services (DoFPS) to conduct activities within Government Reserve Forests and the Biological Corridor. The permission to fell the 774 enumerated trees is an integral part of this single Forestry Clearance; it is not a separate permit. The official Forestry Clearance, which includes the approval for tree felling, was issued by DoFPS on August 13, 2025 (Application ID: 919151). Tree felling for the project will begin only after the designated trees within the Right-of-Way (ROW) corridor have been officially marked by the Forestry Department.
  - ii. *Compensatory Afforestation Program:* In accordance with Section 70 of the Forest and Nature Conservation Act, the unavoidable loss of 774 trees will be compensated for through a comprehensive Compensatory Afforestation Program.
    - Implementation Responsibility: The program will be implemented by the Department of Forest and Park Services (DoFPS), who have the mandate and technical expertise for such activities. The full cost of the program will be borne by the project and will be transferred to DoFPS for execution.
    - Planting Ratio and Quantity: The afforestation will be carried out based on an area-replacement ratio. As stipulated in the Forestry Clearance, the 7.4-hectare temporary RoW will be compensated for at a 2:1 ratio. This means a total of 14.8 hectares will be replanted with native tree species selected by DoFPS. This approach ensures no net loss of forest cover and is the standard methodology applied by DoFPS.
    - Budget and EMP: The indicative cost for this program is included in the Environmental Management Plan (EMP) cost estimates (Chapter IX) to ensure it is fully budgeted for.
  - iii. *Site Rehabilitation:* Upon completion of construction, all disturbed areas within the biological corridor and GRF will be fully restored. This will involve backfilling trenches, re-contouring the landscape to match the original topography, and using bioengineering techniques (e.g., planting of native grasses and shrubs) to stabilize slopes and prevent future erosion or landslides.

## 6. Impacts on Biodiversity in the Biological Corridor and Forest Areas

253. **Impacts.** The project's location within a Biological Corridor and Government Reserve Forest, both managed by the Wangdue Phodrang Forest Division, means that construction activities will have direct impacts on local biodiversity. The linear excavation for the pipeline will involve clearing vegetation, causing habitat disturbance for terrestrial flora and fauna, and potentially disrupting the movement of wildlife. This will also result in the loss of some plants and herbs that may have local medicinal or economic value.

1. **Endangered Species Assessment.** A comprehensive biodiversity assessment was conducted to evaluate the ecological significance of the project's area of influence. The assessment, which included expert-guided field surveys and consultations with the Chief of the Wangdue Phodrang Forest Division, confirmed the presence of three IUCN-listed endangered species. While occasional evidence of these species (e.g., tiger footprints) has been recorded, the data

indicates that the immediate project area is part of their wider range rather than a core or frequently used habitat.

2. To formally classify the habitat's sensitivity, the assessment applied the screening criteria from the International Finance Corporation's (IFC) Guidance Note 6. The results concluded that the subproject area of influence is not a critical habitat for any of these endangered species. However, given that it still serves as an important habitat, a precautionary approach with robust mitigation measures is required to avoid or minimize any adverse impacts from project activities.

254. **Mitigation Measures.** A multi-layered mitigation strategy will be implemented, combining regulatory permit conditions, specific engineering and construction controls, and the recommendations from the biodiversity assessment. These measures will be integrated as mandatory requirements in all bidding and contract documents.

- a) Habitat Protection and Construction Practices
  - (i) Footprint Minimization: All works will be strictly confined to the approved corridor of impact. No activities, storage, or camps will be permitted beyond this corridor.
  - (ii) Scheduling and Timing: Construction activities will be limited to daytime hours to allow wildlife to move freely during dawn, dusk, and night.
  - (iii) Excavation and Pipe Laying: Trench excavation will be minimized to the depth required for pipe safety. Where feasible, smaller excavation equipment will be used to reduce the scale of disturbance. Pipes will be buried where possible to avoid creating long-term surface obstacles.
  - (iv) Blasting Controls: The use of explosives will be avoided. If blasting is unavoidable in hard rock areas, "controlled blasting" methods will be employed to minimise noise and shockwaves.
- b) Species-Specific and Ecological Protection
  - (i) Fish Migration and Breeding: In-stream works at the intake site will be prohibited during the peak breeding seasons for Snow trout (April-June and September-October). Any culverts or crossings will be designed as soft-engineering structures (e.g., causeways) to avoid creating barriers to fish movement.
  - (ii) Wildlife Protection and Encounter Protocol:
    - o A strict ban on poaching and illegal collection of plants will be enforced. All workers will receive mandatory training on the Forest and Nature Conservation Act and its penalties.
    - o Night work is prohibited. All open trenches will be covered or equipped with escape ramps at night to prevent animals from getting trapped.
    - o In the event of a wildlife encounter, especially with an endangered species, work will cease, and the contractor will immediately coordinate with the nearest Forest Range Office for recording or rescue if the animal is injured.
  - (iii) Protection of Specific Flora: The felling of *Illicium* trees is prohibited unless they fall directly within the cleared Right-of-Way.
- c) Site Management and Worker Conduct

- (i) Worker's Code of Conduct: The Contractor will be required to develop and enforce a mandatory Worker's Code of Conduct for all project personnel, including subcontractors. This Code will be a condition of employment and will be included in worker induction training. It will explicitly prohibit:
    - o Hunting, poaching, fishing, or trapping.
    - o Collection of any flora, fauna, or firewood.
    - o Bringing pets, firearms, or traps to the site.
    - o Trespassing into the forest beyond the designated work area.
    - o Indiscriminate disposal of waste and littering.

The Code of Conduct will also outline penalties for non-compliance, up to and including termination of employment.
  - (ii) Worker Training and Awareness: All workers will receive mandatory training on the key elements of the Code of Conduct, the ecological sensitivity of the Biological Corridor, species of concern, and the legal penalties under the Forest and Nature Conservation Act.
  - (iii) Camp and Storage Management: The establishment of worker camps, storage depots, or equipment yards within the biological corridor and Government Reserve Forest is strictly prohibited. All such temporary facilities will be located in pre-approved areas outside of sensitive forest ecosystems.
- d) Regulatory Compliance and Site Restoration
- (i) Forestry Clearance: All terms and conditions stipulated in the Forestry Clearance issued by the Department of Forest and Park Services (DoFPS) will be strictly adhered to.
  - (ii) Collaboration with DoFPS: All work schedules and mobilization plans will be developed in agreement with the local Forest Range Office to minimize the chance of negative wildlife encounters.
  - (iii) Site Restoration: Following construction, all modified areas will be fully restored. This includes re-contouring the land and using bioengineering techniques to stabilize steep slopes, prevent erosion, and facilitate the natural regeneration of native vegetation.

## 7. Impacts on Aquatic Species

255. **Impacts.** Field investigations and the project's biodiversity assessment confirmed the presence of Snow trout (*Schizothorax* sp.) in the Hetshotsangchhu. However, a site-specific assessment at the proposed intake location found no fish. This is attributed to the local river morphology, which includes a series of short waterfalls and high-gradient rapids that act as natural physical barriers, preventing upstream fish migration to this specific point. Consequently, direct impacts on fish movement or critical spawning grounds at the intake site itself are not anticipated.

256. The primary potential impacts of the project are to the aquatic habitats downstream of the intake:

257. **During Construction:** In-stream construction and bank disturbances can increase water turbidity and release sediment downstream. This can degrade water quality and harm aquatic habitats by smothering riverbed substrates and affecting gill-breathing organisms.

258. **During Operation:** The continuous abstraction of water will permanently alter the river's flow regime. If not properly managed, this could reduce the available habitat for species like the Snow trout, especially during the critical low-flow months of the lean season.

259. **Mitigation.** To address these potential downstream impacts, a combination of engineering design controls, construction management practices, and strict worker regulations will be implemented. These measures will be included as mandatory requirements in all bidding and contract documents.

- a) Design and Engineering Controls (Operational Phase)
  - (i) Guaranteed Environmental Flow (E-flow): In compliance with Bhutan's Water Regulation 2014, the intake is designed to ensure a minimum environmental flow of 30% of the instantaneous river flow is always released downstream. This is the primary measure to protect the downstream aquatic ecosystem during operation.
  - (ii) Low-Impact Weir Design: The intake will feature a low-height weir (approximately 1 meter). This design is sufficient for water abstraction while preventing significant damming, which ensures minimal alteration of the upstream aquatic habitat and natural flow dynamics.
- b) Construction Management (Construction Phase)
  - (i) Seasonal Work Scheduling: All major in-stream construction activities will be scheduled during the lean season (post-monsoon). This minimizes work during high-flow conditions and avoids disrupting sensitive biological periods.
  - (ii) Sediment and Turbidity Control: The contractor will be required to use best-practice sediment control measures, such as temporary coffer dams and silt fences, during in-stream work to prevent the release of suspended solids downstream.
- c) Worker Conduct
  - (i) Prohibition on Fishing: The mandatory Worker's Code of Conduct, to be enforced by the Contractor for all project personnel, will include a strict and explicit prohibition on illegal fishing. All workers will be briefed on the relevant laws and associated penalties as part of their induction.

## 8. Impacts on Community Forests

260. **Impact.** The main water transmission pipeline will traverse a total length of 2.681 km through three gazetted Community Forests (CFs), which are managed by local communities. The primary impact will be the clearing of the pipeline's Right-of-Way (RoW), resulting in the felling of trees and the removal of understory vegetation. This will cause a direct loss of forest resources (timber, firewood, Non-Wood Forest Products) that could otherwise be used or generate revenue for the Community Forest Management Groups (CFMGs). Construction activities may also temporarily restrict community access to certain areas of their forest.

Table 23: Affected Community Forests along the Pipeline Alignment (Field survey, June 2022 & August 2025)

#	Community Forest	Location	Distance in km
1		Zababa	1.459
2	Singkhey Khatoed and Singkhey Khamey, Phaka;	Phananey	0.733
2	Tabchakha	Tabchaka Draktsen	0.424
3	Hetsokha	Getsamgang	0.065

#	Community Forest	Location	Distance in km
	<b>Total</b>		<b>2.681</b>

Figure 37: Alignment Section Crossing the Community Forests of Phaka, Singkhey Khatoed, and Singkhey Khamey and Tachakha. (Source: Final Hydraulic Structure Design Report, August 2025, Field survey June 2022 & August 2025)



261. **Mitigation.** A comprehensive strategy centered on community partnership, resource compensation, and responsible construction practices will be implemented. These measures will be formalized through agreements with each affected CFMG and included as mandatory requirements in all bidding and contract documents.

a) *Consultation and Formal Agreements*

262. The project will secure the formal consent of each affected Community Forest Management Group. This will be achieved through the execution of a Memorandum of Understanding (MoU) with each CFMG. The MoU will detail the scope of work within the CF, compensation mechanisms, mitigation measures, and agreed-upon community benefits.

b) *Resource Compensation*

- (i) **Timber Rights:** All timber felled within a Community Forest as a result of RoW clearing will be handed over to the respective CFMG for their use and benefit, as per their approved CF Management Plan.
- (ii) **Compensatory Afforestation:** The project will fund a compensatory afforestation program to replace the lost trees, in line with the requirements of the Department of Forest and Park Services (DoFPS).

c) *Construction Site Controls and Restoration*

The Contractor will be required to strictly adhere to the following site management protocols:

- (i) **Prohibited Activities:** The establishment of worker camps or equipment storage depots within the boundaries of any Community Forest is strictly prohibited.
- (ii) **Controlled Felling:** Only trees that have been officially marked for felling by the DoFPS in the presence of CFMG representatives are permitted to be cut.
- (iii) **Spoil and Muck Management:** All excess excavated soil will be disposed of at a pre-approved site identified in consultation with the CFMG. The dumpsite will be stabilized with retaining structures to prevent erosion and mudslides into the forest. Indiscriminate dumping is strictly forbidden.
- (iv) **Site Restoration:** Once the pipes are laid and trenches are backfilled, the RoW will be cleared of all construction debris. The area will then be rehabilitated and left to allow for natural regeneration of native vegetation.

## 9. Impacts from Sourcing of Construction Materials

263. **Impact.** The project will require significant quantities of construction materials, primarily sand, gravel, and stone aggregates, for use in the intake structure, pipeline bedding, and other civil works. The sourcing of these materials from quarries, if not managed properly, can lead to significant adverse environmental impacts. These include habitat degradation at the quarry site, soil erosion, and the siltation of rivers and streams due to runoff from poorly managed extraction areas and access roads. The primary risk is the potential use of materials from illegal or unapproved quarries that do not adhere to national environmental standards.

264. **Mitigation.** To ensure that all construction materials are sourced responsibly and sustainably, the following legally binding requirements will be incorporated into all bidding and contract documents for the appointed Contractor:

- (i) **Exclusive Use of Licensed Quarries:** The Contractor shall source all raw materials (sand, gravel, aggregates) exclusively from quarries and borrow pits that are fully licensed and approved by the relevant government authorities (e.g., Department of Geology and Mines).
- (ii) **Prohibition on New Quarry Development:** The Contractor is explicitly prohibited from opening any new quarry or borrow pit for the sole purpose of supplying this project. All materials must come from existing, operational sources.
- (iii) **Source Verification and Approval:** Prior to procurement, the Contractor must submit a list of proposed material sources to the PIU for verification and formal approval. This submission must include copies of the quarry's valid operating license and environmental clearance.
- (iv) **Chain of Custody and Reporting:** The Contractor will be required to maintain a clear record of all material sources, including quantities procured. This documentation must be submitted as part of the regular monthly progress reports to the PIU to ensure full transparency and traceability.

## 10. Required Consents, Clearances, and Permits

265. **Requirement for Approval.** The implementation of the Hetshotsangchhu Integrated Water Supply Scheme is contingent upon securing a number of mandatory legal, administrative, and community-level approvals. Failure to obtain these approvals prior to the commencement of any physical works would constitute a legal non-compliance and will result in project delays and potential penalties.

266. **Mitigation and Action Plan.** The Project Implementation Unit (PIU) will be responsible for securing all necessary approvals before construction begins. The PIU will also be responsible for monitoring the validity of these permits throughout the project lifecycle and initiating any required renewal processes. The following clearances, permits, and agreements must be in place:

a) *Statutory Clearances (National Level)*

- (i) Environmental Clearance (EC): A formal EC from the competent national authority is the primary legal requirement for the project to proceed.
- (ii) Forestry Clearance: As the pipeline traverses Government Reserve Forests and a Biological Corridor, a Forestry Clearance from the Department of Forest and Park Services (DoFPS) is mandatory.

b) *Administrative Approvals (Sub-national Level)*

- (i) Dzongkhag Administration: Formal approval from the Wangdue Phodrang Dzongkhag Administration.
- (ii) Gewog Administration: Consent and approval from the administrations of both Gasetsho Gom Gewog and Gasetsho Wom Gewog.

c) *Community-Level Agreements*

- (i) Community Forest Management Groups: Formal agreements, likely in the form of a Memorandum of Understanding (MoU), must be executed with each of the affected Community Forest Management Groups (CFMGs), including those for Shingkey Gaki, Tabchaykha Draktsen, and Hetshokha Community Forests.

## 11. Impacts on Private Agricultural Land

267. **Identification of Impact:** During the October 2025 community consultations and a subsequent joint verification survey, it was confirmed that the proposed pipeline alignment had the potential to temporarily impact three plots of private agricultural land in the Hetshokha and Tonglabji areas (Refer Figure 39). The potential impacts included the temporary loss of land for cultivation, loss of standing crops, and disruption to farming activities, which would directly affect the livelihoods of the landowners.

268. **Mitigation through Impact Avoidance and Minimization (Pre-construction Actions):** In line with the project's commitment to avoiding and minimizing social impacts, a Joint Site Verification Survey was conducted on 15 October 2025. The team - comprising PIU staff, Gewog officials, the Dzongkhag Land Surveyor, and the landowners - assessed the alignment on the ground and agreed upon the following design modifications to reduce the impact:

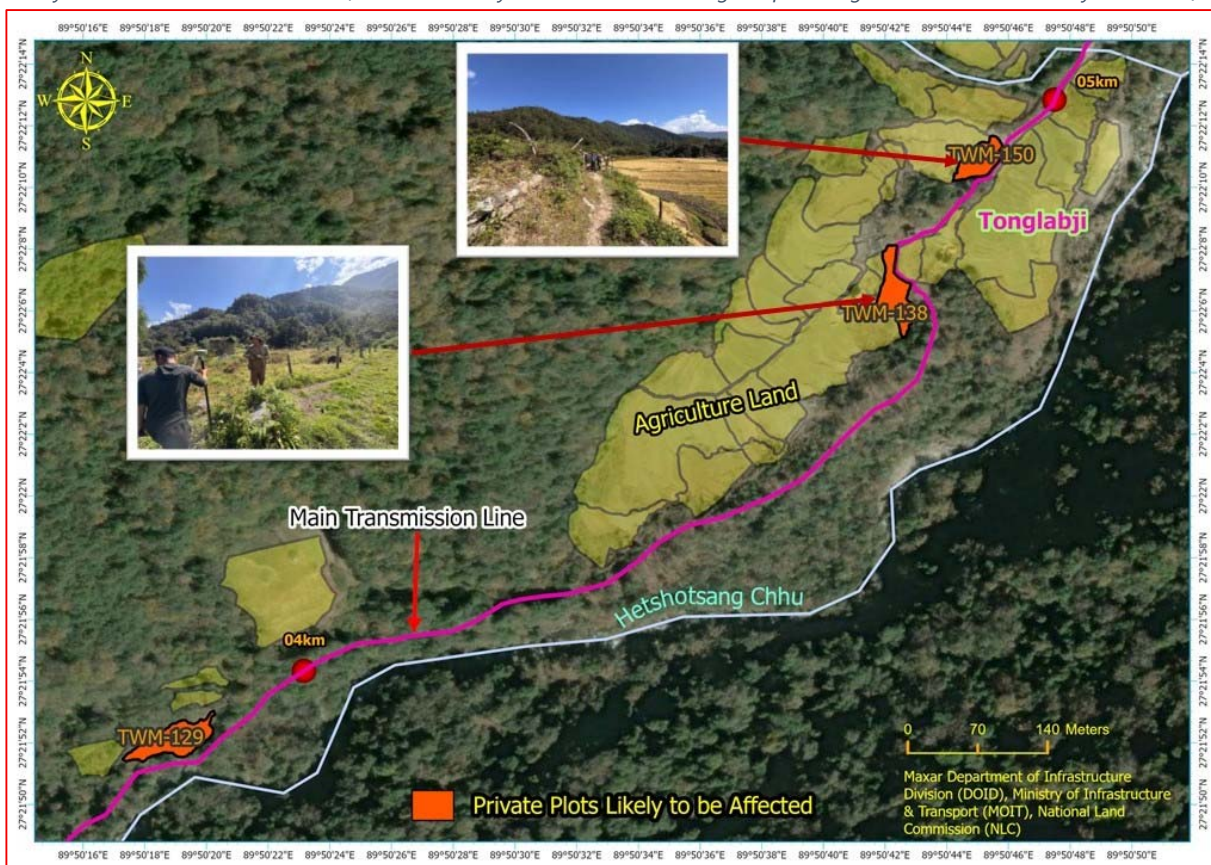
- Plot TWM-150 (Impact Avoided): The joint survey team confirmed that the pipeline alignment can be shifted onto the adjacent corridor of government land to avoid direct impact on the private agricultural plot. To make this feasible within the narrow available space, the team agreed to propose a specific engineering solution: an elevated or raised bed, supported by a retaining wall on the east side of the existing footpath, to carry the pipeline. This proposed design modification will be formally submitted to the project's design team for a full technical and financial feasibility assessment. If deemed viable, the detailed design will be updated

accordingly to ensure all construction is contained within the government-owned right-of-way, thereby completely avoiding any impact on Plot TWM-150.

- Plot TWM-129 (Impact Avoided): It was confirmed that by aligning the pipeline to follow the existing irrigation channel at this location, all construction activities can be contained within the channel's right-of-way, thus avoiding any encroachment onto the private land of Plot TWM-129.
- Plot TWM-138 (Impact Confirmed): After assessing all alternatives, it was confirmed that a temporary impact on a small portion of Plot No. TWM-138 is unavoidable. The exact boundaries of the required construction Right-of-Way (RoW) through this plot were demarcated and agreed upon with the landowner.

269. This proactive joint verification successfully reduced the number of directly affected agricultural plots from three to one.

Figure 38: Private agricultural land likely to be affected at Tonglabji and at Chainage Km 3.7, based on findings from the field survey conducted in October 2025. (Source: Final Hydraulic Structure Design Report, August 2025 & Field Survey Oct. 2025).



## **Resettlement Planning and Compensation:**

270. To address the remaining unavoidable impact on Plot TWM-138, the project will implement the following measures in accordance with its Resettlement Framework and ADB's Safeguard Policy Statement:

- Preparation of a Resettlement Plan (RP): The PIU will prepare a Resettlement Plan detailing the specific impacts on the affected household and the corresponding entitlements for compensation. This RP will be submitted to ADB for review and approval.
- Formal Agreement and Compensation: A formal, signed agreement will be executed with the affected landowner.
- Pre-Construction Compensation Disbursement: All compensation, including cash payments for lost crops at replacement cost and for the temporary loss of land use, will be fully disbursed to the affected household before the civil works contractor is given access to the site. The completion of this step is a mandatory prerequisite for commencing any construction on private land.

## **12. Management of Construction Camps, Storage, and Disposal Areas**

271. **Impacts.** The project will require the establishment of temporary facilities, including a site office, material laydown and stockpile yards, worker accommodation (if necessary), and equipment maintenance areas. The improper siting and management of these ancillary facilities can lead to a range of environmental and social impacts, including:

- Habitat degradation and loss of vegetation.
- Contamination of soil and water resources from fuel spills, improper waste disposal, and untreated wastewater.
- Social friction with local communities.
- Disturbance to local ecology and wildlife.

272. **Mitigation.** To prevent or minimize these impacts, the Contractor will be required to prepare and implement a comprehensive Camp Management Plan as part of their Site-Specific Environmental Management Plan (SEMP). This plan must be submitted to and approved by the PIU before any site establishment activities begin. The plan, and all subsequent operations, must adhere to the following mandatory conditions:

### *a) Site Selection Criteria*

- (i) Prohibited Locations: All construction camps, storage yards, and disposal areas are strictly prohibited in any of the following sensitive locations:
  - Within the boundaries of the Biological Corridor, Government Reserve Forests, or Community Forests.
  - On productive agricultural land.
  - Within 50 meters of any water body, including rivers, streams, and natural drainage channels.
  - On steep, erosion-prone slopes.
- (ii) Siting Approval: All proposed locations must be sited in environmentally and socially acceptable areas and receive prior approval from the PIU.

*b) Camp Layout and Management*

273. The Camp Management Plan must include a detailed layout and operational plan for all worker accommodation and ancillary facilities. The design and operation of these facilities must comply with all national regulations and shall be guided by international best practice, specifically the IFC/World Bank Group EHS Guidelines and the guidance note on "Workers' Accommodation: Processes and Standards." The plan must, at a minimum, incorporate the following specific requirements:

- (i) Detailed Layout Plan: The plan must include a site layout drawing showing the location of accommodation blocks, sanitation facilities, kitchens/canteens, water supply points, waste collection areas, fuel storage, and site drainage. Separate and secure accommodation areas and sanitation facilities for male and female workers must be clearly demarcated.
- (ii) Accommodation Standards:
  - o Structural Integrity: All accommodation structures must be structurally safe, weatherproof, and provide adequate protection from the elements.
  - o Space and Ventilation: The living space per worker shall not be less than 3.0 square meters. Rooms must be provided with adequate ventilation (e.g., windows) and natural/artificial lighting.
  - o Bedding: Each worker shall be provided with a separate bed. The sharing of beds is prohibited.
- (iii) Potable Water Supply:
  - o The Contractor shall provide a reliable and sufficient supply of safe potable water for all workers for drinking and cooking purposes, meeting the National Drinking Water Quality Standards (NDWQS).
  - o A separate, adequate supply of water for bathing, laundry, and general cleaning purposes must also be provided.
- (iv) Sanitation and Hygiene Facilities:
  - o Toilets and Showers: The Contractor shall provide an adequate number of clean and well-maintained toilets and showers, with a minimum ratio of one toilet per 15 workers. Facilities must be gender-segregated and provide privacy.
  - o Wastewater Management: All toilets ("black water") and showers/kitchens ("grey water") must be connected to a properly designed and maintained septic tank and soak pit system. The use of open pit latrines is strictly prohibited. Effluent from these systems must not be discharged directly into any water body.
  - o Handwashing: Handwashing stations with soap and running water must be provided at convenient locations, including outside toilets and near eating areas.
- (v) Solid Waste Management:
  - o A system for segregated solid waste collection must be implemented within the camp, with clearly labelled bins for organic, recyclable, and non-recyclable waste.
  - o All waste must be collected regularly and disposed of only at a government-approved disposal site. Open dumping or burning of waste on or near the project site is strictly prohibited.
- (vi) Canteen and Cooking Facilities:

- If the Contractor provides food, a dedicated, hygienic canteen and kitchen area must be established. Food preparation areas must be kept clean, and food handlers must adhere to strict hygiene standards.
- If workers cook for themselves, designated cooking areas with clean fuel sources (e.g., LPG) must be provided. The use of firewood collected from surrounding forests is prohibited.

c) *Social and Administrative Measures*

- (i) Local Employment: The Contractor will be required to maximize the employment of workers from local communities within the project area. This will minimize the need for establishing large external worker camps and will provide direct economic benefits to the host communities.
- (ii) Liaison with Authorities: The Contractor must formally notify the relevant local authorities (Gewog, health, and security officials) of the establishment and operation of any camp facilities to ensure proper surveillance and coordination.

### 13. Stakeholder Communication and Disclosure Plan

274. **Objective.** A robust Stakeholder Communication and Disclosure Plan will be implemented throughout the project's lifecycle. The objective is to ensure that all stakeholders, particularly local communities in Gasetsho Gom and Gasetsho Wom Gewogs, are kept fully informed of project activities and have formal channels for feedback and grievance redress. This proactive engagement is essential for building trust, managing expectations, and ensuring smooth project implementation.

**Communication Mechanisms.** Following an initial round of consultations, the project will continue its engagement through the following formal mechanisms:

a) *Ongoing Stakeholder Consultations*

275. Meaningful consultations will continue at key project milestones. These sessions will serve to disseminate information and gather feedback on:

- The final design of project components.
- Confirmed environmental and social impacts (both positive and negative).
- The specific mitigation measures outlined in the Environmental Management Plan (EMP).
- The functionality and contact details for the Grievance Redress Mechanism (GRM).

b) *Public Information Disclosure*

276. Information will be made accessible through various channels:

- Project Information Boards: Standardized information boards will be installed at prominent public locations within both Gewogs and at the main worksite. These boards will clearly display the project title, key activities, implementation schedule, and contact information for the PIU and the GRM focal person.
- Digital Disclosure: Key project documents, including this IEE and subsequent environmental monitoring reports, will be uploaded to the project's official website for public access.

c) *Awareness and Training Programs*

277. Targeted awareness programs will be conducted as part of the project's capacity-building efforts:

- **Community Awareness Sessions:** Before construction begins, public meetings will be held in the affected communities to provide detailed information on the construction schedule, potential temporary disruptions (e.g., noise, traffic), safety protocols, and the worker's code of conduct.
- **Worker Induction Training:** All project workers, including those of subcontractors, will undergo a mandatory induction that includes a session on conservation awareness. This training will cover the ecological sensitivity of the project area (especially the Biological Corridor), the strict prohibition on hunting and fishing, and the importance of respecting local customs and communities.

#### 14. Ensuring Contractor Compliance with Safeguard Requirements

278. **Impact and Risk.** A key risk to the project's environmental and social performance is the potential for non-compliance by the contractor with the requirements of the ADB Safeguard Policy Statement (SPS) and the project's Environmental Management Plan (EMP). This non-compliance can stem from a lack of awareness or, more commonly, from the failure to allocate a sufficient budget for safeguard implementation. This can lead to environmental degradation, social conflicts, and a breach of the project's loan covenants.

279. **Mitigation.** To mitigate this risk, a multi-faceted strategy will be implemented to ensure that all safeguard requirements are fully integrated into the procurement process and are legally binding upon the selected Contractor.

- a) *Contractual Integration of Safeguards:* The bidding and contract documents will include specific, non-negotiable clauses to ensure full compliance:
  - i. **EMP as a Binding Document and Bidding Annex:** The full Environmental Management Plan (EMP) as detailed in this IEE report will be included as an integral and binding part of the contract documents, making all its mitigation measures and monitoring requirements legally enforceable.
  - ii. **Priced EMP in Bill of Quantities (BoQ):** The Contractor will be required to submit a priced BoQ for the implementation of the EMP. This ensures that the costs for all environmental and social mitigation measures, including but not limited to traffic management, waste management, and EHS risk management, are budgeted for from the outset. Any bid not accompanied by a priced EHS/EMP plan may be rejected as nonresponsive.
- b) *Contractor Training and Capacity Building*
  - i. **Mandatory Induction:** Prior to the commencement of any works, the PIU will conduct a mandatory induction and awareness training for the Contractor's key management and site staff. This training will cover their specific responsibilities for implementing the EMP, OHS plan, Grievance Redress Mechanism (GRM), and all relevant ADB and government regulations.
- d) *Occupational Health and Safety (OHS) and Labour Standards*

The contract will specify mandatory adherence to national labour laws and OHS standards:

  - i. **OHS Costing:** The BoQ will include a separate, mandatory line item for OHS costs, to be estimated based on the guidelines in the Bhutan Schedule of Rates – 2020.
  - ii. **Labour Requirements:** The contract will explicitly state that the minimum age for employment is 18 years.

- iii. Accident Liability & Past Performance: The contract will confirm that the Contractor is fully liable for providing medical care and accident compensation for all employees in the event of any work-related injury or accident. Bidders will be required to declare their past performance related to EHS compliance, including any contract suspensions or terminations.
- iv. Health and Safety Plan and Code of Conduct: The Contractor will be required to develop and implement a comprehensive Health and Safety Plan that includes protocols for managing public health risks on-site. The submission of a site-specific EHS Management Plan (EHSMP) and a signed EHS Code of Conduct for all personnel will be a contractual requirement.

## **B. Anticipated Impacts and Mitigation Measures During the Construction Phase**

### **1. Impacts from Establishment of Construction Camps and Ancillary Facilities**

280. **Impacts.** The establishment of site offices, material storage yards, and worker camps will involve the clearing of vegetation and require dedicated water, sanitation, and power facilities. If improperly managed, these sites can become significant sources of pollution and social friction. Key risks include:

- Silt-laden runoff from cleared areas degrading nearby water bodies.
- Contamination from improper disposal of solid waste and untreated sanitary wastewater.
- The proliferation of disease vectors due to poor sanitation, posing health risks to both workers and adjacent communities.

281. **Mitigation.** The Contractor will be required to develop, submit for PIU approval, and implement a comprehensive Camp Management Plan as part of their SEMP. This plan must adhere to the following mandatory measures:

#### a) Site Selection and Establishment

- (i) Consultation and Approval: All site locations must be selected in consultation with the local Gewog administration and approved by the PIU prior to establishment. Sites should be located away from villages to minimize social disturbance.
- (ii) Prohibited Locations: No camps, storage yards, or ancillary facilities will be permitted within the Biological Corridor, Government Reserve Forests, Community Forests, or on productive agricultural lands.
- (iii) Minimize Vegetation Clearing: Sites must be located in areas that require minimal vegetation clearance. The felling of trees for establishing facilities is to be avoided. Any unavoidable tree loss must be compensated for as per the project's compensatory afforestation plan.

#### b) Camp Management and Environmental Controls

- (i) Sanitation: The Contractor will provide and maintain properly managed sanitation facilities (e.g., toilets connected to septic tanks) for all workers. Open pit latrines are not permitted.
- (ii) Waste Management: A system for segregated solid waste collection (organic, recyclable, and non-recyclable) must be implemented. All waste must be disposed of regularly at a government-approved disposal site. Open dumping or burning of waste is strictly prohibited.
- (iii) Erosion and Sediment Control: Diversion drains and silt traps will be installed around all cleared areas to prevent sediment-laden runoff from entering any water bodies.

- (iv) Public Health and Safety: The Contractor will be responsible for implementing a Public Health Plan, including adherence to all national health and safety protocols, to protect both workers and the local community.
- c) Site Demobilization and Restoration
- 1) Full Restoration: Upon completion of the work, the Contractor will be responsible for dismantling all temporary facilities, removing all waste and materials, and fully restoring all camp and storage sites to their original condition.
  - 2) Conditional Work Completion: The PIU will not issue the final work completion certificate until all restoration works have been completed to a satisfactory standard.

## 2. Impacts on Agricultural Land

282. **Impact:** Construction activities on the one affected agricultural plot (Plot No. TWM-138) will cause temporary impacts, including the loss of standing crops, disruption of farming activities, and potential degradation of soil quality if not managed properly.

283. **Mitigation Measures:** Following the completion of all pre-construction requirements (including compensation payments), the Civil Works Contractor will be contractually obligated to implement the following specific mitigation measures to minimize the impact on agricultural land:

- a) Timing of Works:
  - To the greatest extent feasible, the Contractor shall schedule construction activities through the agricultural plot during the off-season or post-harvest period (November to February) to minimize the impact on standing crops and active cultivation.
- b) Topsoil Preservation:
  - Before any excavation begins, the Contractor must carefully strip the fertile topsoil (approximately the top 15-20 cm) from the construction corridor and stockpile it separately from the subsoil. This topsoil must be protected from erosion and contamination.
- c) Minimization of Disturbance:
  - All construction activities, machinery movement, and material storage will be strictly confined to the demarcated 3.5-meter Right-of-Way (RoW) to prevent any encroachment on the remaining parts of the field.
- d) Land Restoration:
  - Decompaction: After the trench is backfilled, the Contractor is required to de-compact the soil within the RoW (e.g., through deep ploughing or ripping) to restore its aeration and structure for agricultural use.
  - Topsoil Replacement: The stockpiled fertile topsoil will then be evenly spread back over the RoW as the final surface layer.
  - Final Verification: The land must be restored to a condition that is equal to or better than its pre-project state. The successful restoration must be formally verified and signed off by the landowner and the PIU before the works are considered complete.

## 3. Impacts on Physical Cultural Resources (PCRs)

### 1. Known Physical Cultural Resources

284. **Impact.** The project alignment has been mapped against known Physical Cultural Resources (PCRs). The only identified PCR within 50 meters of the alignment is the Hetsokha Lhakang. The

Lhakhang is located below an existing farm road, while the pipeline alignment is situated on the upper slopes above the road. Due to this spatial separation, no direct physical impacts on the Lhakhang are anticipated. The primary potential impacts are indirect and temporary, limited to nuisance from noise, dust, and vibration during the construction phase.

Figure 39: Location of Hetsokha Lhakhang Showing Proposed Alignment of Transmission Mains (Source: Field Survey, Oct 2025)



285. **Mitigation.** To mitigate these indirect impacts and ensure the full protection of the Hetsokha Lhakhang, a site-specific mitigation strategy, developed in direct consultation with the Hetsokha community in October 2025, will be implemented by the Contractor. This approach moves beyond generic buffer zones to a methodology specifically tailored to the site's conditions and the community's cultural sensitivities.

The following measures are mandatory for all works within 50 meters of the Lhakhang:

- (i) **Prior Community Consultation and Work Scheduling:** The Contractor will consult with the Lhakhang's caretaker and the Hetsokha Tshogpa to identify periods of religious significance, festivals, or prayer ceremonies. All construction activities in this area will be scheduled to avoid these sensitive times.
- (ii) **Controlled and Gradual Excavation Method:**
  - o It was jointly acknowledged by the project team and the community that the rocky terrain makes purely manual excavation unfeasible.
  - o Therefore, the use of high-impact, high-vibration equipment such as heavy rock breakers is strictly prohibited.
  - o Instead, the Contractor will employ a "gradual and careful excavation method" using a small excavator with a bucket attachment to slowly break and remove the rock. This method was proposed by the community as a culturally sensitive alternative to minimize ground vibration.
- (iii) **Prohibition of Vibratory Compaction:** For backfilling the trench, the use of heavy vibratory rollers or plate compactors is prohibited. As requested by the community, the Contractor will

use simple rolling compaction or manual tamping to consolidate the backfill material, thereby avoiding any risk of vibration damage to the Lhakhang's structure.

- (iv) Dust and Noise Control: Strict and enhanced dust suppression measures (e.g., continuous water sprinkling) and noise controls will be rigorously applied for all activities in the vicinity of the Lhakhang.
- (v) Contractor Liability: The contract will explicitly state that the Contractor is fully and financially liable for the cost of repairing any accidental damage to the Lhakhang or any of its associated structures.

## **2. Chance Find Procedure for Unknown PCRs**

286. **Procedure.** While the project area is not a known archaeological site, a formal Chance Find Procedure is a mandatory safeguard for all excavation activities. This procedure ensures that any previously undiscovered artifacts or sites of historical, cultural, or archaeological importance are protected.

287. The Contractor will be contractually obligated to adhere to the following step-by-step procedure in the event of any chance finds:

- (vi) Stop Work Immediately: Cease all construction activities in the immediate vicinity of the find.
- (vii) Secure the Site and Notify: Secure the area to prevent unauthorized access, damage, or theft. Immediately notify the PIU Site Supervisor. The PIU will then be responsible for formally notifying the national Department of Culture.
- (viii) Assessment by Competent Authority: The Department of Culture & Dzongkha Development (or its designated official) will be responsible for assessing the significance of the find and determining the appropriate course of action (e.g., documentation, recovery, or preservation in situ).
- (ix) Await Formal Clearance: Construction work in the affected area shall not resume until the Department of Culture has completed its assessment and the PIU has provided formal written clearance to the Contractor.

## **4. Impacts on Local Access along Footpaths and Mitigation Measures**

288. **Impact:** A significant portion of the pipeline alignment, particularly the 5 km section within the Biological Corridor, has been strategically routed to follow existing traditional footpaths. While this design choice was made to minimize tree felling and new forest fragmentation, it will cause a direct, temporary impact on local community access. These footpaths are used by local residents for daily activities such as accessing community forests, grazing areas for cattle, and traveling between settlements.

289. During the construction phase, activities such as trench excavation, pipe stringing, welding, and backfilling will temporarily obstruct or close sections of these footpaths. This will create disruptions for local community members and their livestock, potentially forcing them to use longer, more difficult alternative routes. Furthermore, open trenches and the presence of construction machinery pose a direct safety risk to people and animals using these paths.

290. **Mitigation:** To manage these impacts and ensure the safety and continued access for the local community, the Contractor will be required to implement a site-specific Community Access Management Plan as part of their SEMP. This plan must include the following mandatory measures:

1. Community Consultation and Notification: The Contractor, in coordination with the PIU and local Gewog leaders, shall consult with the affected communities before starting work on any footpath section. Clear information will be provided on the schedule and duration of the planned works.
2. Phased Construction to Minimize Disruption: Construction along the footpaths will be conducted in short, manageable sections (e.g., a few hundred meters at a time). The "excavate-lay-backfill" cycle will be completed as quickly as possible in each section to minimize the time any part of the path is closed. The trench shall not be left open for more than 48 hours in any given section.
3. Provision of Safe, Alternative Access: Where a footpath section is temporarily closed, the Contractor will be responsible for providing and clearly marking a safe, short, and viable alternative bypass route for pedestrians and livestock.
4. Safe Crossing Points: Where active trenches must be crossed, the Contractor shall install sturdy, temporary footbridges (e.g., planks with handrails) to ensure safe passage for community members.
5. Site Safety and Barricading: All open trenches and hazardous work areas along the footpaths will be clearly demarcated with safety tape or temporary fencing to prevent accidental falls, especially during hours of low visibility.
6. Full Restoration: Upon completion of work in each section, the footpath will be fully restored to its original condition or better, ensuring it is safe and easily passable for the community.

## **5. Impacts on Existing Community Infrastructure**

291. The pre-construction community consultations in October 2025 were instrumental in identifying specific community and private assets located along the pipeline alignment that are at risk of damage or disruption during construction. The following section details these facility-specific impacts and their corresponding mandatory mitigation measures.

292. A Pre-Construction Joint Verification Survey will be a prerequisite for all the measures listed below. Before commencing work in any section, the Contractor, PIU, and community representatives will jointly walk the alignment to precisely map and mark all sensitive infrastructure.

### **a) Impacts on Irrigation Channels and Drinking Water**

293. **Overall Impact:** The 21.1 km pipeline alignment will unavoidably intersect or run parallel to several existing, community-managed irrigation systems that are critical for local agricultural livelihoods. During the October 2025 consultations, communities identified several high-risk locations where construction activities could cause physical damage to channels or spring sources, block water flow with sediment, or disrupt the water supply to paddy fields. As these communities have no alternative irrigation sources, any disruption poses a significant threat to their crop yields and food security.

294. The specific locations and potential impacts are detailed below:

### 1. Hetshokha Chiwog (approx. Chainage 4 km):

- **Nature of Impact:** The pipeline alignment directly overlaps for approximately 400 meters with a key irrigation channel that sources water from the Hetshotsangchhu. This channel is the primary irrigation source for seven households in Hetshokha village. Construction activities such as trenching and backfilling in this section will cause direct, temporary physical disruption to the channel. Refer figure 41 for the location of existing irrigation channel north of Tonglabji.

### 2. Shingkhay Khamay Chiwog (approx. Chainage 14 km):

- **Nature of Impact:** The alignment traverses a sensitive watershed area that serves as both a drinking water and irrigation source for the community. Construction poses a multi-faceted risk:
  - Risk to Spring Sources: The main transmission line passes between two perennial springs -Tashigyem Spring (above the alignment) and Lata Spring (below the alignment). Construction activities could contaminate these critical sources with sediment-laden runoff or physically damage their intake structures. In a worst-case scenario, ground disturbance could alter the hydrology and lead to the permanent degradation or loss of these springs. (Figure 42 for the locations of spring water sources of irrigation and drinking water).
  - Risk to Drinking Water Source: The main transmission line intersects the drinking water pipeline that supplies the Gasetsho-Wom Gewog Centre and two dependent households, and also passes directly above a spring water source serving one independent household. All affected residents rely solely on these sources for their potable water needs. Any physical damage or disruption during construction could severely compromise water availability, posing significant risks to public health and community well-being.
  - Risk to Irrigation Channels: The concrete irrigation channels fed by these springs are at risk of damage from nearby excavation. This system irrigates paddy fields for a total of 17 households (11 in Shingkhay Khamay and 6 in Khatay Chiwog).

### 3. Shingkhay Khatay Chiwog (approx. Chainage 15.9 km and 17.7 km):

- **Nature of Impact:** The community has identified two additional irrigation water sources and their associated channels that are likely to be intersected by the pipeline alignment at approximately km 15.9 (serving Shingkhay Khatay village) and km 17.7 (serving Phakha village). Damage at these crossing points would disrupt both irrigation and, in some cases, drinking water supply for these communities.

### Mitigation Measures for Impacts on Irrigation Channels

To prevent any disruption to agricultural livelihoods, the Contractor will be contractually required to implement the following site-specific protection and restoration measures for all affected irrigation channels and sources in Hetshokha, Shingkhay Khamay, and Shingkhay Khatay Chiwogs. These measures will be a core part of the Contractor's SEMP and a condition for commencing work in these sensitive areas.

#### 1. General Requirements for All Affected Locations:

- Pre-Construction Joint Survey: Before any earthworks begin, the Contractor's Site Supervisor, the PIU Engineer, and community representatives (led by the Tshogpa) will conduct a joint walkover survey to:
    - Precisely map and demarcate all irrigation channels, spring sources, and pipeline crossings.
    - Document the pre-construction condition of the infrastructure with dated photographs.
    - Mutually agree on the specific protection methods and timing of works.
  - Contractor Liability and Immediate Repair: The contract will explicitly state that the Contractor is fully liable for any damage to community infrastructure. Any damage must be repaired immediately to restore full functionality at the Contractor's cost.
  - Final Restoration and Verification: Upon completion, all affected channels and sites will be restored to their original condition or better, to be verified through a final joint inspection with community representatives before acceptance by the PIU.
2. Specific Measures by Location:
- a. Hetshokha Channel (approx. Chainage 4 km):
    - Seasonal Work Scheduling: As requested by the community, all major construction activities along the 400-meter overlapping section will be scheduled during the agricultural off-season (November to February) to the greatest extent feasible.
    - Contingency for In-Season Work: If any work must be carried out during the agriculture season, the Contractor is required to install a temporary bypass pipe to ensure the uninterrupted flow of irrigation water.
    - Phased Construction: Work will be conducted in short, manageable segments to minimize the duration of any potential disruption.
  - b. Shingkhay Khamay Channels and Springs (approx. Chainage 14 km):

The Contractor must implement a multi-layered mitigation strategy in this sensitive watershed area to address the distinct risks to drinking water sources, pipelines, and irrigation channels.

- Protection of Spring Sources (Taashigyem and Lata Springs):
  - A "No-Entry" and "No-Disturbance" buffer zone of at least 15 meters will be clearly demarcated around the intake points of both springs. No machinery, material storage, fuel handling, or waste disposal will be permitted within this zone.
  - Enhanced Sediment Control: A robust system of check dams, silt fences, and log barriers (covering an estimated 370 meters of the downslope area) will be installed *before* earthworks begin to prevent any sediment runoff into the springs or channels.
- Protection of Drinking Water Pipelines:
  - Manual Excavation: To prevent accidental pipe rupture, all excavation within 1.5 meters of the identified drinking water pipelines (serving the Gewog Centre and households) must be carried out by hand.
  - Provision of Alternative Water Supply: The Contractor must have a contingency plan in place. If any temporary, unavoidable disruption to the drinking water supply occurs,

the Contractor must immediately provide an alternative source of safe potable water (e.g., via tankers) to the affected households and the Gewog Centre for the full duration of the disruption.

- Protection of Irrigation Channels:
  - Structural Protection: The concrete irrigation channels will be protected from machinery and excavation activities. Where necessary, temporary physical barriers or supports will be put in place.
  - Maintain Flow: The Contractor must ensure that the channels remain clear of any construction debris and that irrigation flow is not impeded at any time.
- Seasonal Work Scheduling:
  - As requested by the community, all major construction activities along the 400-meter overlapping section will be scheduled during the agricultural off-season (November to February) to the greatest extent feasible

295. This combination of buffer zones, manual excavation, enhanced sediment control, and contingency planning is designed to safeguard all critical water infrastructure within this area.

- c. Shingkhay Khatay and Phakha Channel Crossings (approx. Km 15.9 and Km 17.7):
  - Protection at Crossings: At the points where the pipeline crosses these two irrigation channels, the Contractor will implement structural protection measures, such as temporary supports or shoring, to ensure the channels remain stable and functional during and after construction.
  - Ensure Continuous Flow: The Contractor must ensure that water flow in these channels is maintained throughout the construction period, using temporary diversions if necessary.

Figure 40: The main transmission line crossing and running parallel to the existing Irrigation channel of Hetshokha Chiwog (Source: Hydraulic Structure Design Report, Hesotshamchu IWSS, Wangdue Dzongkhag, Aug 2025. & Field survey, Oct. 2025)

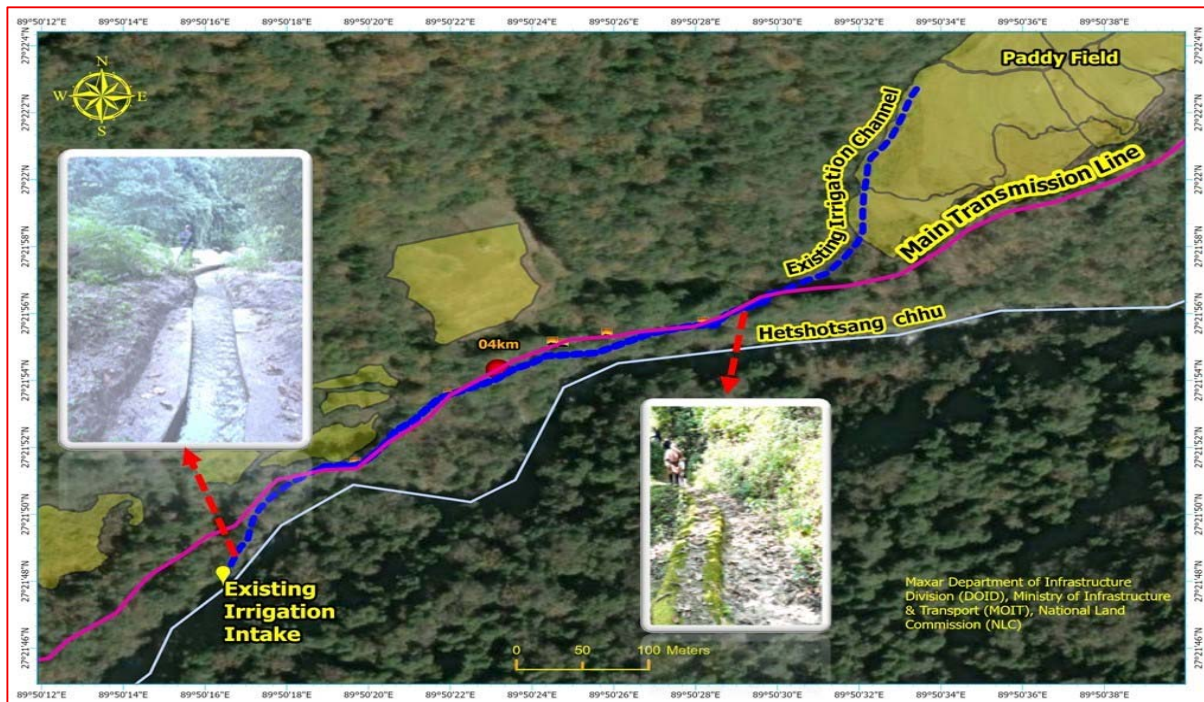


Figure 41: The main transmission line crossing and running parallel to the existing Irrigation water sources and Irrigation channel of Shingkhay Khamay Chiwog as well drinking water sources of 3 Households and the Gasetsho-Wom Gewog Centre. (Source: Hydraulic Structure Design Report, Hesotshamchu IWSS, Wangdue Dzongkhag, Aug 2025. & Field survey, October 2025)

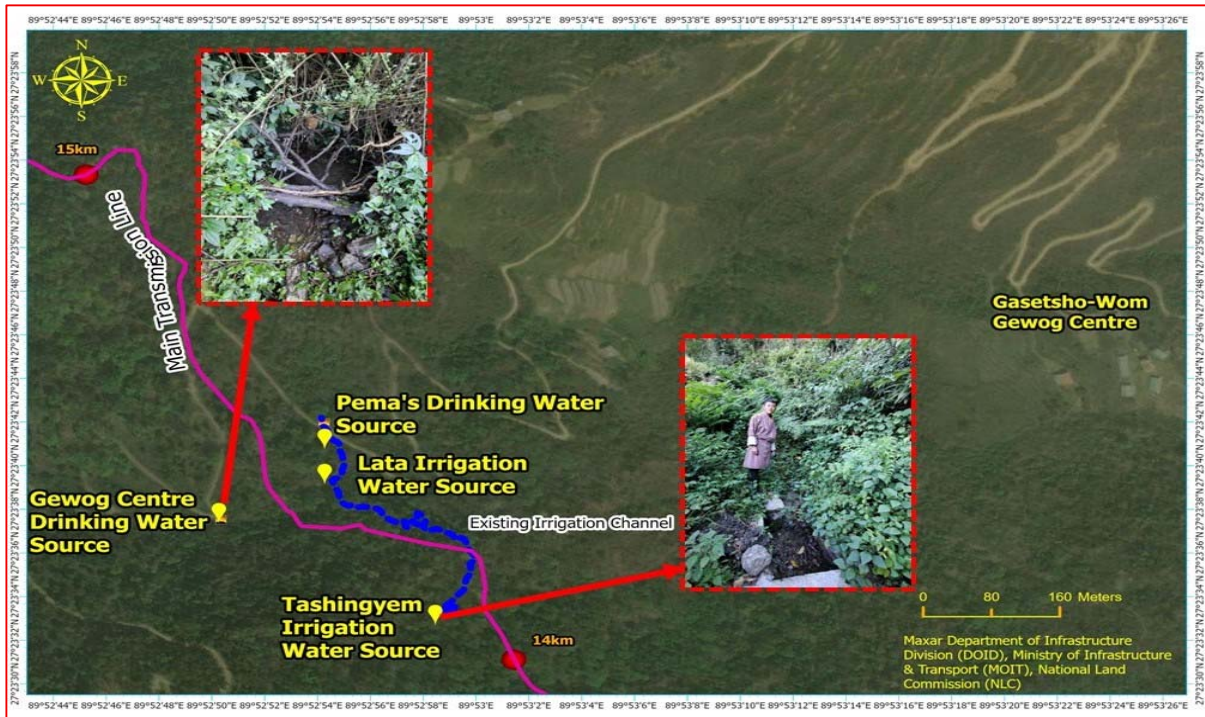


Figure 42: Existing irrigation channels and water sources of Tonglabji, Hetschokha Chiwog and Shingkhay Khamay Chiwogs (Source: Field Survey, October 2025)



## 6. Impacts on Farm Roads and Associated Infrastructure

### Overall Impact:

296. As shown in Figure 44, the pipeline alignment between approximately Chainage 5 km and 6 km runs directly alongside and frequently intersects the existing farm road serving Hetschokha, Tongchaykha, and Tonglabji villages. Community consultations confirmed that construction along this critical corridor poses a multi-faceted risk of disrupting community movement and damaging essential infrastructure. The specific impacts, visually confirmed during 13-15 October 2025, are detailed below.

### **1. Impact on Community Access and Movement**

297. Impact: Trenching and pipe-laying activities directly on or alongside the narrow farm road will temporarily block or restrict the primary route used by the community for daily travel between homes, agricultural fields at Tonglabji and Tongchaykha. This will cause significant disruption for pedestrians and any farm machineries & vehicles.

### **2. Impact on Road Surface and Drainage Structures**

298. Impact: The process of excavation along the farm road poses a direct risk to the road surface and its essential drainage infrastructure. The specific impacts are twofold:

- **General Risk to Drainage System:** The alignment intersects at least three existing culverts between Chainage 5 km and 6 km (refer to Figure 44). If these structures are damaged by machinery or blocked by construction spoil, it will impede the natural cross-drainage. This can lead to waterlogging on the road, accelerated erosion of the road surface, and potential localized flooding during rainfall.
- **Critical Risk at Thab Chhu Crossing:** The culvert over the Thab Chhu stream has been identified by the Hetshokha community as a point of particular concern. The structure is reportedly in a dilapidated condition and may not withstand the stress of construction traffic or nearby excavation. The failure of this specific culvert would be a critical issue, as it would completely cut off access for the people of Hetshokha to their agricultural lands in Tonglabji, severely impacting their livelihoods. This represents a significant, site-specific social and economic risk associated with the project's construction phase.

### **3. Impact on Utilities (Electric Poles and Water Taps)**

299. Impact: The map confirms the community's concerns by showing several critical utilities located on the edge of the road, directly in the path of or adjacent to the construction corridor:

- **Electric Poles:** The alignment passes in very close proximity to at least four existing electric poles (marked as red lines on the map, Figure 44 & 45). Excavation near the base of these poles could compromise their stability, posing a safety risk and disrupting power supply.
- **Private Water Tap:** In Tonglabji, the alignment passes extremely close to an outdoor private water tap (marked as a green star in the map, Figure 41), which is a key source of water for local resident.

### **Mitigation Measures for Farm Roads and Associated Infrastructure**

300. To address these site-specific risks, the Contractor will be required to implement the following measures as part of their SEMP.

#### **1. Pre-Construction Joint Survey:**

301. Before commencing any work along the farm road section, a joint walkover survey will be conducted with the Contractor, PIU, and community representatives. The survey will precisely map and mark the location of all culverts, side drains, electric poles, and water taps along the alignment. The pre-construction condition of the road and all assets will be documented with dated photographs.

#### **2. Community Access Management:**

302. To manage the temporary disruption to the farm road serving Hetshokha and Tonglabji, the Contractor will be required to implement the following measures:

- **Phased Construction:** All work along the road will be executed in short, rolling sections. The Contractor will be required to complete the excavate-lay-backfill cycle and restore passage in one section before moving to the next, minimizing the length of active disruption at any given time.
  - **Maintain Agricultural and Pedestrian Access:** A safe and continuous passage for community members and their livestock must be maintained at all times. Specifically, as requested by the community, the Contractor must ensure that a clear and stable access path, with a minimum width of 1.5 meters, is always available to allow for the movement of power tillers between Hetshokha and the agricultural fields in Tonglabji. This may require the use of temporary steel plates to cover open trenches.
  - **Continuous Community Consultation and Notification:**
    - **Advance Notification:** The Contractor, through the PIU, will provide the community with a clear work schedule at least one week in advance of starting work on the road section.
    - **On-site Coordination:** The Contractor's Site Supervisor must consult directly with the Tshogpa of Hetshokha Chiwog prior to commencing excavation in any new segment. This ongoing, on-the-ground coordination is mandatory to manage daily access needs and resolve any immediate issues.
3. **Protection of Road and Drainage Structures:**
- a. **General Protection of Drainage Structures:**
    - **Maintain Functionality:** The Contractor is required to keep all four existing culverts and all associated side drains along the farm road free from soil, construction debris, and other obstructions at all times to ensure that the natural drainage is not impeded.
    - **Damage Prevention:** Machinery and materials must be stored and operated in a manner that avoids causing any physical damage to the existing culvert structures.
  - b. **Specific Action for the Dilapidated Culvert over Thab Chhu Stream:**
    - **Community Request for Upgrade:** The project formally acknowledges the request from the Hetshokha community to upgrade the existing, dilapidated culvert over the Thab Chhu stream. The community proposed that the project replace this structure with a wider, more robust, multipurpose culvert capable of safely supporting both community vehicles (including power tillers) and the new transmission pipeline.
    - **Project Commitment to Assess:** In response to this goodwill request, the Project Implementation Unit (PIU) will conduct a technical and financial feasibility assessment for this proposed enhancement. The findings will be shared with the Dzongkhag administration and the community to determine the viability of including this upgrade within the project's scope.
  - c. **Road Surface Management and Final Restoration:**
    - **Damage Minimization and Repair:** The Contractor is required to operate heavy machinery in a manner that minimizes damage to the road surface and will be held fully liable for the immediate repair of any damages caused during construction.

- Full Restoration: Upon completion of all works, the entire affected road section, including its surface and all drainage structures, must be fully restored to its original or better condition. The final restoration will be formally verified through a joint inspection with the PIU and community representatives before the work is accepted as complete.

#### 4. Protection of Utilities:

303. To prevent damage to essential public utilities located along the farm road, the following specific protection measures are mandatory:

- Controlled Excavation in Proximity Zones:
  - Within a 3-meter radius of any identified electric pole and a 1.5-meter radius of the community water tap and its associated pipeline, standard bulk excavation with large machinery is prohibited.
  - In these controlled zones, the Contractor must use precision excavation methods. This may include the use of smaller machinery (e.g., excavator with smaller bucket) or pneumatic tools (e.g., jackhammers) to carefully break up rock and soil. The final excavation immediately adjacent to the utility must be completed using hand tools.
- Structural Support for Poles: If excavation is required to a depth that could compromise the stability of any electric pole, temporary structural supports (e.g., guy wires or bracing) must be installed before work begins in that area. This work shall be done in consultation with the relevant power utility authority.
- Contractor Liability for Damages: The contract will hold the Contractor fully and financially liable for the immediate repair and restoration of any damaged utilities. The Contractor must have a clear protocol for immediately notifying the PIU and the relevant utility provider in the event of any damage to ensure the swift restoration of services.

Figure 43: Detailed Alignment and Location of Sensitive Community Infrastructure in Hetshokha and Tonglabji (Source: Hydraulic Structure Design Report, Hesotshamchu IWSS, Wangdue Dzongkhag, Aug 2025. & Field survey, October 2025)

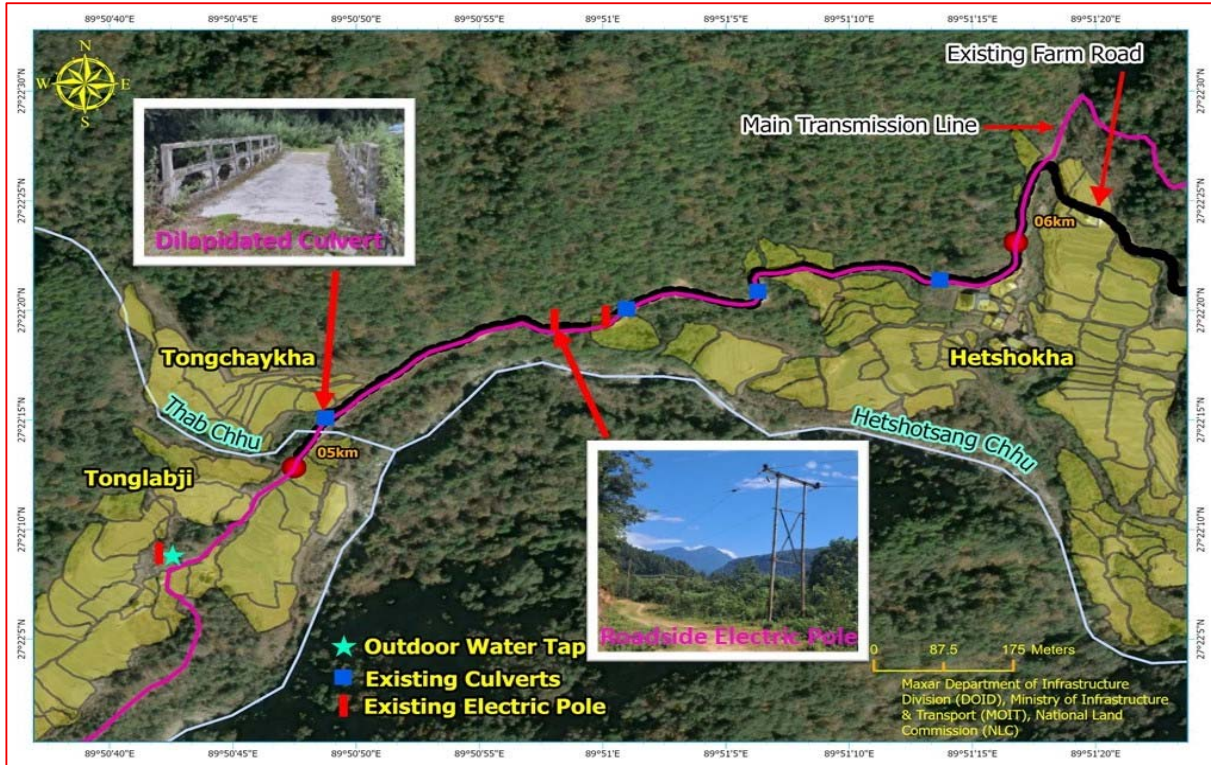


Figure 44: Photographs of Utilities and Culvert over Thab Chhu stream that are likely to be damaged during excavation works (Source: Field survey, October 2025)



## 7. Impacts from Transportation of Materials and Equipment

304. **Impacts.** The transportation of construction materials (sand, aggregates, pipes) and the movement of heavy machinery will generate a range of temporary, localized impacts. These include:

305. **Increased Traffic and Safety Risks:** Project-related vehicle traffic can increase congestion on local roads and pose safety risks to other road users and pedestrians.

- Air Pollution: Dust will be generated from the movement of vehicles on unpaved roads and from uncovered loads. Exhaust fumes from trucks and machinery will also contribute to local air pollution.

- Noise Pollution: The movement of heavy vehicles will generate noise, which can be a nuisance to nearby communities and sensitive receptors.
- Road Damage: Local farm roads and access tracks may be damaged by the repeated passage of heavy, loaded trucks.

306. **Mitigation.** To manage these impacts, the Contractor will be required to develop and implement a comprehensive Traffic Management Plan as part of their SEMP. This plan will include the following mandatory measures:

*a) Traffic and Road Safety Management*

- (i) Scheduling: Transportation of materials will be scheduled during off-peak hours where possible to minimize disruption to local communities.
- (ii) Road Maintenance: The Contractor will be responsible for maintaining the access roads used by project vehicles in a safe, passable condition and for repairing any damage caused by project traffic.
- (iii) Safe Stockpiling: The temporary stockpiling of materials along roadsides must be done in a manner that does not obstruct traffic flow or create safety hazards for the public.

*b) Dust and Air Pollution Control*

- (i) Covered Loads: All trucks transporting loose materials (sand, soil, aggregates) must be fitted with securely fastened tarpaulin covers to prevent dust emissions during transit.
- (ii) Dust Suppression: Regular watering of unpaved access roads and active work areas will be conducted, particularly during dry and windy conditions, to suppress dust.
- (iii) Vehicle and Equipment Maintenance: All project vehicles and machinery will be maintained in good working order and regularly serviced to ensure compliance with national (RSTA) emission standards and to minimize visible exhaust smoke.

## **8. Impacts of Temporary Access Path Construction on Hilly or Steep Terrain**

307. **Impacts.** The construction of temporary access paths along the pipeline alignment on steep, mountainous terrain poses significant environmental and safety risks. Poorly planned or executed works can lead to:

- Slope Destabilization and Landslide Risk: Improper cutting into slopes can trigger soil erosion, slope failure, and landslides, particularly during the monsoon.
- Habitat Degradation: The physical construction footprint, combined with the downslope-disposal of excavated material, can destroy a much wider swath of vegetation and habitat than just the path itself.
- Occupational Health and Safety (OHS): Working with machinery on unstable, steep ground presents a high risk of accidents for construction personnel.

308. **Mitigation.** A systematic and environmentally sound approach to access path construction is mandatory. The Contractor will be required to adhere to the final alignment approved by the PIU and DoFPS and implement the following measures:

- a) *Planning and Pre-construction*
  - (i) Precise Demarcation: Prior to any clearing, the approved alignment and its boundaries will be clearly staked and marked on the ground to prevent unnecessary vegetation removal and over-cutting.
- b) *Excavation and Spoil Management*
  - (i) Strict Prohibition on Side-Casting: The indiscriminate dumping or pushing of excavated soil, rock, and debris ("spoil") downslope is strictly forbidden.
  - (ii) Controlled Spoil Disposal: All excess spoil material must be collected and transported to pre-approved and properly engineered disposal sites, as defined in the Spoil Management Plan (SMP).
  - (iii) Controlled Tree Felling: Trees will be felled directionally (inward toward the alignment) to prevent damage to adjacent vegetation and to ensure logs do not roll downslope.
- c) *Construction Techniques and Equipment*
  - (i) Minimize Blasting: The use of explosives will be minimized. Where rock removal is necessary, preference will be given to mechanical methods such as ripping with an excavator bucket or using hydraulic hammers.
  - (ii) Controlled Blasting: If blasting is unavoidable, "controlled" blasting techniques will be employed to minimize noise, vibration, and over-break.
  - (iii) Appropriate Machinery: Hydraulic excavators suitable for steep terrain will be used to minimize the construction footprint and enhance operational safety.
- d) *Slope Stabilization and Drainage*
  - (i) Temporary Drainage: Temporary drainage channels (catch drains) will be constructed along the access path to safely convey rainwater and prevent the formation of erosive gullies.
  - (ii) Slope Stabilization: In critically steep or unstable sections, engineered slope stabilization measures, such as retaining walls and bioengineering (e.g., jute netting, planting of native grasses), will be implemented concurrently with the construction.

## **9. Impacts and Mitigation for Works within the Biological Corridor and Government Reserve Forest**

309. **Impacts.** All construction activities within the Biological Corridor and Government Reserve Forest will cause temporary but direct impacts. These include localized habitat disturbance from vegetation clearing and excavation, noise and dust from machinery, and potential disruption to wildlife movement. Without stringent controls, these activities could degrade the ecological integrity of these nationally important protected areas.

310. **Mitigation:** Special Environmental Management Protocols. To ensure the highest level of protection for these sensitive areas, the Contractor will be contractually required to implement the following Special Environmental Management Protocols. These protocols supplement the general EMP and are mandatory for all works within the Biological Corridor and Government Reserve Forest.

- a) *Work Protocols and Timing*
  - (i) Seasonal Scheduling: All major in-stream and earthworks will be scheduled during the lean season to minimize erosion risk and avoid periods of high biological activity.

- (ii) Daylight Working Hours: All construction activities will be strictly limited to daytime hours (from dawn until dusk) to allow for free and undisturbed movement of wildlife at night.
  - (iii) Controlled Excavation: The use of smaller, appropriate machinery (e.g., handheld or mini excavators) is required to minimize the construction footprint. The depth of excavation will be limited to the minimum required for pipe safety.
  - (iv) Blasting Prohibition: The use of conventional explosives is prohibited. Where hard rock is encountered, "controlled blasting" techniques must be used.
- b) *Site Establishment and Waste Management*
- (i) Prohibited Facilities: The establishment of any worker camps, equipment yards, or material storage areas within the boundaries of the Biological Corridor or Government Reserve Forest is strictly forbidden.
  - (ii) Waste Management: Indiscriminate dumping of any construction debris, spoil, or waste is strictly prohibited. All waste materials must be collected and disposed of at pre-approved sites outside of sensitive areas.
- c) *Habitat Restoration and Compensation*
- (i) Compensatory Afforestation: The project will fully fund a compensatory afforestation program, to be implemented by the DoFPS, to compensate for all trees felled. The program will use native species selected by DoFPS.
  - (ii) Progressive Restoration: All disturbed areas will be progressively restored as work is completed. This includes re-contouring the land and using bioengineering methods on steep slopes to ensure long-term stability and facilitate natural regeneration.
- d) *Biodiversity Protection and Compliance*
- (i) Worker's Code of Conduct: The Contractor will enforce a strict Worker's Code of Conduct that explicitly prohibits hunting, fishing, poaching, and the collection of any forest products by any project personnel. Mandatory awareness training on this code and the legal penalties under the Forest and Nature Conservation Act will be provided to all workers.
  - (ii) Consultation with DoFPS: All work plans and schedules within these protected areas will be developed in close consultation with, and be subject to the approval of, the Chief Forest Officer of the Wangdue Phodrang Forest Division.

## 10. Soil Erosion

311. **Impact.** Soil erosion is a primary environmental risk associated with the project, given that construction activities—including excavation for the pipeline trench, establishment of access paths, and clearing of ancillary sites—will take place on the region's steep, mountainous terrain. During rainy periods, exposed soil can be easily washed away by surface runoff. This can destabilize slopes, lead to the loss of valuable topsoil, and cause sedimentation of the Hetshotsangchhu and its tributaries, degrading water quality and aquatic habitats.

312. **Mitigation.** The Contractor will be required to prepare and implement a site-specific Erosion and Sediment Control Plan (ESCP) as part of their SEMP. This plan will be a condition for the commencement of any earthworks and must incorporate the following mandatory measures:

- a) *Work Planning and Exposure Minimization*
  - (i) The extent and duration of soil exposure will be minimized at all times. Construction will be phased to the extent possible, and disturbed areas will be progressively rehabilitated rather than left exposed until the end of the project.
  - (ii) Major earthworks will be scheduled to avoid the peak monsoon season where feasible.
- b) *Spoil and Stockpile Management*
  - (i) The indiscriminate dumping or side-casting of excavated material (spoil) is strictly prohibited. All excess spoil will be collected and transported to pre-approved disposal sites as defined in the Spoil Management Plan.
  - (ii) Temporary stockpiles of soil and other materials will be located away from drainage paths, covered with tarpaulins, and surrounded by silt fences to contain any runoff.
- c) *Runoff and Sediment Control Measures*
  - (i) Structural controls such as silt fences, check dams, and temporary diversion drains will be installed down-slope of all construction areas and material stockpiles. These measures will intercept and slow runoff, allowing sediment to settle before the water enters natural drainage channels.
  - (ii) All backfilled trenches will be properly compacted to prevent subsidence and the formation of erosive channels.
- d) *Site Stabilization and Restoration*
  - (i) Upon completion of work in any given area, all disturbed surfaces will be promptly stabilized and revegetated with native grasses and shrubs to provide long-term protection against erosion.

## 11. Impacts on Surface Water Quality

313. **Impacts.** Construction activities pose a direct risk to the surface water quality of the Hetshotsangchhu and its tributaries, particularly during the monsoon season. Runoff from the project site can transport pollutants into the river system, leading to temporary but significant degradation. The primary risks are:

- **Sediment Runoff:** Exposed soil from the pipeline trench, access paths, and material stockpiles can be easily eroded by rainfall, increasing the turbidity (suspended solids) of the river. This can harm aquatic life and degrade downstream habitats.
- **Chemical Contamination:** Spills or leaks of fuel, oils, and lubricants from construction machinery and storage areas can contaminate both soil and water, introducing toxic substances into the aquatic environment.
- **Waste Contamination:** Improper disposal of solid waste and untreated sanitary wastewater from worker camps can pollute the river with pathogens and other contaminants.

314. **Mitigation.** To protect surface water quality, the Contractor will be required to prepare and implement a comprehensive Water Quality Management Plan as part of their SEMP. This plan must include the following mandatory measures:

- a) *Erosion and Sediment Control*
- (i) Seasonal Scheduling: All major earthworks and in-stream activities shall be scheduled during the dry season to the greatest extent feasible, avoiding the peak monsoon months.
  - (ii) Sediment Barriers: Silt fences, check dams, and other sediment barriers shall be installed and maintained down-slope of all construction areas, stockpiles, and spoil disposal sites to intercept runoff before it reaches any water body.
  - (iii) Proper Backfilling: All backfilled trenches will be properly compacted in layers to prevent subsidence and erosion.
- b) *Hazardous Materials and Chemical Management*
- (i) Designated Storage: All fuel, oil, and chemical storage shall be located on an impervious base within a secure, bunded area at least 50 meters away from any water body. The bunded area must have a capacity of 110% of the largest container stored within.
  - (ii) Controlled Refuelling and Maintenance: Vehicle and equipment refuelling and maintenance shall occur in a designated, protected area away from water bodies.
  - (iii) Spill Response: A fully stocked spill response kit will be maintained on-site at all times, and workers will be trained in its use.
- c) *Site and Waste Management*
- (i) Camp and Stockpile Setbacks: Worker camps, toilets, and material stockpiles shall be located at least 50 meters away from the Hetshotsangchhu or any other watercourse.
  - (ii) Waste Disposal: All solid waste and wastewater from camp facilities will be managed and disposed of at approved off-site locations, in accordance with the Camp Management Plan.
- d) *Water Quality Monitoring*
- (i) Regular Monitoring: Water quality monitoring will be conducted as specified in the Environmental Management Plan (EMP), with samples taken upstream and downstream of major work areas, particularly after significant rainfall events, to ensure mitigation measures are effective. Key parameters will include turbidity and pH.

## 12. Impacts on Surface Water Quality

315. **Impacts.** Construction activities pose a direct risk to the surface water quality of the Hetshotsangchhu and its tributaries, particularly during the monsoon season. Runoff from the project site can transport pollutants into the river system, leading to temporary but significant degradation. The primary risks are:

- Sediment Runoff: Exposed soil from the pipeline trench, access paths, and material stockpiles can be easily eroded by rainfall, increasing the turbidity (suspended solids) of the river. This can harm aquatic life and degrade downstream habitats.
- Chemical Contamination: Spills or leaks of fuel, oils, and lubricants from construction machinery and storage areas can contaminate both soil and water, introducing toxic substances into the aquatic environment.
- Waste Contamination: Improper disposal of solid waste and untreated sanitary wastewater from worker camps can pollute the river with pathogens and other contaminants.

316. **Mitigation.** To protect surface water quality, the Contractor will be required to prepare and implement a comprehensive Water Quality Management Plan as part of their SEMP. This plan must include the following mandatory measures:

a) *Erosion and Sediment Control*

- (i) Seasonal Scheduling: All major earthworks and in-stream activities shall be scheduled during the dry season to the greatest extent feasible, avoiding the peak monsoon months.
- (ii) Sediment Barriers: Silt fences, check dams, and other sediment barriers shall be installed and maintained down-slope of all construction areas, stockpiles, and spoil disposal sites to intercept runoff before it reaches any water body.
- (iii) Proper Backfilling: All backfilled trenches will be properly compacted in layers to prevent subsidence and erosion.

b) *Hazardous Materials and Chemical Management*

- (i) Designated Storage: All fuel, oil, and chemical storage shall be located on an impervious base within a secure, bunded area at least 50 meters away from any water body. The bunded area must have a capacity of 110% of the largest container stored within.
- (ii) Controlled Refuelling and Maintenance: Vehicle and equipment refuelling and maintenance shall occur in a designated, protected area away from water bodies.
- (iii) Spill Response: A fully stocked spill response kit will be maintained on-site at all times, and workers will be trained in its use.

c) *Site and Waste Management*

- (i) Camp and Stockpile Setbacks: Worker camps, toilets, and material stockpiles shall be located at least 50 meters away from the Hetshotsangchhu or any other watercourse.
- (ii) Waste Disposal: All solid waste and wastewater from camp facilities will be managed and disposed of at approved off-site locations, in accordance with the Camp Management Plan.

d) *Water Quality Monitoring*

- (i) Regular Monitoring: Water quality monitoring will be conducted as specified in the Environmental Management Plan (EMP), with samples taken upstream and downstream of major work areas, particularly after significant rainfall events, to ensure mitigation measures are effective. Key parameters will include turbidity and pH.

### **13. Impacts on Air Quality**

317. **Impacts.** Construction activities will temporarily degrade the local air quality. The primary impacts are:

- Dust Generation (Particulate Matter): Excavation, material transportation, and vehicle movement on unpaved surfaces will generate significant dust, especially during dry and windy conditions.
- Exhaust Emissions: The operation of construction vehicles, machinery, and generators will release gaseous pollutants, including Nitrogen Oxides (NO<sub>x</sub>), Carbon Monoxide (CO), and Sulphur Oxides (SO<sub>x</sub>), which will add to the already elevated background levels of NO<sub>2</sub>.

318. The significance of these impacts is greatly amplified by the area's specific atmospheric conditions. The baseline monitoring has established that the local airshed has a very poor natural dispersion capacity, with calm conditions prevailing 50% of the time. This means that pollutants are not easily diluted or carried away, but instead tend to linger and accumulate near their source.

319. The release of NO<sub>x</sub> from machinery is of particular concern, as it will exacerbate the already elevated background levels of Nitrogen Dioxide (NO<sub>2</sub>), which already exceed WHO health guidelines. While much of the alignment is in forested areas away from community settlements, this poor dispersion poses a direct health risk to on-site workers and can degrade the sensitive ecosystem of the Biological Corridor.

320. Mitigation. The Contractor will be required to prepare and implement a comprehensive Air Quality Management Plan as part of their SEMP. This plan must include the following mandatory measures:

*a) Dust Control and Management*

- (i) **Water Suppression:** Active work areas, unpaved access roads, and material stockpiles shall be regularly sprayed with water to suppress dust, especially during dry periods.
- (ii) **Covered Transport and Stockpiles:** All trucks transporting loose materials (soil, sand) must be fitted with securely fastened tarpaulin covers. Stockpiles left idle shall also be covered.
- (iii) **Vehicle Speed Limits:** Strict speed limits will be enforced for all project vehicles on unpaved roads to minimize dust generation.
- (iv) **Vehicle Cleaning at Exit Points:** At the exit points of all major material stockpile areas, quarry sites, and spoil disposal sites, the Contractor shall establish and operate a vehicle cleaning station. All trucks must have their wheels and undercarriages washed down before entering public roads to prevent the tracking of mud and dirt, which is a major source of road dust.

*b) Emission Control from Vehicles and Machinery*

- (i) **Regular Maintenance:** All vehicles and machinery will undergo regular maintenance in accordance with manufacturers' specifications to ensure efficient fuel combustion and compliance with national (RSTA) emission standards.
- (ii) **Reduced Idling:** The unnecessary idling of engines is strictly prohibited. Machines and vehicles shall be shut off when not in use.

*c) Work Practices and Site Management*

- (i) **Sequential Construction:** Work will be conducted sequentially (excavation, pipe laying, immediate backfilling) to minimize the area and duration of exposed soil at any given time.
- (ii) **Spoil Management:** Excess excavated soil will be removed from the worksite promptly and transported to a pre-approved disposal area. Stockpiling of spoil material on-site will be minimized.

*d) Monitoring*

- (i) **Visual Monitoring:** The PIU Site Supervisor will conduct daily visual inspections for excessive dust or smoke emissions.

- (ii) Instrumental Monitoring: Ambient air quality monitoring will be conducted periodically as specified in the Environmental Management Plan (EMP) to ensure that mitigation measures are effective and standards are not exceeded.

#### 14. Impacts Due to Noise and Vibration

321. **Anticipated Impacts.** During the construction phase, a significant and highly perceptible increase in ambient noise levels is expected. Noise and vibration will be generated by:

- The operation of heavy machinery (excavators, generators).
- The movement of transport vehicles.
- Construction activities such as cutting and pipe handling.

322. The baseline noise monitoring confirmed that the project area is an extremely quiet, rural environment. The night-time ambient noise level (46.14 dBA) is already slightly above the WHO's health-based guideline (< 45 dBA) for preventing sleep disturbance. This establishes that the acoustic environment, particularly at night, is highly sensitive and has no capacity to absorb additional noise without causing significant adverse impacts.

323. Any noise generated by the project will therefore be highly intrusive, posing a risk of:

- Disturbance to Wildlife: Disrupting the behaviour of sensitive fauna within the Biological Corridor, especially nocturnal species accustomed to near-silence.
- Nuisance to Communities: Causing annoyance and sleep disturbance to residents in nearby settlements.
- Disruption to Sensitive Receptors: Interfering with the tranquillity of the Hetshokha Lhakhang.

324. **Mitigation Measures.** Given the highly sensitive acoustic environment, the Contractor will be required to prepare and implement a comprehensive Noise and Vibration Management Plan as part of their SEMP. This plan must include the following mandatory measures:

*a) Work Scheduling and Timing Controls*

- (i) Strict Daytime Working Hours: All construction activities generating significant noise will be strictly limited to daytime hours (e.g., 08:00 to 18:00). No night-time work is permitted. This is a critical measure to protect the sensitive night-time environment.
- (ii) Consultation with Sensitive Receptors: The Contractor will coordinate with the caretakers of the Hetshokha Lhakhang and local community leaders to schedule noisy works to avoid periods of religious ceremonies, festivals, or other sensitive occasions.

*b) Equipment and Source Controls*

- (i) Well-Maintained Equipment: All machinery and vehicles must be kept in good working order and fitted with effective, manufacturer-recommended exhaust silencers.
- (ii) Blasting Controls: Conventional blasting is prohibited. Where hard rock removal is necessary, "Controlled blasting" techniques must be used to minimise noise and vibration impacts.
- (iii) Prohibition on Unnecessary Horn Use: Vehicle horns shall only be used for essential safety warnings.

c) *Monitoring and Compliance*

- (i) Regular Monitoring: The PIU will conduct periodic noise monitoring at sensitive receptor locations during the construction phase to verify compliance with the NEC ES 2020 daytime limit of 65 dBA.

## 15. Impacts on Community Health and Safety

325. **Impacts.** The project's primary interface with the public will be in and around Hetshokha village. While overall traffic congestion is not anticipated on the low-volume farm roads, the movement of heavy construction vehicles on these narrow, unpaved, and steep roads poses a significant safety risk, particularly to pedestrians and students walking to and from school. Additionally, physical hazards from open trenches and the conduct of the construction workforce can create safety and social risks for the community.

### Mitigation.

a) *Traffic and Pedestrian Safety*

- (i) Driver Conduct and Speed Limits: All project drivers will be educated on safe driving practices. A strict speed limit of 20-25 km/h will be enforced for all project vehicles operating near settlements, schools, and on farm roads. The use of horns will be prohibited unless absolutely necessary to prevent an accident.
- (ii) Traffic Management: Trained flagpersons will be deployed to manage the safe passage of traffic and pedestrians around active work sites on local roads.
- (iii) Controlled Parking: Vehicles and machinery will only be parked in pre-designated, earmarked areas. Parking on narrow road sections or in a manner that obstructs local traffic is strictly prohibited.

b) *Site Safety and Hazard Management*

- (i) Site Demarcation: All active work sites will be clearly demarcated with warning signs and safety barricades to prevent unauthorized public access.
- (ii) Trench Management: In areas near villages or houses, open trenches will be backfilled or securely covered within 48 hours of excavation to minimize hazards.

c) *Public Health and Worker Conduct*

- (i) Adherence to International Standards: The Contractor will be required to follow international best practices on community health and safety, such as those in Section 4.3 of the World Bank Environmental Health and Safety (EHS) Guidelines on Construction and Decommissioning Activities<sup>18</sup>.
- (ii) Worker's Code of Conduct: A mandatory Code of Conduct will be enforced for all project personnel as a condition of employment. This code will explicitly prohibit:
- o Trespassing on private property.
  - o Open defecation, littering, and unauthorized firewood collection.
  - o Setting of fires except in designated and controlled locations.
  - o Restricting worker movement to designated work areas
  - o Unauthorized overstaying at construction sites.

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<sup>18</sup> IFC World Bank Group. 2007. Environmental, Health, and Safety (EHS) Guidelines – General EHS Guidelines: Construction and Decommissioning.

- Undertaking potentially dangerous work without the use of proper Personal Protective Equipment (PPE).
- (iii) Public Health Protocols: The Contractor will be responsible for implementing a health plan that includes proper site sanitation and adherence to all national guidelines for preventing the spread of infectious diseases.
- d) *Community Communication and Grievance Redress*
  - (i) Advance Notification: The Contractor, through the PIU and Gewog administration, will provide the local community with advance notification of all construction schedules and potential temporary disruptions.
  - (ii) Grievance Mechanism: The project's Grievance Redress Mechanism (GRM) will be made clearly accessible. A formal complaint logbook will be maintained at the worker's camp and site office to ensure all complaints are officially recorded, tracked, and addressed promptly.
- e) *Control of Construction Nuisance*
  - (i) Restriction on Work Hours: To minimize disturbance to nearby residents, no nighttime construction activities, including material or waste haulage, will be permitted near or within residential areas between the hours of 9:00 PM and 7:00 AM.

## 16. Impacts on Occupational Health and Safety

326. **Anticipated Impacts and Risks.** Construction activities inherently expose workers to a range of occupational health and safety risks. Key risks for this project include:

- Physical Hazards: Accidents arising from the operation of moving vehicles and machinery, excavation on steep terrain, and the handling of heavy materials.
- Exposure Hazards: Health issues resulting from prolonged exposure to construction dust, vehicle and machinery exhaust fumes, and high levels of noise.
- Health and Sanitation Risks: The potential for the spread of communicable diseases is a significant concern, particularly if worker camps are established with inadequate sanitation and hygiene facilities.
- Worker Fatigue: Failure to adhere to regulated working hours can lead to fatigue, increasing the likelihood of accidents.

### **Mitigation: Occupational Health and Safety (OHS) Plan**

327. The Contractor will be contractually required to develop, implement, and maintain a comprehensive Occupational Health and Safety (OHS) Plan for the project. This plan must be approved by the PIU prior to the commencement of any works and must, at a minimum, incorporate the following components:

- a) Hazard Identification and Site Safety
  - i. The plan will be based on a Hazard Identification and Risk Assessment (HIRA) specific to the project's activities and site conditions.
  - ii. All work areas will be properly managed to prevent accidents, including the use of clear signage, barricades around open excavations, and adequate lighting.
- b) Worker Health and Welfare

- i. Compliance with Law: The plan must ensure full compliance with Bhutan's Labour and Employment Act of 2007 and its associated regulations, including the Regulation on Occupational Health, Safety and Welfare 2012.
  - ii. Sanitation and Hygiene: The Contractor will provide adequate sanitation facilities, clean drinking water, and proper waste management at all work sites and in any established camps.
  - iii. Infectious Disease Control: A protocol for managing communicable diseases will be a mandatory part of the OHS plan. This will include adherence to all prevailing national guidelines for preventing the spread of infectious disease outbreaks, covering aspects such as worker health screening, hygiene protocols, and procedures for managing any potential cases on-site.
- c) Personal Protective Equipment (PPE)
- i. The Contractor will provide all workers with appropriate, task-specific PPE (e.g., helmets, safety boots, gloves, high-visibility vests, dust masks, hearing protection) free of charge.
  - ii. The plan will include procedures for ensuring the proper use and maintenance of all PPE.
- d) Emergency Preparedness and Response
- i. Emergency Procedures: Clear and simple procedures for responding to accidents and emergencies will be established and communicated to all workers.
  - ii. First Aid: A fully stocked first-aid station will be readily accessible at every primary worksite.
  - iii. Emergency Contacts and Transport: A list of emergency contact numbers (hospital, PIU, etc.) will be visibly posted. The Contractor will ensure that reliable emergency transport is available to transfer any injured or ill worker to the nearest medical facility.
- e) Training, Awareness, and Responsibility
- i. OHS Officer: The Contractor will appoint a dedicated and trained OHS Officer who will be responsible for overseeing the implementation of the OHS Plan.
  - ii. Induction Training: All workers will receive mandatory OHS induction training before starting work. This will include awareness programs on site-specific hazards, safe work practices, and social issues such as human trafficking and the prevention of sexually transmitted diseases (STDs).
- f) Worker Rights and Compensation
- i. Zero-Tolerance for Fatalities: The OHS plan will affirm a zero-tolerance policy for work-related fatalities.
  - ii. Compliance with Compensation Laws: The Contractor will be fully liable for providing medical care and compensation for any work-related injury, illness, or loss of life, in strict accordance with national laws. Specifically, the Contractor must adhere to all provisions of the "Labour and Employment Act of 2007" and the "Compensation Rules and Regulations for Workmen, 2009" (or the latest superseding regulation).
  - iii. Mandatory Insurance: As part of this legal compliance, the Contractor will be required to secure and maintain adequate workmen's compensation insurance for all project personnel, including those of subcontractors. This insurance must cover medical expenses, disability, and compensation in the event of injury or death. Proof of valid

insurance coverage will be a mandatory prerequisite for the Contractor's mobilization and for the continuation of works.

g) Accident Reporting, Investigation, and Corrective Actions

## **C. Anticipated Impacts and Mitigation Measures During the Post-Construction (Demobilization) Phase**

### **1. Impacts from Site Closure and Demobilization**

328. **Impacts.** Upon completion of construction, the primary environmental and social risks are associated with the improper closure of worksites. If not managed correctly, this can lead to:

- Environmental Pollution: Leftover construction materials, solid waste, excess spoil, and hazardous materials (e.g., spent oils and lubricants) can contaminate soil and water resources.
- Aesthetic Degradation: Un-rehabilitated sites, spoil dumps, and leftover debris create a visual blight on the landscape.
- Safety Hazards: Un-restored excavations or unstable spoil piles can pose long-term safety risks to the community and livestock.

329. **Mitigation:** Site Demobilization and Restoration Plan. To ensure a clean and safe handover of the project site, the Contractor will be required to prepare and implement a comprehensive Site Demobilization and Restoration Plan. This plan will be a contractual requirement, and its satisfactory completion will be a condition for the final payment and issuance of the project completion certificate. The plan must include the following mandatory actions:

#### *a) Waste Removal and Disposal*

- (i) Complete Waste Removal: The Contractor shall remove all construction-related materials and waste from the site. This includes, but is not limited to, excess aggregates, wood scraps, steel cuttings, packaging materials, and any temporary structures.
- (ii) Hazardous Waste Management: All hazardous wastes, such as spent oils, lubricants, and contaminated soil, must be collected and disposed of at a government-approved facility certified to handle such materials.
- (iii) Spoil Site Finalization: All approved spoil disposal sites must be properly graded, compacted, and stabilized to ensure long-term stability and prevent erosion.

#### *b) Site Rehabilitation and Revegetation*

- (i) Restoration of Temporary Sites: All areas used for temporary facilities, such as the site office, worker camps, and material laydown yards, will be fully decommissioned and restored to their pre-project condition.

#### *c) Final Site Inspection and Handover*

- (i) Joint Inspection: A final joint site inspection will be conducted by the PIU, the Contractor, and representatives from relevant stakeholders (e.g., DoFPS, Gewog) to verify that all demobilization and restoration requirements have been met.
- (ii) Conditional Project Acceptance: The PIU will only accept the project and issue the final completion certificate after all restoration works have been completed to a satisfactory standard.

## 2. Long-Term Management of the Project Access Road

330. **Context and Opportunity:** The access road constructed for the pipeline is a long-term asset. While essential for periodic maintenance and emergency repairs, a permanent, uncontrolled road—especially through the Biological Corridor—poses a risk of enabling illegal activities like poaching. However, the Wangdue Phodrang Dzongkhag Administration has identified a strategic opportunity to repurpose this corridor to deliver sustainable socio-economic benefits.

### **Mitigation and Management Plan: A Multi-Purpose Corridor Approach**

331. To ensure the long-term protection of the Biological Corridor and minimize ecological disturbance, the project is committed to fully decommissioning the access road within designated sensitive areas immediately following the construction phase. The formal management plan for this section includes the following firm commitments:

a) *Decommissioning and Ecological Restoration:*

- Upon completion of pipeline laying and associated civil works, the access road designated for decommissioning will undergo full restoration. This will involve ripping the compacted surface to promote soil aeration and water infiltration, followed by replanting with suitable native tree and shrub species to restore the original forest habitat.

b) *Strict Access Restriction:*

- To safeguard the trail's ecological integrity and prevent illegal activities (such as logging or poaching), vehicular access will be permanently restricted after decommissioning.
- Future access for routine pipeline maintenance and inspection in this section will be restricted to foot travel only. Permanent physical barriers (such as earth berms or boulders) will be installed at the entry points to prevent unauthorized vehicular entry.

c) *Stakeholder Views on Future Alternatives (Outside Project Scope):*

- During stakeholder consultations, a long-term vision was proposed by the Dasho Dzongdag to potentially manage the route as a "multi-purpose corridor." Suggestions included repurposing it as an eco-trail/mountain biking trail integrated into the district's ecotourism master plan, or maintaining it as a strategic route for Department of Forest and Park Services (DoFPS) during forest fire emergencies.
- It is formally noted that these alternative proposals are outside the scope of the current project and this IEE. They are not recommended as part of this project's mitigation plan. Any future decision by the Dzongkhag Administration or DoFPS to pursue these alternatives would require separate, detailed feasibility studies, a new full IEE, and fresh environmental and forest clearances.

## **D. Anticipated Impacts and Mitigation Measures During the Operation Phase**

332. The long-term sustainability of the project depends on the effective operation and maintenance (O&M) of the water supply scheme. To ensure this, a suite of comprehensive management plans and protocols will be developed and implemented. The responsibility for the preparation and subsequent implementation of all operational-phase plans rests with the Wangdue Phodrang Dzongkhag Administration, as the designated O&M agency.

## 1. Development and Timeline for Operational Management Plans

333. The following key operational plans will be prepared by the Wangdue Phodrang Dzongkhag Administration, with technical support from the Project Management Supervision Consultant (PMSC). The preparation of these plans will commence during the construction phase to ensure they are finalized, approved, and ready for implementation before the official handover of the project for operation. The target for their completion is at least six months prior to the scheduled construction completion date.

1. Comprehensive O&M Manual: This will be the overarching document for the system's operation. It will contain all the specific plans and protocols listed below and will serve as the primary guide for the O&M staff.
2. Water Safety Plan (WSP): A risk-management-based plan covering the entire water supply chain, from catchment to consumer. It will detail:
  - Source water protection measures.
  - Operational protocols for the treatment (sedimentation and chlorination) systems.
  - A robust water quality monitoring and testing schedule.
  - Contingency plans for addressing water quality incidents.
3. Source Sustainability Management Plan: A plan focused on the long-term viability of the Hetshotsangchhu water source. It will include:
  - The formal establishment of a Water Resource Management Committee.
  - A strict water allocation protocol (E-flow, Drinking Water, Irrigation).
  - Procedures for long-term flow monitoring and adaptive management.
4. Emergency Preparedness and Response Plan (EPRP): A comprehensive plan to manage risks from natural hazards. It will detail:
  - Standard Operating Procedures (SOPs) for system shutdown and operation during floods.
  - A routine inspection and preventative maintenance schedule for critical infrastructure.
  - Protocols for rapid response and repair in the event of damage from landslides or other events.
  - Arrangements for a dedicated contingency fund for emergency repairs.
5. O&M Waste Management Protocol: A specific protocol for the handling of all waste generated during routine maintenance activities, including procedures for the collection and safe disposal of both solid waste (e.g., replaced pipe fittings) and any hazardous waste (e.g., spent chemical containers).

334. The final, approved versions of all these plans will be a condition for the final handover and operational acceptance of the project.

## 2. Management of Drinking Water Quality

335. **Impact.** The primary operational risk is the potential failure to consistently deliver drinking water that meets Bhutan's National Drinking Water Quality Standards (NDWQS). Such failure could result from source water contamination, inadequate treatment, or issues within the distribution network, posing a direct risk to public health and hygiene.

336. **Mitigation:** Implementation of a Water Safety Plan. To proactively manage this risk, the Dzongkhag Administration will be required to develop and implement a comprehensive Water Safety Plan (WSP). The WSP is a risk-management framework that covers all stages of the water supply process, from the catchment to the consumer. This plan will be a core component of the O&M Manual and will include, at a minimum, the following key elements:

- (i) Source Water Protection: Procedures for the regular monitoring of the Hetshotsangchhu catchment area to identify and manage any emerging sources of contamination.
- (ii) Routine Maintenance Program: A detailed schedule for the regular inspection, cleaning, and preventative maintenance of all system components, including the intake structure, transmission mains, chlorination tanks, dosing equipment, and the distribution network.
- (iii) Water Quality Monitoring Protocol: A robust water quality testing protocol. This will include regular sampling of both raw water (to inform treatment needs) and treated water at various points in the distribution network to verify consistent compliance with NDWQS.
- (iv) Water Treatment and Disinfection: Strict operational procedures for the chlorination system to ensure effective and continuous disinfection of the water supply before it enters the distribution network.
- (v) Supply Prioritization Protocol: A clear protocol that prioritizes the allocation of water for drinking and domestic use over irrigation, especially during the lean season, to ensure the reliability of the potable water supply is never compromised.

### 3. Management of O&M Waste

337. **Impact.** Routine operation, maintenance, and repair activities will inevitably generate waste. This may include solid waste (e.g., replaced pipe sections, broken fittings) and potentially hazardous waste (e.g., spent chemicals from water treatment, empty containers, used oils from maintenance equipment). The indiscriminate disposal of these wastes can pollute the local environment and degrade the aesthetics of the area.

338. **Mitigation.** The Dzongkhag Administration's O&M Manual will include a formal O&M Waste Management Protocol. This protocol will ensure that all wastes are handled and disposed of in compliance with national environmental regulations. The protocol will specify procedures for:

- (i) Solid Waste: The collection of all solid waste generated during maintenance and its transportation to a government-approved site for final disposal.
- (ii) Hazardous Waste: The safe handling, storage, and disposal of any hazardous materials, such as spent chemicals and their containers, in accordance with national regulations for hazardous waste management.

### 4. Management of Landslide and Flood Risks

339. **Impact.** The project is located in a seismically active region with steep, sloping terrain, making the infrastructure inherently vulnerable to natural hazards. Landslides or flash floods, triggered by heavy precipitation or seismic events, could damage the intake or sections of the transmission pipeline, leading to a prolonged and critical disruption of water supply to both communities and irrigation systems.

340. **Mitigation.** To manage these operational risks, the O&M Manual will include a comprehensive Emergency Preparedness and Response Plan (EPRP). The EPRP will be designed to ensure financial readiness, rapid response, and proactive maintenance to minimize service disruptions. Key components of the EPRP will include:

a) *Financial Preparedness*

- (i) A dedicated annual O&M budget will be allocated to cover routine maintenance and to create a contingency fund for emergency repairs in case of damage from flash floods, landslides, or earthquakes.

b) *Emergency Response Plan (ERP)*

- (i) Standard Operating Procedures (SOPs) will be developed for the safe shutdown and operation of the scheme during major flood events. These SOPs will be linked to the project's climate-smart early warning system to ensure timely action.

c) *Routine Inspection and Preventative Maintenance*

- (i) A rigorous inspection schedule for critical infrastructure will be implemented. This includes visual inspections of the intake and vulnerable sections of the pipeline:
  - o At least once before the onset of the monsoon.
  - o Immediately after any extreme weather or seismic event.
  - o At least once after the monsoon season.
- (ii) A policy of immediate repair for any minor damages identified during inspections will be enforced to prevent small issues from escalating into major failures.
- (iii) Regular inspection of the entire irrigation network will be conducted to identify and repair any leaks, which could otherwise cause localized erosion or wastage of water.

## 5. Management of Source Sustainability

341. **Impact.** The long-term sustainability of the water source can be threatened by factors that evolve during the operational phase. These include climate change-induced reductions in lean season flow, user demand that exceeds projections, or unforeseen upstream land-use changes. Failure to proactively manage the water resource could lead to shortages, conflicts between drinking water and irrigation users, and negative impacts on the downstream hydropower and riverine ecosystem.

342. **Mitigation:** Source Sustainability Management Plan. To ensure the long-term viability of the water supply, the Dzongkhag Administration's O&M Manual will include a comprehensive Source Sustainability Management Plan. This plan will be built on three core pillars: governance, operational protocols, and adaptive management.

a) *Governance and Stakeholder Coordination*

- (i) A Water Resource Management Committee will be formally constituted. This committee will be chaired by the Dzongkhag Administration and will include representatives from the Gasetsho Gom and Gasetsho Wom Gewogs, and the Druk Green Power Corporation (Basochhu Hydropower Plant). The committee's mandate will be to oversee water allocation, review monitoring data, and mediate any potential resource-sharing conflicts.

b) *Water Allocation and Environmental Flow Protocol*

- (ii) A strict water allocation protocol will be enforced, with the following non-negotiable priorities:
- Priority 1: Environmental Flow: A minimum of 30% of the instantaneous river flow must be released downstream at all times to protect the river's ecological health and meet the requirements of the agreement with the hydropower plant.
  - Priority 2: Drinking Water: The supply for drinking and domestic use will be the second priority, ensuring that community health and sanitation needs are always met.
  - Priority 3: Irrigation: Water for irrigation will be supplied based on the remaining available flow after the E-flow and drinking water needs are met.

c) *Long-Term Monitoring and Adaptive Management*

- (i) Flow Data Monitoring and Review: The flow of the Hetshotsangchhu will be continuously monitored at the intake. The Water Resource Management Committee will review this data annually against the original design projections. If a significant, sustained decrease in flow is observed, the committee will be responsible for commissioning a new sustainability analysis and recommending adjustments to the water allocation plan.
- (ii) Future Source Identification: As part of its long-term water security planning, the Dzongkhag Administration will proactively identify and assess potential alternative water sources to augment the supply in the future, ensuring resilience against events or demands that go beyond the project's original projections.

## 6. Impacts and Management of the Irrigation Scheme

343. **Anticipated Impacts.** The primary operational risks of the irrigation scheme are associated with the potential for mismanagement or improper maintenance. If not managed effectively, this can lead to a cascade of negative environmental impacts, including:

- Soil Degradation: Waterlogging, soil salinization, and the leaching of essential soil nutrients due to the excessive or inefficient application of water.
- Water Resource Issues: Contamination of runoff and downstream water bodies with excess fertilizers and pesticides, and the potential for soil erosion from farm plots.
- Infrastructure and Health Issues: Clogging or scouring of canals, which can reduce efficiency and create breeding grounds for vectors of waterborne diseases.

### **Mitigation: Irrigation Management Plan**

344. To mitigate these risks, the Dzongkhag Administration's O&M Manual will include a comprehensive Irrigation Management Plan. This plan will be centered on three core pillars: smart infrastructure, effective on-farm management, and routine maintenance.

a) *Smart Infrastructure and Water Control*

The project will upgrade the 22 existing irrigation schemes with modern, climate-smart technology to enable precise, real-time control over water distribution. This includes:

- (i) Remote Monitoring and Control: The installation of smart devices such as automated flow meters, pressure controls, and flow valves connected to a central control system (e.g., SCADA). This technology will allow operators to manage the extensive infrastructure

efficiently, respond quickly to extreme weather events, and optimize water delivery based on real-time data.

- (ii) Regulated Offtake Structures: The system's offtake structures will allow the volume and velocity of water to be carefully regulated. This is the primary mechanism for preventing excess water application, minimizing the risk of nutrient leaching and soil erosion, and preventing the scouring or clogging of canals.

*b) Routine Infrastructure Maintenance*

345. A routine maintenance schedule will be implemented to ensure the long-term physical integrity and efficiency of the system. This includes the regular inspection and cleaning of irrigation canals to prevent blockages, repair of any leaks in the pipelines, and servicing of all control valves and meters.

*c) Implementation of On-Farm Water Management and Livelihood Support*

346. To ensure the long-term sustainability of the irrigation scheme and to maximize its benefits for the farming community, a comprehensive program of on-farm water management and livelihood support will be implemented as an integral part of the project. The responsibility for implementing these "soft" components is shared between the Project and a specialized grant-funded initiative.

1. Project-Led Activities (under Output 3):

As part of the project's Output 3: Capacity, Governance, and Awareness Strengthened, the Project Implementation Unit (PIU) and the Dzongkhag Administration will be responsible for:

- Strengthening Water User Associations (WUAs): The project will support the capacity of local WUAs in both the newly irrigated and existing command areas. This includes training on governance, financial management, and the development of operational protocols for the new infrastructure.
- Farmer Training on System O&M: Training will be provided to farmers and WUAs on the proper use and routine maintenance of the new control infrastructure (e.g., valves, meters) to ensure the system is operated efficiently and within its design parameters.

2. Grant-Funded Activities (under Output 4): The more specialized agricultural support activities will be delivered under Output 4: Farmers' Livelihood Improved and Made Climate Resilient. This component will be fully implemented and funded by a grant from the Japan Fund for Prosperous and Resilient Asia and the Pacific (JFPR). The implementing agencies for this output, working in coordination with the PIU, will be responsible for:

- Promotion of Best Practices: The program will encourage the adoption of Integrated Pest Management (IPM) and sustainable fertilizer use to minimize the runoff of agrochemicals.
- Training on Climate-Resilient Agriculture: Tailored training will be provided to at least 300 farmers on efficient irrigation techniques (e.g., scheduling water delivery to match crop needs), soil conservation practices, crop diversification, post-harvest processing, and marketing.

347. This combined approach ensures that both the institutional capacity to manage the new infrastructure (Project-led) and the agricultural knowledge to use the water effectively (Grant-led) are developed concurrently.

## VI. ANALYSIS OF ALTERNATIVES

### A. Context and Project Rationale

348. The Hetshotsangchhu integrated scheme was developed in response to the growing water insecurity in Gasetsho Gom and Gasetsho Wom Gewogs. Existing local sources are increasingly unreliable, threatening both public health and agricultural livelihoods. The project has been designed to meet the projected water demand for the next 30 years (design year 2052). The analysis of alternatives was a critical part of the design process, ensuring that the final configuration delivers the necessary benefits while minimizing adverse environmental and social impacts.

#### 1. The "No Project" Alternative

349. The "No Project" alternative was the first option considered. This would involve leaving the current situation unchanged, with communities continuing to rely on their diminishing traditional water sources.

- Impact: This would lead to worsening water shortages, impacting sanitation, hygiene, and food security. It would also fail to meet the Royal Government of Bhutan's objectives under the Water Act of 2011 to provide safe drinking water and support food self-sufficiency.
- Conclusion: Due to these severe and unacceptable socio-economic consequences, the "No Project" alternative was rejected.

#### 2. Analysis of Project Design Alternatives

350. With the need for the project established, several design alternatives were evaluated to find the most sustainable and least-damaging configuration.

##### a) *Alternative Water Sources*

- Analysis: A review of hydrological resources in the region determined that the Hetshotsangchhu is the only perennial river with sufficient discharge to reliably meet the 30-year projected demand for both drinking water and expanded irrigation for the two Gewogs. Smaller, localized sources were deemed insufficient and unsustainable.
- Conclusion: The Hetshotsangchhu was selected as the only viable water source. The analysis then focused on optimizing the location of the intake and the alignment of the transmission line.

##### b) *Alternative Intake Locations on the Hetshotsangchhu*

351. Two primary locations for the water intake were considered, balancing the need for sufficient gravitational head with the goal of minimizing encroachment into the Biological Corridor.

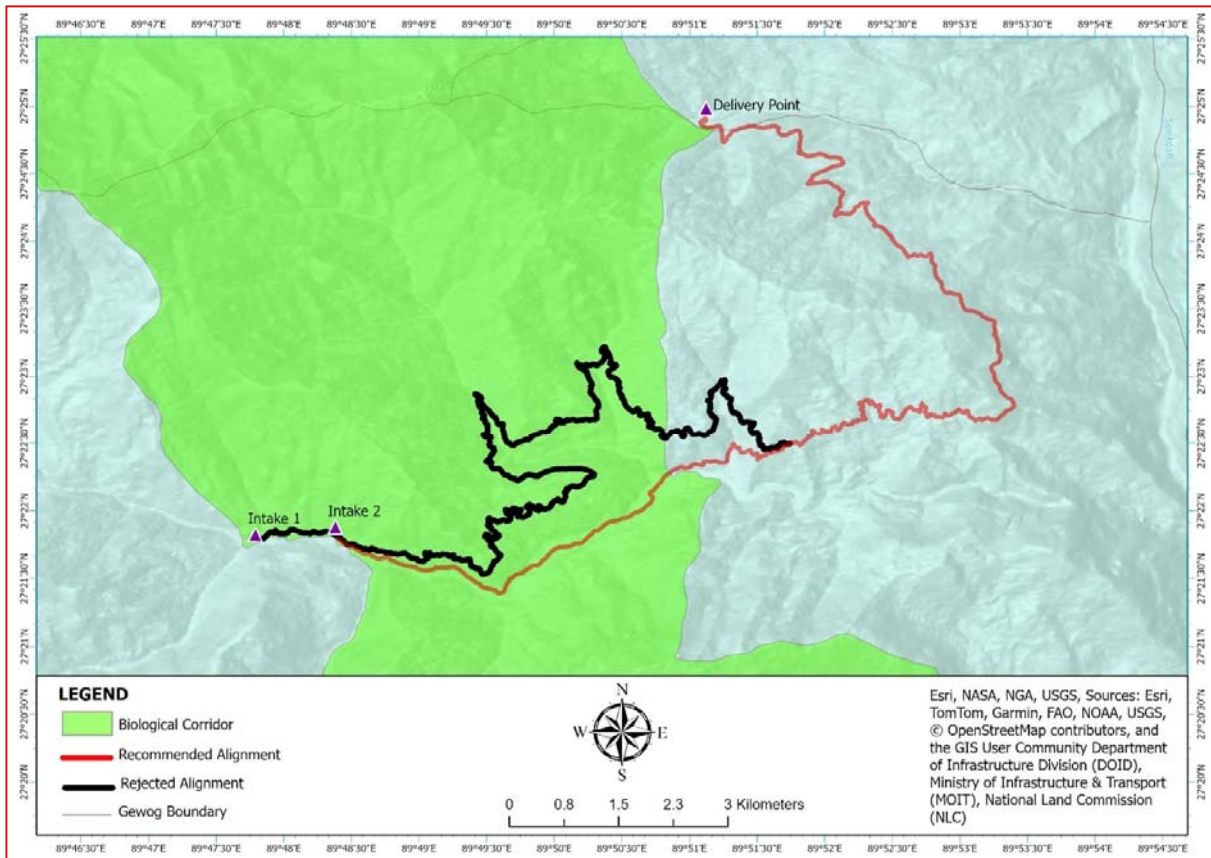
- Option 1 (Intake 1- Rejected): An intake at a higher elevation of 2,300 masl. This would have provided a greater head but would have required a longer pipeline, increasing the length of construction within the Biological Corridor.
- Option 2 (Intake 2 - Selected): An intake at a lower elevation of 2,225 masl. This location was confirmed to provide sufficient and optimal head for the entire scheme while reducing the required pipeline length within the protected area by approximately 1 km. This was selected as the preferred option.

c) *Alternative Transmission Line Alignments*

352. The alignment of the 22 km transmission line was the most critical environmental decision.

- Alternative 1 - High-Contour Alignment (Rejected): The initial design proposed an alignment that ran for approximately 16 km deep within the higher-altitude, more pristine sections of the Biological Corridor. While technically efficient for gravity flow, this route would have caused extensive and unacceptable damage to a highly biodiverse ecosystem.
- Alternative 2 - Optimized Low-Contour Alignment (Selected): In view of the severe environmental impacts, the alignment was re-routed to follow a lower contour, running parallel to existing footpaths. This optimization reduced the length of the pipeline within the Biological Corridor from 16 km to approximately 5 km. While this shorter route creates higher pressure drops requiring the use of more robust materials (e.g., GI pipes instead of HDPE) and engineering solutions like break-pressure tanks, these technical trade-offs were deemed acceptable in exchange for a massive reduction in environmental impact. This was chosen as the final, preferred alignment.

Figure 45: Map showing Alternative Alignments and Location options considered for the Intake (Source: Final Hydraulic Structure Design Report, August 2025).



## VII. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

### A. Objectives of Stakeholder Consultation

353. Public consultation and participation are integral and continuous components of the project's planning, design, and implementation process. The project is committed to a two-way dialogue with all stakeholders, ensuring that engagement is not a one-time event but an ongoing process throughout the project lifecycle.

354. The primary objectives of this ongoing engagement are to:

- Ensure Continuous Information Flow: Disseminate clear, timely, and accurate information about the project's progress, schedule, potential impacts, and mitigation measures at all stages.
- Provide an Accessible Platform for Feedback: Establish and maintain formal and informal channels for affected communities and other stakeholders to voice concerns, ask questions, and provide feedback on project activities and contractor performance.
- Incorporate Local Knowledge and Adaptively Manage Impacts: Integrate valuable local knowledge into the project's mitigation strategies and use ongoing community feedback to adaptively manage and respond to any unforeseen impacts or concerns that may arise during construction.
- Foster Collaborative Partnership and Ownership: Build a sense of co-ownership and a collaborative partnership between the project team, local government, and the community to ensure smooth project implementation, manage expectations, and resolve issues amicably.
- Enhance Transparency and Accountability: Maintain a transparent process by making project information publicly accessible and ensuring that commitments made during consultations are documented and acted upon, with feedback provided to the community on how their concerns have been addressed.

### B. Consultation Methodology

355. The project has employed, and will continue to employ, a multi-pronged methodology to ensure meaningful engagement with all stakeholders. This approach is divided into two key phases: (1) consultations conducted during the project preparation and detailed design phase to inform the project scope and this IEE, and (2) a continuous engagement plan to be implemented throughout the construction and operation phases.

#### 1. Consultations Completed During Project Preparation

356. During the project preparation and detailed design phase (up to October 2025), a comprehensive series of consultations were carried out to inform the project design and gather initial feedback. The primary methodologies used included:

- Formal Public Meetings: Community-wide meetings were held in the affected Gewogs to present the initial project concept, discuss the need for the project, and obtain broad-based community support and in-principle agreements.
- Focus Group Discussions (FGDs): Targeted FGDs were conducted with specific stakeholder groups to address detailed impacts and mitigation measures. This included crucial meetings

with the Community Forest Management Groups (CFMGs) to discuss the pipeline alignment and the protocol for handling felled timber.

- Key Informant Interviews (KIIs): One-on-one discussions were held with key government officials (from the Dzongkhag, Gewog administrations, and DoFPS) and community leaders to ensure institutional alignment, identify regulatory requirements, and frame key agreements, such as the water-sharing MoU with the Basochhu Hydropower Plant.

357. This initial phase of consultation was instrumental in securing the necessary "No Objection" clearances and shaping the mitigation measures detailed in this updated IEE.

## **2. Continuous Engagement Plan (During Implementation)**

358. Building on the foundation of the initial consultations, the project is committed to a continuous, two-way dialogue throughout the construction and operational phases. The following methodologies will be employed:

- Ongoing Stakeholder Meetings: The PIU will conduct phased, formal public meetings at key project milestones (e.g., prior to contractor mobilization, mid-construction) to provide progress updates, discuss construction schedules, and gather feedback on the contractor's performance.
- Community Liaison and Informal Engagement: The PIU will designate a Community Liaison Officer to serve as a direct and accessible point of contact for residents. This officer will conduct regular informal visits to affected communities to listen to concerns, address immediate issues, and facilitate communication between the community and the contractor.
- Grievance Redress Mechanism (GRM): The formal GRM will be the primary channel for documenting and resolving community and individual grievances in a structured and transparent manner.

359. This combined approach ensures that both the historical basis for the project's design and the plan for future, ongoing engagement are clearly documented.

## **C. Summary of Consultations Held**

360. A multi-stage consultation process has been undertaken to ensure stakeholder input is integrated at all phases of the project. This includes initial consultations during the concept and design phase, and more recent, detailed consultations during the pre-construction phase to address site-specific issues.

### **1. Initial Design-Phase Consultations (June 2022)**

361. Initial consultations were conducted during the project's concept and design phase to ensure stakeholder input was considered from the outset. A series of formal public consultation meetings were held in June 2022, which were instrumental in securing in-principle agreements and shaping the overall project design:

- First Consultation: 3rd June 2022 at Wangdue Dzongkhag.
- Second Consultation: 4th June 2022 (Community meetings).
- Third Consultation: 21st June 2022 (Community meetings).

## 2. Pre-Construction Stakeholder and Community Consultations (October 2025)

362. As the project moved toward implementation, a series of targeted stakeholder and community consultations were held on 13 and 14 October 2025 to finalize the transmission line alignment, address site-specific concerns, and reaffirm community support (Refer figure 47). The consultations were conducted across affected Gewogs and Chiwogs, with the following key engagements:

- 13 October 2025
  - Stakeholder consultation held with Wangdue Dzongkhag officials at the office of Dasho Dzongdag, Wangdue Phodrang Dzong. Total attendance: 9 participants, including 1 woman.
  - Public consultation held with Hetshokha and Tonglabji communities at Hetshokha Lhakhang, Hetshokha village. A total of 20 participants attended, including 11 women.
- 14 October 2025
  - Public consultation held with Tabchaykha-Mepisa communities at Tabchaykha, with 19 participants including 7 women.
  - Public consultation conducted with Shingkhay Khatay and Shingkhay Khamay communities at Gasetsho-Wom Gewog Centre, with a total of 27 participants, including 16 women.
  - Consultation meeting with Gasetsho-Gom Gewog officials at the Gewog Centre, involving 15 participants including 2 women. Attendees included the Gup, Mangmi, Tshogpas (four Chiwogs), Community Centre Officer, and Agriculture Extension Officer.

363. (Detailed attendance lists, minutes, and photographs from these consultations for June 2022 and October 2025 are provided in Appendix 7.)

Figure 46: Photographs documenting stakeholder engagement activities conducted from October 13 to 15, 2025, including interactions with Wangdue Phodrang Dzongkhag and Gasetsho-Gom Gewog officials, public consultations with communities from Hetshokha, Tabchaykha, and Shingkhay Khatay & Khamay Chiwogs, and joint field verification exercises with affected community members.



## **D. Key Outcomes of the Consultation Process**

364. The multi-stage consultations were instrumental in achieving key project milestones and shaping the final design. The outcomes from both the initial (June 2022) and pre-construction phases (October 2025) are summarized below.

### **1. Key Outcomes of the Initial Design-Phase Consultations (June 2022)**

365. The initial consultations held in 2022 were foundational to the project's approval and design. The primary outcomes from this phase included:

- **Broad-Based Community Endorsement:** Securing widespread public support and in-principle clearance from the communities in Gasetsho Gom and Gasetsho Wom for the overall project concept.
- **Initial Agreement on Forest Access:** Obtaining the initial consent, in the form of "No Objection" Certificates (NOCs), from the relevant Community Forest Management Groups (CFMGs) to allow the pipeline to traverse their forests. NOC's mentions that all timber felled within a Community Forest would be handed over to the respective CFMG as compensation.
- **Framework for Water Sharing:** Facilitating the crucial discussions that led to the framework for a water-sharing agreement between the Dzongkhag, the two Gewogs, and the downstream Basochhu Hydropower Plant.

### **2. Key Outcomes of the Pre-Construction Consultations (October 2025)**

366. The consultations in October 2025 focused on the final, detailed alignment and site-specific construction impacts, leading to the following key outcomes and refinements:

1. **Overwhelming Community Endorsement and Urgency:** All consulted communities and stakeholders expressed strong and unequivocal support for the project. The consultations in October 2025 highlighted a growing sense of urgency, with communities like Tabchaykha-Mepisa describing the progressive drying of their springs and the Gup of Gasetsho-Gom noting that even new Chiwogs are now requesting inclusion due to failing water sources. This confirms the project's critical importance and timeliness.
2. **Community Forest & Formalization of MoUs:** During the consultations, particularly with the community of Tabchaykha-Mepisa & Shingkhay Khatay & Khamay Chiwogs, residents raised the important issue of the pipeline passing through their designated Community Forest. While they reaffirmed their in-principle agreement for the project to use their land, their primary concern was regarding the rights to the forest resources that would be cleared. Community members recalled earlier discussions and sought explicit reconfirmation that the commitment to hand over all felled trees and firewood from the Right-of-Way clearance would be honoured. This outcome highlights the community's focus on ensuring that the project adheres to the principles of community forestry management, where local communities retain the rights and benefits from the resources within their designated forests. They view the handover of the timber not as a new request, but as the fulfilment of a previously established understanding.
3. The community consultations were vital in identifying specific, on-the-ground risks and opportunities related to the final project alignment and construction methodology. The key points raised by the communities and stakeholders are detailed below:

- a) **Protection of Cultural Heritage:** The ground near Hetshokha Lhakhang is too rocky for digging by hand, so the project team and community agreed that manual trenching isn't possible. However, the community doesn't want rock breakers used near the Lhakhang because they're worried it could damage the building and disturb its sacredness. Instead, they asked for a slow and careful digging method using excavator. For filling the trench, they also suggested using gentle rolling tools instead of machines that shake the ground, to avoid harming the Lhakhang.
- b) **Safeguard Local Water Infrastructure:** During consultations, communities in Hetshokha, Tonglabji, Shinkhay Khatey, and Khamey voiced serious concerns about the project's alignment near vital water infrastructure, including irrigation channels, community-managed spring sources, and public and private drinking water pipelines. They emphasized that these systems are often their only source of water for both agricultural and domestic needs, with no viable alternatives. Fears were raised that construction activities—such as excavation, machinery movement, and runoff—could physically damage earthen and concrete channels, contaminate pristine spring sources with sediment, and disrupt water supply to fields and homes, posing significant risks to their livelihoods and daily well-being.
- c) **Farm Roads and Associated Infrastructure:** Community members expressed concern regarding excavation, trenching, and pipe-laying activities along the existing farm road between Hetshokha and Tonglabji. These works will obstruct or disrupt regular movement between Hetshokha and agricultural fields located in Tonglabji. To avoid disruption, the community requested that the project maintain a minimum clear passage for power tillers and ensure uninterrupted, safe pedestrian access throughout the construction period.
- d) **Controlled Blasting:** The part of the transmission line that runs along the rocky cliff above Gasetsho-Wom Gewog Centre could be dangerous if blasting is not done carefully. If the work isn't precise, it might damage nearby buildings and put people at risk. The community stressed that strong safety measures and careful planning are needed in this area.
- e) **Potential Repurposing of Access Road as an Eco-Trail:** The Dasho Dzongdag proposed that after project completion, the access road could be repurposed as an eco-trail to support the Dzongkhag's ecotourism master plan. This vision aims to create a nature-based tourism corridor, potentially boosting the local economy and creating sustainable livelihoods. This proposal is documented as a stakeholder aspiration. The project's confirmed environmental commitment remains the full decommissioning and ecological restoration of the access road within the Biological Corridor.
- f) **Collaborative Opportunities and Project Enhancements:**
  - **Community-Proposed Design Modification:** The Hetshokha community, with support from the Mangmi of Gasetsho-Wom, shared that they do not experience water shortages and have agreed to allow the project to tap and transmit water through their land to benefit neighbouring communities in Gasetsho-Gom and Gasetsho-Wom. As a gesture of goodwill, they requested the replacement of the

existing narrow culvert, just over 2 meters wide, with a redesigned, multipurpose culvert that can accommodate both vehicle traffic and the transmission line. They emphasized that the alternative route via Thab Chhu stream is unreliable during the wet season due to high water levels, and a permanent, all-weather culvert would better serve both community and project needs.

- Feasibility Assessment for Mini-Hydropower Integration: The Dasho Dzongdag suggested that the project assess the feasibility of integrating a mini-hydropower component into the water supply scheme. Given the significant elevation drop and controlled water flow, there may be potential to harness energy for local use, adding a renewable energy generation benefit to the project.
- Enhancement for Forest Fire Emergencies: To improve the region's resilience to forest fires, the Dasho Dzongdag also recommended exploring the installation of automatic motorized systems or dedicated offtakes at strategic points along the pipeline. This would allow for the rapid extraction of water by firefighting crews during emergencies, leveraging the new infrastructure for disaster response.

g) Process and Coordination Enhancements:

- Proactive Local Governance and Support: The consultations demonstrated strong local leadership and a commitment to proactive problem-solving. The Dzongkhag Agriculture Officer recommended involving Gewog Agriculture Extension Officers in future engagements to improve grassroots communication. Furthermore, the Gup of Gasetsho-Gom committed to immediately mobilizing a joint team to verify any potentially affected private plots, ensuring land-related issues are resolved before they can cause delays.

367. These outcomes demonstrate a successful, two-way engagement process where community knowledge has directly informed and strengthened the project's design, mitigation strategies, and implementation plan.

368. The key environmental and social issues raised and responses provided by the Project Team are summarized in the table below.

Table 24: Summary of Stakeholder and Community Consultations: Issues Raised, Inputs Received, and Actions Taken (June 2022)

No.	Environmental safeguard issue	Discussion	Outcome / Action Taken
1	Forest clearance and tree removal	A no objection was sought from the community to allow the transmission main to traverse through the Community Forest	This is included in the Annex of the IEE
2	Compensatory afforestation	The CF representatives said that they will definitely get the clearance from all their members as this project is a requirement from their communities. Meeting agreed that the community would anyway have the right to the felled trees as it is in their CF. Regarding compensatory afforestation, the community representatives said that once the alignment is cleared for the irrigation channel, there will be no room to replant new trees, so the community would not be able to use that fund to replant as is being done by the Forest Department. Also, as the project is loan financed, they will not seek the compensation cost.	Compensatory afforestation funds will be estimated and included in the EMP to be carried out by DOFPS based on their guidelines

No.	Environmental safeguard issue	Discussion	Outcome / Action Taken
3	Construction access	The community agreed that the access that is required to create the trenches and carry the pipes should be blocked after the project and restricted.	Included in the EMP  This is included as a condition in their CF letter of clearance
4	Project affected households	Only one household will be impacted by the project.	The exact magnitude of the impact will be assessed during the realignment survey and in consultation with the social safeguards consultant
5	Community safety	Community members expressed concern regarding work being carried out on the cliff above Tapchakha village and that the contractor must take care or boulders will fall on village and canals when cliffs are being blasted  Also, concern was expressed on identifying a muck dumping site as the rains will wash all the excavated soil down slope onto the village if dumped carelessly.  This was agreed that both points would be included in the EMP and as a requirement for the contractor to follow	Included in the EMP
6	GRM process	The consultants explained the GRM mechanism and informed the meeting on the process and explained how the community could address emerging impacts from the construction process	Included in the IEE
7	Unanticipated impacts	The community was made aware that they can report to the PIU if there are any unanticipated impacts so that mitigative actions can be undertaken	This will be included in the EMP

Table 25: Summary of Stakeholder and Community Consultations: Issues Raised, Inputs Received, and Actions Taken (October 2025)

No.	Topic / Issue Raised	Summary of Discussion and Community/Stakeholder Input	Outcome / Action Taken
<b>A. STAKEHOLDER CONSULTATION (Wangdue Dzongkhag Officials)</b>			
1	Post-Construction Use of Access Road	Dasho Dzongdag proposed that the project's access road be repurposed into an eco-trail to align with the Dzongkhag's ecotourism goals, creating local employment and livelihood opportunities.	The project has formally noted the proposal. The feasibility of this post-construction enhancement will be explored in coordination with the Dzongkhag Administration.
2	Potential for Mini-Hydropower Integration	Dasho Dzongdag suggested assessing the feasibility of integrating a mini-hydropower component into the water supply scheme to generate renewable energy for local use.	The project has recorded this strategic suggestion and will forward it to the relevant technical agencies and the Dzongkhag for a feasibility assessment as a potential value-addition.
3	Use of Pipeline for Forest Fire Emergencies	Dasho Dzongdag recommended exploring the installation of automatic motorized systems or dedicated offtakes along the pipeline to support rapid water extraction during forest fire emergencies.	The project has noted this important disaster resilience enhancement. The technical feasibility and potential locations for firefighting offtakes will be reviewed by the design team in coordination with the forestry department.
4	Enhancing Grassroots Engagement	The Dzongkhag Agriculture Officer recommended that the project actively involve Gewog Agriculture Extension Officers in all future field visits and community consultations. This was proposed as a way to improve communication, better understand local agricultural issues, and ensure more inclusive, context-sensitive planning.	The project has adopted this recommendation. The Ongoing Consultation and Engagement Plan has been updated to formally include Gewog Agriculture Extension Officers as key participants in all future community-level engagements.
<b>B. COMMUNITY CONSULTATIONS (Hetshokha, Tonglabji, Tabchaykha-Mepisa, Shinkhay Khatey &amp; Khamey)</b>			
4	Construction Impacts on Hetshokha Lhakhang (PCR)	The Hetshokha community requested that heavy machinery (rock breakers, vibratory rollers) be avoided near the sacred Lhakhang. They proposed using gradual excavation methods and simple rolling compaction instead.	The EMP has been updated to include a mandatory mitigation measure prohibiting heavy machinery within a buffer zone and requiring the use of manual/alternative methods as requested by the community.
5	Risks to Local Water & Utility Infrastructure	Communities in Hetshokha, Tonglabji, Shinkhay Khatey, and Khamey raised concerns that construction could damage their critical irrigation channels, spring sources, and private/public water pipelines, for which there are no alternatives.	The EMP now requires the Contractor to conduct a pre-construction joint survey with community representatives to map all sensitive infrastructure. The Contractor will be contractually liable for implementing protection measures and for the immediate repair of any damages.

No.	Topic / Issue Raised	Summary of Discussion and Community/Stakeholder Input	Outcome / Action Taken
5	Safety Risks from Blasting	The Shinkhay Khamey community highlighted the significant safety risk of potential blasting on the rocky cliff above the Gasetsho-Wom Gewog Centre.	The requirement for the Contractor to use strict "controlled blasting" techniques, with advance community notification, has been reinforced in the EMP for this specific sensitive location.
5	Confirmation of Forest Resource Compensation	The Tabchaykha-Mepisa community sought reconfirmation that the timber and firewood from trees felled within their Community Forest would be handed over to them as previously agreed.	The project team reaffirmed the commitment. This will be legally codified in the formal Memorandum of Understanding (MoU) to be signed with the CFMG before construction.
6	Community Goodwill Request (Hetshokha)	In recognition of their cooperation, the Hetshokha community requested the project to upgrade a narrow local culvert into a wider, multipurpose structure that can support both vehicles and the pipeline, ensuring all-weather community access.	The project has formally recorded the request and will conduct a technical and financial feasibility assessment of this potential design enhancement.
<b>C. STAKEHOLDER CONSULTATION (Gasetsho-Gom Gewog Officials)</b>			
7	Project Endorsement and Growing Urgency	All consulted communities expressed strong support and relief that the project is proceeding. They highlighted the progressive drying of their local water sources, underscoring the project's urgent necessity. The Gup of Gasetsho-Gom even noted a new Chiwog has requested inclusion due to a failed source.	This overwhelming endorsement validates the project's rationale and urgency. The project team has noted the request for inclusion of the new Chiwog for future consideration.

## E. Future Consultation and Information Disclosure

369. The project is committed to a process of continuous and meaningful stakeholder engagement that extends beyond the initial design and pre-construction phases and continues throughout the project's lifecycle. The feedback and suggestions received during the October 2025 consultations have been directly used to refine and strengthen this forward-looking engagement plan.

### 1. Ongoing Consultation and Engagement Plan

370. The project will maintain a continuous, two-way dialogue with all stakeholders. The plan is designed to be comprehensive, ensuring that all affected parties—including project beneficiaries, communities along the alignment, and institutional stakeholders—are kept informed and have accessible channels for feedback.

- **Meaningful Engagement:** All future consultations will be conducted in accordance with the ADB SPS (2009) definition of "meaningful<sup>19</sup> consultation," ensuring they are timely, inclusive, and allow for the genuine incorporation of stakeholder views.
- **Comprehensive Stakeholder Outreach:** The engagement plan will continue to cover all groups potentially affected by the project. This will be achieved through:
  - **Regular Community Meetings:** Phased public meetings will be held in the Gasetsho Gom and Gasetsho Wom gewogs at key construction milestones to provide progress

<sup>19</sup> Per ADB SPS, meaningful consultation means consultation with affected people that (i) begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle; (ii) provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people; (iii) is undertaken in an atmosphere free of intimidation or coercion; (iv) is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and (v) enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.

updates, discuss upcoming temporary disruptions (e.g., noise, traffic), and gather feedback on the contractor's performance.

- Inclusive Planning and Ground-Truthing: In line with the recommendation from the Dzongkhag Agriculture Officer, future field visits and community consultations will actively involve Gewog Agriculture Extension Officers. This will enhance grassroots participation, ensure context-sensitive communication, and support inclusive, on-the-ground problem-solving.
- Direct and Informal Communication: The PIU will designate a Community Liaison Officer to conduct regular informal visits to affected villages, providing a direct and accessible point of contact for residents to raise immediate concerns.
- Adaptive Measures: The project will employ adaptive consultation methods, such as virtual meetings or phone calls, to ensure engagement can continue even if public health restrictions or other logistical challenges arise.

371. This comprehensive and adaptive approach ensures that the perspectives of all affected parties are continuously considered and that the project is implemented in a collaborative and transparent manner.

## **2. Information Disclosure Strategy**

372. A multi-channel information disclosure strategy will be implemented to ensure that project information is accessible to all stakeholders.

- (i) Local Language and Accessibility: A summary of this Initial Environmental Examination (IEE) report will be translated into Dzongkha. Hard copies of this summary will be made available at the offices of the PIU, the Gewog administrations, and the Contractor's site office for easy public access. Other communication methods will be used for illiterate community members.
- (ii) Full Document Access: A full English-language version of the IEE will be available for public viewing at the PIU office. Electronic versions of all cleared safeguard documents will be uploaded to the official project or MOIT website.
- (iii) ADB Public Disclosure: In compliance with ADB's Access to Information Policy (2018), the following documents will be disclosed on the ADB website:
  - This final IEE report.
  - Any updated IEEs or corrective action plans prepared during implementation.
  - Semi-annual environmental monitoring reports (during construction) and annual monitoring reports (during operation).

## **3. Integration into Contracts**

373. Contractor's Reference: A full copy of this IEE and its Environmental Management Plan (EMP) will be included as a binding part of the contract documents for the selected Contractor, ensuring they are fully aware of and legally obligated to comply with all safeguard requirements.

## VIII. GRIEVANCE REDRESS MECHANISM (GRM)

### A. Objective and Principles

374. A formal Grievance Redress Mechanism (GRM) will be established to provide a clear, accessible, and transparent channel for affected persons to voice concerns, file complaints, and seek resolutions for any project-related issues. The GRM will be established before the commencement of any construction activities and will be accessible to all stakeholders at no cost.

375. The GRM is designed to be a problem-solving mechanism that resolves issues efficiently at the local level. While it provides a structured process, an aggrieved person retains the right to access the country's legal system at any stage of the GRM process.

### B. Disclosure and Awareness

376. Information about the GRM, including the step-by-step procedure and contact details for focal persons, will be widely disclosed. This will be done through:

- Public information boards installed in the Gewog offices and at the main construction site.
- Inclusion in public consultation meetings and community awareness sessions.
- Posting on the official project or ministry website.

### C. The Three-Tiered Grievance Redress Process

377. The GRM follows a three-tiered system designed to resolve issues at the lowest possible level.

#### Tier 1: On-Site Resolution (The Contractor and PIU)

- Action: For immediate, construction-related issues (e.g., dust, noise, access disruption), the affected person should first approach the Contractor's Site Representative or the PIU Site Supervisor.
- Procedure: The complaint will be logged in a site register. The Contractor is required to resolve the issue and provide a response within 5 working days.
- Escalation: If the complainant is not satisfied with the on-site resolution, they can escalate the grievance to Tier 2.

#### Tier 2: Dzongkhag-Level Grievance Redress Committee (GRC)

- Action: For unresolved issues or more significant complaints (e.g., related to land, compensation, or persistent environmental impacts), the complainant can file a formal grievance with the PIU, which will then be taken up by the Dzongkhag-level GRC.
- Composition: The GRC will be chaired by the Dzongdag (District Administrator) and will include the PIU Project Manager, district-level officials (environment, legal, land records), and elected town representatives.
- Procedure: The GRC will convene a hearing with the complainant to mediate and resolve the issue. A formal resolution is required within 15 working days of receiving the complaint.
- Escalation: If the issue remains unresolved, the GRC will assist the complainant in escalating the grievance to Tier 3.

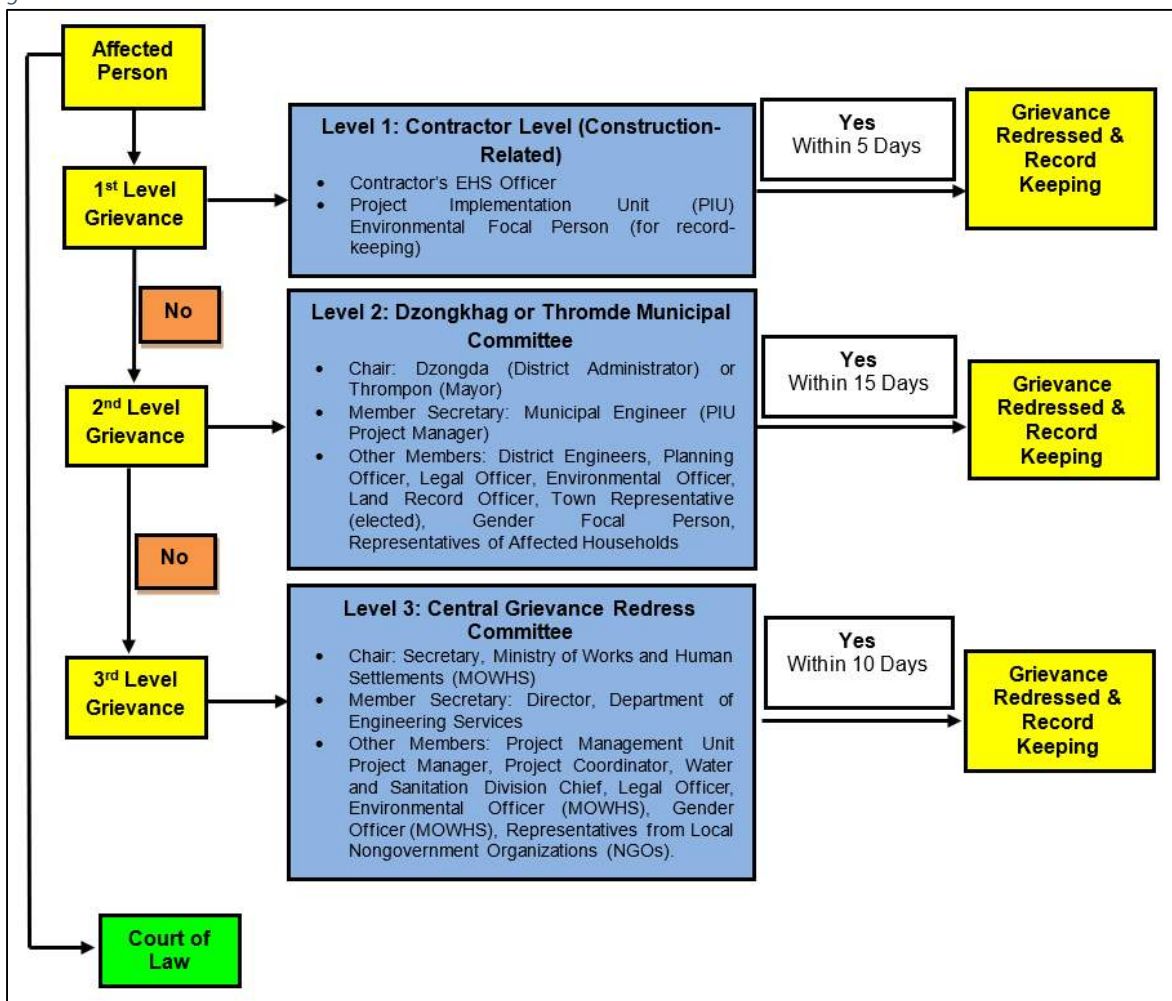
**Tier 3: Central-Level Grievance Redress Committee (PMU)**

- Action: Grievances that are not resolved at the Dzongkhag level can be elevated to the Central GRC at the ministry level.
- Composition: This high-level committee will be chaired by the Secretary of the MOIT and will include the PMU Project Manager, ministry directors, and legal officers.
- Procedure: The Central GRC will review the case and is required to provide a final resolution within 10 working days.

**D. Access to the Legal System**

378. It is important to note that the GRM does not impede access to the legal system. An aggrieved person can choose to pursue legal recourse through the courts at any stage, regardless of their engagement with the GRM.

Figure 47: Grievance Redress Mechanism



**E. GRM Procedures and Accessibility**

379. To ensure the GRM is effective and accessible to all, the following procedures will be implemented:

- (i) Information Dissemination: The GRM process, including timelines and contact details of focal persons, will be discussed in all stakeholder meetings. This information will be made continuously available to the community.
- (ii) Accessibility for All: The PIU will hold periodic community meetings to address common grievances and provide assistance. Special provisions will be made for non-literate or vulnerable persons, where the PIU's designated grievance officer will assist them in recording their complaints in writing and will guide them through the process.
- (iii) Communication of Outcomes: A clear and timely response will be provided to the complainant at each stage of the process. The final resolution will be communicated formally via letter, email, or a method agreed upon with the complainant.
- (iv) Flexibility of Timelines: The timeframes for grievance resolution may be extended in the event of extraordinary circumstances, such as public health restrictions or natural disasters, as determined by the PMU.

## **F. Record Keeping and Reporting**

380. A systematic record of all grievances will be maintained to ensure transparency and accountability.

- (i) Grievance Log: The PIU's Environmental and Social Safeguard Officers will be responsible for maintaining a comprehensive grievance log. This log will record, at a minimum: the complainant's contact details, the date the grievance was received, the nature of the complaint, the actions taken, the final resolution, and the date of closure. A template for this log is provided in Appendix 8.
- (ii) Public Disclosure and Reporting: A summary of the grievances received and resolved will be disclosed at the PIU office. This information will also be formally reported in the semi-annual environmental and social monitoring reports submitted to ADB.

## **G. GRM Costs and Review**

381. Costs: All costs associated with the GRM process, including meetings, communication, and site visits, will be borne by the project (PMU/PIU). There will be no cost to the complainant.

382. Periodic Review: The PMU and PIU will periodically review the functioning of the GRM to assess its effectiveness and identify any areas for improvement, ensuring the mechanism remains responsive to the needs of the community.

## **H. ADB Accountability Mechanism**

383. In addition to the project-level GRM, affected persons have ultimate recourse through the ADB Accountability Mechanism. This is a final option if a satisfactory resolution cannot be achieved through the project's GRM.

- (i) Process: It is recommended that affected persons first work in good faith with the concerned ADB operations department (the Bhutan Resident Mission) to resolve the issue. If still dissatisfied, they can then file a formal complaint directly with the Complaint Receiving Officer (CRO) at ADB headquarters.

(ii) Disclosure: Information on the ADB Accountability Mechanism will be included in all project information materials distributed to the affected communities.

## **IX. ENVIRONMENTAL MANAGEMENT PLAN (EMP)**

### **A. Purpose**

384. The Environmental Management Plan (EMP) translates the mitigation measures identified in this updated Initial Environmental Examination (IEE) into a set of specific, actionable requirements. Its purpose is to provide a clear and unambiguous framework for the implementation of environmental safeguards, defining the responsibilities of each party and the procedures that must be followed during the project's construction and operation phases.

385. This EMP has been revised and enhanced based on the project's final detailed engineering design and supersedes the preliminary EMP that was prepared during the project processing phase. Crucially, this EMP has also been strengthened and made more site-specific by incorporating direct feedback and concerns raised by stakeholders and affected communities during the public consultations held in October 2025. It now includes specific, community-informed mitigation measures for the protection of cultural heritage sites, local water infrastructure, and community access routes.

386. The EMP is a legally binding document. Its requirements, including all mitigation and monitoring measures detailed in the following sections, will be integrated as a mandatory component of the civil works contracts. Compliance with this EMP is a contractual obligation for the appointed Contractor.

### **B. Institutional Roles and Responsibilities**

387. A clear institutional arrangement is essential for the effective implementation of the EMP. The primary entities and their safeguard responsibilities are defined below.

#### **1. Project Management Unit (PMU)**

388. The PMU, housed within the Executing Agency (MOIT), holds the primary responsibility for overall strategic oversight and ensuring project-wide compliance with all safeguard requirements. The PMU's Environmental Safeguards Officer will lead these efforts, with key responsibilities including:

- Oversight and Compliance: Reviewing and approving the final, updated IEE; ensuring the EMP is included in all bidding and contract documents; and reviewing and approving the Contractor's Site-Specific Environmental Management Plan (SEMP).
- Monitoring and Reporting: Consolidating quarterly reports from the PIU and submitting the required Semi-annual Environmental Monitoring Reports (SEMRs) to ADB.
- Support and Capacity Building: Ensuring adequate budget is allocated for all safeguard activities, managing the GRM at the central level (Tier 3), and organizing necessary training for the PIU and other stakeholders.

#### **2. Project Implementation Unit (PIU)**

389. The PIU, based at the Wangdue Phodrang Dzongkhag Administration, is the frontline entity responsible for day-to-day supervision and monitoring of the Contractor's environmental performance on-site. The PIU's Environmental Safeguards person will:

- Field Supervision: Conduct regular site inspections and spot checks to verify the Contractor's implementation of the EMP and SEMP.
- Reporting: Review the Contractor's monthly reports and prepare quarterly environmental monitoring reports for submission to the PMU.
- GRM Management: Act as the primary focal point for the Grievance Redress Mechanism at the local level (Tier 1 and Tier 2).

### **3. Project Management Supervision Consultant (PMSC)**

390. The PMU and PIU will be supported by a Project Management Supervision Consultant (PMSC), which will include an Environmental, Social and Gender Specialists. The PMSC will provide independent technical oversight and support for EMP implementation. Key safeguard responsibilities include:

- Technical Support: Assisting the PIU in reviewing the Contractor's SEMP and other environmental sub-plans to ensure they meet the project's technical and safeguard standards.
- Independent Monitoring and Verification: Conducting regular independent site inspections to verify the Contractor's compliance with the EMP and the accuracy of their monitoring reports.
- Capacity Building: Designing and delivering environmental management training for the PMU, PIU, and Contractor personnel.
- Reporting Support: Assisting the PIU and PMU in preparing quarterly and semi-annual environmental monitoring reports to ensure they meet ADB standards.

### **4. Civil Works Contractor**

391. The Contractor holds the direct responsibility for the on-the-ground implementation of all mitigation measures specified in this EMP. The Contractor's obligations are legally binding and will include:

- Key Environmental Personnel:
  - EHS Officer: Appointing a qualified, full-time Environment, Health, and Safety (EHS) Officer who will be listed as Key Personnel. This officer will be the primary focal point for all general safeguard matters across the entire project alignment.
  - Biodiversity Supervisor / Forestry Expert: In addition to the EHS Officer, the Contractor must engage a qualified Biodiversity Supervisor or Forestry Expert for the duration of all construction activities within the sensitive areas (the Biological Corridor and Government Reserve Forests). This expert will be responsible for overseeing the implementation of all specific biodiversity protection measures, including the pre-felling fauna surveys, enforcement of the Worker's Code of Conduct in the forest, and ensuring compliance with the special environmental protocols for working in protected areas. This role can be a dedicated person or a qualified expert from a local institution engaged by the contractor.
- Site-Specific Environmental Management Plan (SEMP): Preparing and implementing a detailed SEMP based on this EMP. The SEMP will detail the specific procedures, site layouts

(camps, storage, disposal sites), and schedules for implementing all mitigation measures. No civil works can commence until the SEMP is approved by the PIU/PMU.

- Occupational Health & Safety (OHS) and Labour Standards: Implementing a comprehensive OHS Plan, providing all necessary PPE, ensuring safe and hygienic conditions, and adhering to all national labour laws.
- Reporting: Submitting monthly progress reports to the PIU, detailing the implementation of the SEMP, any incidents, and corrective actions taken.
- Chance Find Procedure: Immediately halting work and following the Chance Find Procedure detailed in this IEE in the event of discovering any potential Physical Cultural Resources.

#### **5. Partner Agency: Department of Forest and Park Services (DoFPS)**

392. DoFPS is a key partner agency in the implementation and monitoring of the EMP, particularly for activities within protected areas. Their responsibilities include:

- Joint Monitoring: Conducting joint site inspections with the PIU to monitor the contractor's compliance with the Forestry Clearance conditions and the specific EMP protocols for the Biological Corridor and Government Reserve Forests.
- Technical Guidance: Providing expert advice on biodiversity protection, wildlife encounter protocols, and site restoration with native species.
- Implementing Compensatory Afforestation: Serving as the implementing agency for the project-funded Compensatory Afforestation Program to ensure no net loss of forest cover.

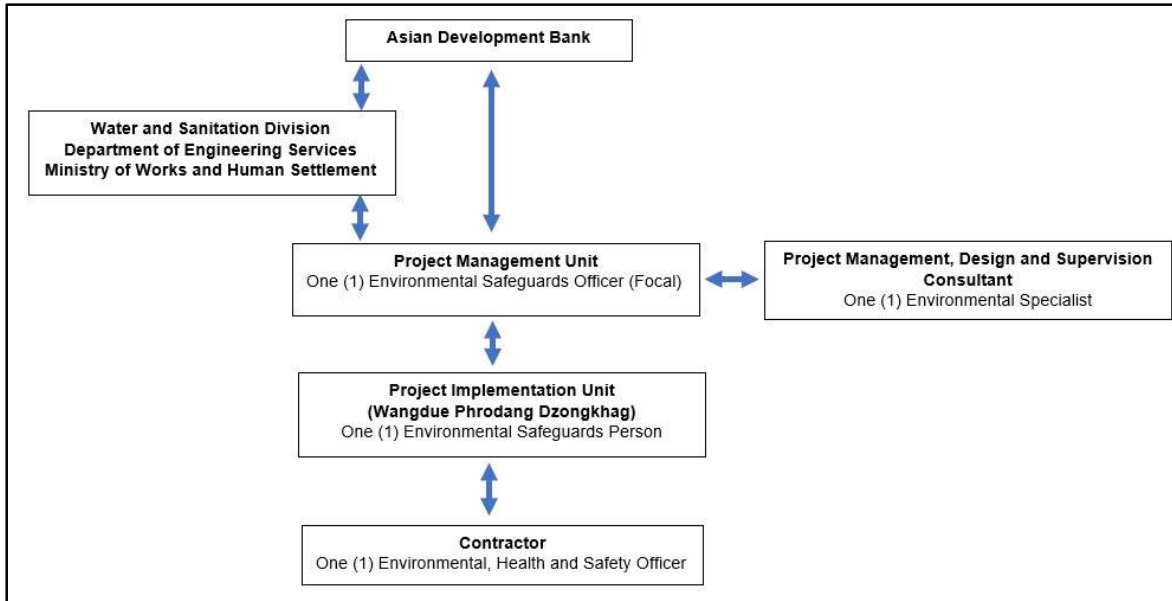
#### **6. Operation and Maintenance (O&M) Agency: The Wangdue Phodrang Dzongkhag Administration**

393. Upon completion of the construction phase and the contractor's defects liability period, the full responsibility for the Operation and Maintenance (O&M) of the Hetshotsangchhu Integrated Water Supply Scheme will be handed over to the Wangdue Phodrang Dzongkhag Administration.

394. As the designated O&M agency, the Dzongkhag Administration will be responsible for the long-term implementation of all operational-phase environmental management and monitoring requirements as detailed in the Environmental Management Plan (EMP). Key responsibilities will include:

- Implementation of the Operational EMP: Ensuring the implementation of all operational mitigation measures, including the Water Safety Plan (WSP), Source Sustainability Management Plan, and the O&M Waste Management Protocol.
- Long-Term Monitoring: Conducting routine monitoring of water quality, system performance, and source sustainability.
- Reporting: Preparing and submitting annual environmental monitoring reports to the relevant regulatory authorities and ADB as required.
- Budgetary Allocation: Ensuring that adequate annual budget is allocated for all O&M activities, including the costs associated with implementing the operational-phase EMP.

Figure 48: Institutional Arrangement for Environmental Safeguards (Source: Draft IEE Report, Hesotsamchhu Integrated Drinking Water and Irrigation Scheme Subproject, Oct 2022).



## C. Environmental Management Plan (EMP) Matrix

### 1. Purpose and Scope

395. The following matrix constitutes the core of the Environmental Management Plan (EMP) for the Hetshotsangchhu Integrated Water Supply Scheme. It systematically translates the findings of the environmental assessment into a set of specific, actionable, and legally binding commitments. The matrix details:

- The potential environmental and social impacts at each stage of the project (pre-construction/design, construction, and operation).
- The specific mitigation and management measures required to avoid, minimize, or compensate for these impacts.
- The precise location where each measure is applicable.
- The designated entity responsible for implementing the measure.
- The entity responsible for monitoring and verifying implementation.

### 2. Legal Standing and Implementation

396. This EMP is a legally binding document. The mitigation measures detailed herein will be fully integrated into the bidding documents and will form an inseparable part of the civil works contract awarded to the selected Contractor. The responsibility for implementation is divided by project phase:

- Construction Phase: The Civil Works Contractor will be directly responsible for implementing all pre-construction and construction-phase mitigation and monitoring measures. The costs for these activities will be included in the Contractor's bid price and Bill of Quantities (BoQ). Implementation will be supervised by the PIU and PMU.

- Operation Phase: The Wangdue Phodrang Dzongkhag Administration, as the designated O&M agency, will be responsible for implementing all operational-phase mitigation and monitoring measures. The costs for these long-term activities will be integrated into the annual Operation and Maintenance (O&M) budget of the Dzongkhag Administration.

397. Compliance with this EMP is mandatory. Any failure to implement the specified measures will be considered a non-compliance with the contract (during construction) or with operational protocols (during operation) and will require immediate corrective action.

Table 26: Environmental Management Plan Matrix (Updated)

Subproject Activities / Field	Potential Environmental Impacts	Mitigation Measures	Location	Cost	Implementation	Supervision
<b>Pre-construction Phase</b>						
Design and Siting of Project Infrastructure	Impact due to Extreme Weather Events: Damage to project infrastructure (intake, pipeline) from intensified extreme weather events such as flash floods, landslides, and debris flows. The risk is confirmed by a severe, unseasonal flash flood in the Hetshotsangchhu in November 2024, which demonstrated the area's vulnerability. This can lead to prolonged service disruption and operational shutdowns due to extreme water turbidity.	Incorporate Climate Resilience into the Detailed Engineering Design: 1. Flood-Resilient Intake: The intake structure and weir are designed to withstand a 100-year return period flood. The design includes a 28-meter-long primary desilting tank to manage high sediment loads during flood events and protect downstream infrastructure. 2. Strategic Pipeline Routing: The final alignment was selected to avoid high-risk landslide-prone areas identified during geotechnical surveys. The route utilizes existing pathways where possible to minimize new cuts on steep slopes. 3. Slope Stabilization Measures: The design incorporates bioengineering measures (e.g., retaining walls, planting of native vegetation) for slope stabilization in vulnerable sections of the pipeline corridor. 4. Smart Water Management System: The design includes the integration of a climate-smart water management system with SCADA/smart devices to provide early warning of floods and droughts, enabling faster operational response.	Entire 21.1km	Included in the detailed engineering design and civil works contract costs.	PIU, PMU, Design Consultants	PMU
Transmission Main and Access Path Construction	Impacts due to Clearing and Earthworks: 1. Loss of Forest Resources: Confirmed loss of 774 trees and clearance of understory vegetation within a temporary construction Right-of-Way (RoW) of approximately 7.4 hectares. 2. Geotechnical Instability: High risk of soil erosion, slope instability, and localized landslides due to excavation, trenching, and formation cutting on predominantly steep, mountainous terrain.	1. Alignment Optimization to Minimize Impact (Completed in Design): a. The final alignment was strategically selected to reduce the pipeline length within the Biological Corridor to ~5 km and to follow existing footpaths, minimizing the number of trees to be felled. 2. Controlled Construction and Felling Practices (Contractor Requirement): a. Footprint Minimization: The construction RoW will be strictly limited to a width of 3.5 meters. b. Prohibition on Side-Casting: All spoil will be managed via end-hauling to approved disposal sites as per a Spoil Management Plan (SMP). c. Pre-Felling Fauna Survey Protocol: Prior to any tree felling, the Contractor's EHS Officer must: - Conduct a visual inspection of each tree (no more than 48 hours in advance) to check for active bird nests or other inhabiting fauna. - If an active nest is found, establish a "No-Cut" buffer zone and postpone felling until the young have fledged. - Document all survey findings in a site logbook. 3. Compensation and Restoration: a. Compensatory Afforestation: The project will fully fund a compensatory afforestation program, to be implemented by DoFPS, to replant 14.8 hectares (a 2:1 ratio) with native species. b. Full Site Restoration: All disturbed areas will be progressively restored using bioengineering techniques.	Entire 21.1 km	Included in the detailed engineering design and civil works contract costs.	PIU, PMU, Contractor	PMU, PIU
Water Source Management	Impacts on Source Sustainability and Seasonal Availability: The Hetshotsangchhu experiences extreme seasonal variability, with a minimum recorded flow of 117 lps in December. This indicates the river is already stressed during the dry season.	A multi-faceted Source Sustainability Management Plan will be incorporated into the project design and operational protocols: 1. Catchment Management: In collaboration with DoFPS and local communities, a basic catchment protection plan will be developed for the area upstream of the intake. This will include measures to manage grazing, prevent deforestation, and control invasive species to enhance the watershed's natural flow regulation capacity.		Included in the detailed engineering design and civil works contract costs.	PIU, PMU (Design Phase)  Dzongkhag Administration (Operational Phase)	PMU (Design Phase)  Water Resource Management Committee

Subproject Activities / Field	Potential Environmental Impacts	Mitigation Measures	Location	Cost	Implementation	Supervision
	Climate change is expected to exacerbate this, leading to more severe and prolonged low-flow periods, which could threaten the long-term sustainability of the water source for all users (community, irrigation, and downstream hydropower).	2. Demand-Side Management: The project will promote water-use efficiency through the installation of water meters for all connections and the implementation of a public awareness campaign on water conservation. 3. Monitoring and Response Protocol: A long-term flow monitoring protocol will be established at the intake site, defining critical low-flow thresholds that will trigger pre-planned drought response actions (e.g., water use restrictions).		Operational costs included in the O&M budget.		(Operational Phase)
All works within the Biological Corridor and Government Reserve Forests	Direct habitat disturbance, loss of forest resources, and disruption to wildlife within protected areas. Specific impacts include: - Overall loss of 774 trees and habitat disturbance including the 5 km pipeline corridor inside the BC. - Disruption to wildlife behaviour and movement patterns due to noise, vibration, and human presence. - Physical risks to fauna, such as entrapment in open trenches.	Implement Special Environmental Management Protocols (SEMPs) for Sensitive Areas: The Contractor will be contractually obligated to adhere to the following strict protocols for all works within the BC and GRF: 1. Work Timing: a. Daylight Working Hours: All construction activities are strictly limited to daytime hours (dawn to dusk) to allow for undisturbed wildlife movement at night. b. Controlled Blasting: Conventional blasting is prohibited. Where hard rock is encountered, "Controlled blasting" techniques must be used. 2. Site Establishment and Waste Management: a. Prohibited Facilities: The establishment of any worker camps, equipment yards, or material storage areas within the BC or GRF is strictly forbidden. b. Waste Disposal: Indiscriminate dumping is prohibited. All waste and spoil must be collected and disposed of at pre-approved sites outside of the protected areas. 3. Biodiversity Protection and Worker Conduct: a. Worker's Code of Conduct: Enforce a strict code of conduct prohibiting hunting, fishing, poaching, and the collection of any forest products. Mandatory awareness training on this code and the Forest and Nature Conservation Act will be provided to all workers. b. Wildlife Encounter Protocol: In the event of a wildlife encounter, work will cease, and the nearest Forest Range Office will be immediately contacted. c. Trench Safety: All open trenches will be covered or equipped with escape ramps at the end of each working day to prevent animals from getting trapped. 4. Habitat Restoration and Compensation: a. Compensatory Afforestation: The project will fund a compensatory afforestation program, implemented by DoFPS, to compensate for all felled trees. b. Full Site Restoration: All disturbed areas will be progressively restored, including re-contouring and stabilizing slopes with bioengineering methods. 5. Regulatory Compliance: a. All work plans and schedules within the protected areas will be developed in close consultation with, and be subject to the approval of, the Chief Forest Officer of the Wangdue Phodrang Forest Division.	0 – 5 Km within Biological Corridor	Included in the Contractor's SEMP implementation costs and the overall civil works contract.	Contractor	PIU, DoFPS, PMU
All Construction and Operation Activities	Impacts on Biodiversity: 1. Habitat Disturbance: From the clearing of 7.4 ha of vegetation and felling of 774 trees within the RoW. 2. Disturbance to Fauna: Disruption to the movement and behaviour of wildlife, particularly species of concern like the Dhole	A multi-layered biodiversity mitigation strategy will be implemented: 1. Habitat Protection and Construction Practices: a. Footprint Minimization: All works will be strictly confined to the approved RoW. Use of smaller machinery is required to reduce the scale of disturbance. b. Scheduling and Timing: Construction activities will be limited to daytime hours only (from dawn to dusk).	Entire 21.1km	Included in the Contractor's SEMP implementation costs and the overall	Contractor	PIU, DoFPS, PMU

Subproject Activities / Field	Potential Environmental Impacts	Mitigation Measures	Location	Cost	Implementation	Supervision
	(Endangered), from noise and human presence. 3. Impacts on Aquatic Species: Potential harm to Snow Trout (Vulnerable) from in-stream construction and altered flow regimes. 4. Loss of Flora: Loss of individual plants of conservation concern, such as Star Anise (Endangered), within the construction footprint.	c. Controlled Blasting: "controlled blasting" techniques will be used to minimize noise, vibration, and shockwaves. 2. Species-Specific Protection: a. Fish Breeding: All in-stream works at the intake site are prohibited during the peak breeding seasons for Snow Trout (April-June and September-October). b. Wildlife Protection Protocol: No night work is permitted. All open trenches will be covered or equipped with escape ramps at night to prevent animal entrapment. In the event of a wildlife encounter, work will cease, and the Forest Range Office will be contacted. c. Flora Protection: The felling of Illicium (Star Anise) trees is prohibited unless they fall directly within the cleared RoW. 3. Worker Conduct and Site Management: a. Worker's Code of Conduct: A mandatory Code of Conduct will be enforced for all personnel, explicitly prohibiting hunting, fishing, poaching, and the collection of any forest products. All workers will receive training on this code and the Forest and Nature Conservation Act. 4. Compensation and Restoration: a. Compensatory Afforestation: The project will fully fund a compensatory afforestation program, to be implemented by the DoFPS, to replace the 774 trees felled. b. Full Site Restoration: All disturbed areas will be progressively restored using bioengineering techniques to facilitate the natural regeneration of native vegetation.		civil works contract.		
Intake Construction and System Operation	Impacts on Aquatic Biodiversity: 1. Habitat Degradation (Construction): Increased turbidity and sedimentation from in-stream works and bank disturbances can harm aquatic habitats and gill-breathing organisms like Snow Trout (IUCN, Vulnerable). 2. Reduced Habitat (Operation): Continuous water abstraction will alter the downstream flow regime, potentially reducing the available habitat for aquatic species, especially during the critical low-flow months.	A combination of engineering controls, construction management, and worker regulations will be implemented: 1. Design and Operational Phase Controls: a. Guaranteed Environmental Flow (E-flow): The intake is designed and will be operated to ensure a minimum environmental flow of 30% of the instantaneous river flow is released downstream at all times. This is the primary measure to protect the downstream aquatic ecosystem. b. Low-Impact Weir Design: The intake features a low-height weir (approx. 1 meter) to prevent significant damming and minimize alteration of the natural flow dynamics. 2. Construction Phase Management: a. Seasonal Work Scheduling: All major in-stream construction activities will be scheduled during the lean season (post-monsoon) to avoid high-flow conditions and sensitive biological periods. b. Sediment and Turbidity Control: The Contractor will use best-practice sediment control measures (e.g., temporary coffer dams, silt fences) during in-stream work to prevent the release of suspended solids downstream. 3. Worker Conduct: a. Strict Prohibition on Fishing: The mandatory Worker's Code of Conduct will include a strict and explicit prohibition on illegal fishing. All workers will be briefed on the relevant laws and associated penalties as part of their induction training.	Stretch along of transmission line running close to Hetshotsang chhu and other water bodies.	Included in the detailed engineering design and civil works contract costs.	PIU, PMU (Design)  Contractor (Construction)  Dzongkhag Administration (Operation)	PMU, PIU, DoFPS
Water Resource Allocation and Management	Competing Water Use: Water abstraction from the Hetshotsangchhu creates a direct resource competition with	A formal Water Resource Management framework will be implemented, governed by legal agreements and operational protocols: 1. Formal Water Sharing Agreement:	Intake/ Water source	Included in the detailed	PIU, PMU (Design/MoU)	PMU (Design/MoU)

Subproject Activities / Field	Potential Environmental Impacts	Mitigation Measures	Location	Cost	Implementation	Supervision
	the downstream Basochhu Hydropower Plant (BHP) and the river's ecological needs. This impact is most critical during the lean season (Nov-Dec), when low flows could otherwise compromise hydropower generation and ecosystem health.	<p>a. A Memorandum of Understanding (MoU) has been executed between the PIU and the Druk Green Power Corporation (DGPC). This agreement formally outlines the terms of water sharing and provides a clear framework for cooperative management.</p> <p>2. Water Allocation and Environmental Flow Protocol:</p> <p>a. A strict water allocation protocol will be enforced with the following non-negotiable priorities:</p> <ul style="list-style-type: none"> <li>- Priority 1: Environmental Flow: A minimum of 30% of the instantaneous river flow will be released downstream at all times.</li> <li>- Priority 2: Drinking Water: The supply for drinking and domestic use will be the second priority.</li> <li>- Priority 3: Irrigation: Water for irrigation will be supplied based on the remaining available flow.</li> </ul> <p>3. Governance and Stakeholder Coordination (Operational Phase):</p> <p>a. A Water Resource Management Committee will be constituted, chaired by the Dzongkhag Administration and including representatives from the Gewogs and DGPC. The committee's mandate is to oversee water allocation, review monitoring data, and mediate any resource-sharing conflicts.</p>		<p>engineering design costs.</p> <p>Operational costs included in the O&amp;M budget.</p>	Dzongkhag Administration and Water Resource Management Committee (Operation)	Water Resource Management Committee (Operation)
Project Legal and Administrative Approvals (Pre-Construction Phase)	Legal Non-Compliance and Project Delays: Failure to secure all mandatory statutory, administrative, and community-level approvals prior to the mobilization of the contractor would constitute a breach of national law and ADB policy, leading to significant project delays and potential penalties.	<p>Action Plan for Securing Approvals: The PIU will be responsible for securing all of the following approvals prior to the award of the civil works contract:</p> <p>1. Statutory Clearances (National Level):</p> <p>a. A formal Environmental Clearance (EC) from the competent national authority.</p> <p>b. A formal Forestry Clearance from the Department of Forest and Park Services (DoFPS).</p> <p>2. Administrative Approvals (Sub-national Level):</p> <p>a. Formal approval from the Wangdue Phodrang Dzongkhag Administration.</p> <p>b. Formal consent and approval from the administrations of both Gasetsho Gom Gewog and Gasetsho Wom Gewog.</p> <p>c) Finalize and Execute Legally Binding Community-Level Agreements:</p> <p>(i) Formalize Memoranda of Understanding (MoUs): The PIU will finalize and execute formal MoUs with each of the affected CFMGs, including those for Shingkhay Gaki, Tabchaykha Draktsen, and Hetshokha Community Forests. These MoUs build upon the initial "No Objection" clearances and are a mandatory prerequisite before the contractor can be mobilized or commence any work in these areas.</p> <p>(ii) Content of the MoUs: Each MoU will be a detailed, legally binding document that, at a minimum, specifies:</p> <ul style="list-style-type: none"> <li>● Consent and Scope: Formal consent for the project to traverse the community forest along the officially demarcated alignment and a defined Right-of-Way (RoW).</li> <li>● Resource Compensation: The agreed-upon protocol for the felling, logging, and official handover of all timber to the respective CFMG for their use and benefit, as per their approved CF Management Plan.</li> <li>● Contractor Obligations: Clear stipulations on the contractor's responsibilities for spoil and muck management (prohibiting indiscriminate dumping), site restoration protocols, and the strict prohibition of establishing worker camps or storage depots within the CF boundaries.</li> </ul>	Hetshokha, Tabchaykha Shingkhay Khatay & Khamay Chiwogs	Included in project administration and management costs.	PIU, with oversight from PMU	PMU

Subproject Activities / Field	Potential Environmental Impacts	Mitigation Measures	Location	Cost	Implementation	Supervision
		<ul style="list-style-type: none"> <li>Community Monitoring Role: The role of the CFMG representatives in participating in the marking of trees for felling and monitoring the contractor's compliance with the MoU's terms.</li> <li>(iii) Verification: Signed copies of all MoUs must be submitted to the PMU and made available for ADB's review as a key milestone for compliance verification prior to the start of construction in these sensitive areas.</li> </ul>				
Social Safeguards and Land Access	Impacts on Private Agricultural Land: Temporary loss of land, crop damage, and livelihood disruption for households whose private agricultural plots are traversed by the construction corridor.	<p>Implement the Resettlement Framework (Pre-construction Actions):</p> <ol style="list-style-type: none"> <li>1. Joint Verification (Completed): A joint survey was conducted on 15 October 2025, successfully avoiding impacts on 2 of the 3 potentially affected plots through minor re-alignment.</li> <li>2. Resettlement Planning: A Resettlement Plan will be prepared for the one remaining unavoidably affected plot (TWM-138).</li> <li>3. Compensation Disbursement: All compensation for lost crops and temporary land use will be paid in full to the affected household before any construction begins on their land.</li> </ol>	Tonglabji, Hetshokha	Costs to be covered under the project's Resettlement Budget.	PIU, Dzongkhag Land Record Office	PMU
Pre-Construction Site Surveys and Planning	Unmitigated Impacts on Local Infrastructure: Failure to identify and plan for the protection of critical community assets (irrigation channels, water pipelines, cultural sites) before construction begins.	<p>Mandatory Pre-Construction Joint Surveys: Before mobilizing in any new work area, the Contractor, PIU, and community representatives must conduct a joint survey to:</p> <ol style="list-style-type: none"> <li>1. Map and Document: Precisely map and document the pre-construction condition of all sensitive assets identified during consultations, including irrigation channels, drinking water sources/pipelines, electric poles, and the Hetshokha Lhakhang.</li> <li>2. Agree on Mitigation: Mutually agree on the specific protection measures, work schedules, and access arrangements for that section.</li> </ol>	All along 21.1km (particularly sites which are high lighted in this IEE report	Included in the Contractor's bid price and SEMP implementation costs.	Contractor, PIU, Community Representatives	PIU, PMU
Sourcing of Construction Materials	<p>Indirect Environmental Impacts from Quarrying:</p> <p>The primary risk is the use of materials (sand, gravel, aggregates) from illegal or poorly managed quarries. This can lead to significant off-site environmental impacts, including:</p> <ul style="list-style-type: none"> <li>- Habitat degradation at the quarry site.</li> <li>- Soil erosion and siltation of rivers from unmanaged runoff.</li> </ul>	<p>Implement a Mandatory Responsible Sourcing Protocol: The Contractor will be contractually required to adhere to the following:</p> <ol style="list-style-type: none"> <li>1. Exclusive Use of Licensed Quarries: The Contractor shall source all raw materials exclusively from quarries and borrow pits that are fully licensed and approved by the relevant government authorities (e.g., Department of Geology and Mines).</li> <li>2. Prohibition on New Quarry Development: The Contractor is explicitly prohibited from opening any new quarry or borrow pit for the sole purpose of supplying this project.</li> <li>3. Source Verification and Approval: Prior to procurement, the Contractor must submit a list of proposed material sources to the PIU for verification and formal approval. This submission must include copies of the quarry's valid operating license and environmental clearance.</li> <li>4. Chain of Custody and Reporting: The Contractor will maintain a clear record of all material sources, including quantities procured. This documentation must be submitted as part of the regular monthly progress reports to the PIU to ensure full transparency and traceability.</li> </ol>	Across the ferry road corridor	Included in the Contractor's bid price and overall civil works contract.	Contractor	PIU (verification of sources and review of reports), with oversight from PMU
Establishment of Construction Camps, Stockpile, Storage, and Disposal Areas	<p>Inappropriate siting and poor management of ancillary facilities can lead to:</p> <ul style="list-style-type: none"> <li>- Habitat degradation and loss of vegetation.</li> <li>- Contamination of soil and water resources from fuel spills, improper waste disposal, and untreated wastewater.</li> <li>- Social friction with local communities.</li> <li>- Disturbance to local ecology and wildlife.</li> </ul>	<p>The Contractor will prepare and implement a comprehensive Camp Management Plan as part of their SEMP. This plan must be approved by the PIU before any site establishment begins and must adhere to the following mandatory conditions:</p> <ol style="list-style-type: none"> <li>1. Site Selection Criteria: <ol style="list-style-type: none"> <li>a. Prohibited Locations: All construction camps, storage yards, and disposal areas are strictly prohibited in any of the following sensitive locations:</li> </ol> </li> </ol>	Camp locations	Included in the Contractor's SEMP implementation costs and the overall	Contractor	PIU, with oversight from PMU

Subproject Activities / Field	Potential Environmental Impacts	Mitigation Measures	Location	Cost	Implementation	Supervision
		<ul style="list-style-type: none"> <li>- Within the boundaries of the Biological Corridor, Government Reserve Forests, or Community Forests.</li> <li>- On productive agricultural land.</li> <li>- Within 50 meters of any water body, including rivers, streams, and natural drainage channels.</li> <li>- On steep, erosion-prone slopes.</li> </ul> <p>b. Siting Approval: All proposed locations must be sited in environmentally and socially acceptable areas and receive prior approval from the PIU.</p> <p>2. Camp Layout and Management:</p> <p>a. Detailed Layout Plan: The plan must include a detailed layout showing the location of all temporary structures, site roads, fuel storage/refuelling areas, and waste management facilities.</p> <p>b. Waste Management: The Contractor must establish proper sanitation and segregated solid waste collection (organic, recyclable, hazardous) for disposal at government-approved sites only. Open garbage pits are not permitted.</p> <p>3. Social and Administrative Measures:</p> <p>a. Local Employment: The Contractor will maximize the employment of workers from local communities to minimize the need for large external worker camps.</p> <p>b. Liaison with Authorities: The Contractor must formally notify relevant local authorities (Gewog, health, security) of the establishment and operation of any camp facilities.</p> <p>4. Site Demobilization and Restoration:</p> <p>a. Full Restoration: Upon completion, the Contractor will dismantle all temporary facilities, remove all waste, and fully restore all sites to their pre-project condition.</p> <p>b. Conditional Work Completion: The PIU will not issue the final work completion certificate until all restoration works have been completed to a satisfactory standard.</p>		civil works contract.		
Project Disclosure and Community Awareness	<p>Lack of awareness can lead to:</p> <ul style="list-style-type: none"> <li>- Misunderstandings about project activities and timelines.</li> <li>- Social friction between the community and the contractor.</li> <li>- Ineffective use of the Grievance Redress Mechanism (GRM).</li> </ul>	<p>Implement a Continuous Stakeholder Communication and Engagement Plan:</p> <p>1. Information Disclosure:</p> <p>a. Project Information Boards: Install and quarterly update information boards at Gewog offices and the main worksite, displaying project status, schedules, and GRM contact details,</p> <p>b. Local Language Accessibility: Provide a translated Dzongkha summary of the IEE at all public locations.</p> <p>c. Digital Disclosure: Upload the final IEE and all Semi-annual Environmental Monitoring Reports to the ADB and ministry websites for public access.</p> <p>2. Continuous and Two-Way Engagement:</p> <p>a. Phased Community Meetings: Hold formal public meetings at key milestones (e.g., pre-mobilization, mid-construction) to provide updates and gather feedback.</p> <p>b. Community Liaison Officer: The PIU will designate a Community Liaison Officer to conduct regular informal visits to affected communities, serve as a direct point of contact, and facilitate on-the-ground communication.</p>	Gasetsho Gom and Gasetsho Wom Gewogs, main worksites, and project-affected areas.	Included in the project administration and management costs.	PIU	PMU

Subproject Activities / Field	Potential Environmental Impacts	Mitigation Measures	Location	Cost	Implementation	Supervision
		<p>c. Inclusive Planning: Actively involve Gewog Agriculture Extension Officers in future field visits and consultations to enhance grassroots communication, as per the Dzongkhag's recommendation.</p> <p>3. Targeted Awareness Programs:</p> <p>a. Contractor's Community Briefings: Before starting work in a new area, the Contractor must hold a local briefing to discuss specific schedules, disruptions (e.g., footpath closures), and safety protocols.</p> <p>b. Worker Induction: All workers must undergo a mandatory induction on community respect and the Worker Code of Conduct.</p>				
Safeguard Compliance and Capacity Building	<p>Risk of EMP Non-Compliance: Failure to properly integrate safeguard requirements into contracts and build capacity can lead to widespread non-compliance with the EMP. This can result in:</p> <ul style="list-style-type: none"> <li>- Unmitigated environmental damage.</li> <li>- Social conflicts and safety issues.</li> <li>- A direct breach of ADB loan covenants and national regulations.</li> </ul>	<p>Implement a multi-faceted strategy to ensure full contractor compliance:</p> <p>1. Contractual Integration of Safeguards:</p> <p>a. EMP as a Binding Document: The full Environmental Management Plan (EMP) will be included as an integral part of the bidding and contract documents, making all its requirements legally enforceable.</p> <p>b. Priced EMP in Bill of Quantities (BoQ): The Contractor will be required to submit a priced BoQ for the implementation of the EMP. This ensures that all environmental and social mitigation costs are budgeted for from the outset.</p> <p>c. OHS and Labour Standards: The contract will include mandatory clauses requiring adherence to all national OHS and labour laws.</p> <p>2. Procurement and Bidding Stage:</p> <p>a. Mandatory Pre-Bid Briefing: The PIU will conduct a mandatory pre-bid briefing for all prospective bidders to clearly explain the EMP requirements, the GRM, OHS standards, and the requirement for a priced EMP.</p> <p>3. Post-Award Capacity Building:</p> <p>a. Mandatory Contractor Induction Training: Prior to commencement of works, the PIU will conduct a mandatory induction training for the Contractor's key management and site staff. This will cover their specific responsibilities for implementing the EMP, SEMP, OHS Plan, and GRM.</p>	-	Included in the Contractor's bid price (for implementation) and project administration costs (for training).	PMU, PIU	PMU
<b>Construction Phase</b>						
Establishment and Operation of Contractor's Site Facilities (Camps, Offices, Storage Yards)	<p>Improper siting and management of ancillary facilities can lead to:</p> <ul style="list-style-type: none"> <li>- Habitat degradation and loss of vegetation.</li> <li>- Contamination of soil and water resources from fuel spills, improper waste disposal, and untreated wastewater.</li> <li>- Social friction with local communities and the spread of disease.</li> </ul>	<p>The Contractor will prepare and implement a comprehensive Camp Management Plan as part of their SEMP. This plan must be approved by the PIU before any site establishment begins and must adhere to the following mandatory conditions:</p> <p>1. Site Selection and Establishment:</p> <p>a. Prohibited Locations: All facilities are strictly prohibited within the Biological Corridor, Government Reserve Forests, Community Forests, or on productive agricultural lands.</p> <p>b. Setbacks: All facilities must be sited at least 50 meters away from any water body.</p> <p>c. Consultation and Approval: All site locations must be selected in consultation with the local Gewog administration and receive prior approval from the PIU.</p> <p>2. Camp Management and Environmental Controls:</p> <p>a. Sanitation: The Contractor will provide and maintain properly managed sanitation facilities (e.g., toilets connected to septic tanks). Open pit latrines are not permitted.</p>	Camp and storage yard locations	Included in the Contractor's SEMP implementation costs and the overall civil works contract.	Contractor	PIU, with oversight from PMU

Subproject Activities / Field	Potential Environmental Impacts	Mitigation Measures	Location	Cost	Implementation	Supervision
		<p>b. Waste Management: Implement a system for segregated solid waste collection for disposal at a government-approved site. Open dumping or burning of waste is strictly prohibited.</p> <p>c. Erosion and Sediment Control: Install diversion drains and silt traps around all cleared areas to prevent sediment-laden runoff.</p> <p>d. Public Health: Implement a Public Health Plan, including adherence to all national health and safety protocols.</p> <p>3. Site Demobilization and Restoration:</p> <p>a. Full Restoration: Upon completion of the work, the Contractor will dismantle all temporary facilities, remove all waste, and fully restore all sites to their pre-project condition.</p> <p>b. Conditional Work Completion: The PIU will not issue the final work completion certificate until all restoration works have been completed to a satisfactory standard.</p>				
Excavation and Earthworks (All Areas where there are Physical Cultural Resources & chance finds	<p>Impacts on Physical Cultural Resources (PCRs):</p> <p>1. Known PCRs: Indirect impacts (vibration, noise, dust) on the Hetsokha Lhakhang from nearby construction.</p> <p>2. Unknown PCRs: Risk of accidental discovery and damage of unknown archaeological or historical artifacts ("chance finds") during excavation.</p>	<p>Implement a Comprehensive PCR Protection Measures:</p> <p>1. Mitigation for Hetsokha Lhakhang (Known PCR):</p> <p>a. Prohibited Equipment: Prohibit the use of heavy rock breakers and vibratory rollers within the demarcated 50-meter buffer zone.</p> <p>b. Controlled Methods: Use "gradual excavation methods" and "simple rolling compaction" as agreed with the community to minimize vibration.</p> <p>c. Consult and Schedule: Consult with the Lhakhang caretaker to schedule works to avoid religious ceremonies.</p> <p>2. Mandatory "Chance Find" Procedure (Unknown PCRs):</p> <p>The Contractor must adhere to the following procedure for any chance finds across the entire alignment:</p> <p>a. Stop Work Immediately in the vicinity of the find.</p> <p>b. Secure the Site to prevent damage or unauthorized access.</p> <p>c. Notify the PIU Supervisor immediately. The PIU will then formally notify the Department of Culture.</p> <p>d. Await Formal Clearance: Do not resume work in the affected area until formal written clearance has been provided by the PIU, following an assessment by the Department of Culture.</p>	<p>- Known PCR: The 50-meter buffer zone around the Hetsokha Lhakhang,</p> <p>- Unknown PCRs: The entire 21.1 km construction alignment.</p>	Included in the Contractor's SEMP implementation costs.	Contractor	PIU, Department of Culture
Transport of Construction Materials and Equipment	<p>The movement of heavy vehicles and machinery will generate temporary, localized impacts, including:</p> <ul style="list-style-type: none"> <li>- Increased Traffic and Safety Risks on narrow, unpaved local roads</li> <li>- Air Pollution from dust and vehicle exhaust fumes.</li> <li>- Noise Pollution causing nuisance to communities and wildlife.</li> <li>- Damage to Local Roads from repeated passage of heavy loads.</li> </ul>	<p>The Contractor will be required to develop and implement a comprehensive Traffic Management Plan as part of their SEMP. This plan must include:</p> <p>1. Traffic and Road Safety Management:</p> <p>a. Scheduling: Transportation of materials will be scheduled during off-peak hours where possible to minimize disruption.</p> <p>b. Road Maintenance: The Contractor will be responsible for maintaining all access roads used by project vehicles and repairing any damage caused.</p> <p>c. Safe Stockpiling: Temporary stockpiling of materials along roadsides must not obstruct traffic flow or create safety hazards.</p> <p>2. Dust and Air Pollution Control:</p> <p>a. Covered Loads: All trucks transporting loose materials (soil, sand) must be fitted with securely fastened tarpaulin covers.</p> <p>b. Dust Suppression: Regular watering of unpaved access roads and active work areas will be conducted.</p> <p>c. Stockpile Management: All material stockpiles that will be left idle for an extended period will be covered with tarpaulins.</p>	All along ferry route	Included in the Contractor's SEMP implementation costs and the overall civil works contract.	Contractor	PIU (daily supervision and spot checks), with oversight from PMU

Subproject Activities / Field	Potential Environmental Impacts	Mitigation Measures	Location	Cost	Implementation	Supervision
		d. Vehicle and Equipment Maintenance: All project vehicles and machinery will be maintained in good working order to prevent excessive smoke belching and ensure compliance with the RSTA emission standards.				
Construction of Access Path and Trench in Hilly, Steep, and Rocky Terrains	<ul style="list-style-type: none"> <li>- Slope Destabilization &amp; Landslides: Improper excavation on steep slopes triggering erosion and slope failure.</li> <li>- Habitat Degradation: Damage to vegetation from uncontrolled spoil disposal (side-casting).</li> <li>- OHS Risks: Hazardous working conditions for personnel on steep terrain.</li> <li>- Community Safety Risk from Blasting: Potential for property damage and harm to residents from uncontrolled blasting on the rocky cliff above the Gasetsho-Wom Gewog Centre.</li> </ul>	<p>Implement a systematic and environmentally sound approach to all earthworks in steep terrain:</p> <ol style="list-style-type: none"> <li>1. Excavation and Spoil Management: <ol style="list-style-type: none"> <li>a. Strictly Prohibit Side-Casting: All excavated spoil must be collected and transported to pre-approved, engineered disposal sites except for unavoidable areas.</li> <li>b. Precise Demarcation: Clearly stake the 3.5m RoW before any clearing to prevent over-cutting.</li> </ol> </li> <li>2. Construction Techniques and Equipment: <ol style="list-style-type: none"> <li>a. Minimize Blasting: Prioritize mechanical rock removal (ripping, hydraulic hammers) over blasting.</li> <li>b. Enhanced Blasting Controls for Sensitive Areas: For any unavoidable blasting, particularly on the cliff section above the Gasetsho-Wom Gewog Centre, the Contractor must: <ul style="list-style-type: none"> <li>- Prepare a site-specific, detailed Blasting Plan for PIU approval.</li> <li>- Use "controlled blasting" techniques (e.g., smaller charges, blasting mats) to eliminate fly-rock and minimize ground vibration.</li> <li>- Provide advance notification to the Gewog administration and residents.</li> </ul> </li> <li>c. Use Appropriate Machinery: Employ hydraulic excavators with rock breaker suitable for steep terrain.</li> </ol> </li> <li>3. Slope Stabilization and Drainage: <ol style="list-style-type: none"> <li>a. Implement concurrent slope stabilization (retaining walls, bioengineering) in steep and unstable sections.</li> <li>b. Construct temporary catch drains to manage rainwater runoff.</li> </ol> </li> </ol>	Entire alignment, with specific focus on sections with slopes >30% and the rocky cliff above Gasetsho-Wom Gewog Centre. Near by Chainage Km 14.	Included in the Contractor's SEMP implementation costs and the overall civil works contract.	Contractor	PIU, with oversight from PMU
Biodiversity	<p>Impacts on Biodiversity:</p> <ol style="list-style-type: none"> <li>1. Habitat Disturbance: From vegetation clearing and excavation within the RoW.</li> <li>2. Disturbance to Fauna: Disruption to the movement and behaviour of wildlife, particularly species of concern like the Dhole (Endangered), from noise and human presence.</li> <li>3. Impacts on Aquatic Species: Potential harm to Snow Trout (Vulnerable) from in-stream construction.</li> <li>4. Loss of Flora: Potential loss of individual plants of conservation concern, such as Star Anise (Endangered).</li> </ol>	<p>A multi-layered biodiversity mitigation strategy will be implemented, combining habitat protection, species-specific controls, worker conduct protocols, and restoration commitments:</p> <ol style="list-style-type: none"> <li>1. Habitat Protection and Construction Practices: <ol style="list-style-type: none"> <li>a. Footprint Minimization: All works will be strictly confined to the approved RoW. Use of smaller machinery is required to reduce the scale of disturbance.</li> <li>b. Scheduling and Timing: Construction activities will be limited to daytime hours only (from dawn to dusk).</li> <li>c. Controlled Blasting: "Controlled blasting" techniques will be used to minimize noise, vibration, and shockwaves.</li> <li>d. Prohibited Facilities: The establishment of any worker camps, equipment yards, or material storage areas within the BC or GRF is strictly forbidden.</li> </ol> </li> <li>2. Species-Specific Protection: <ol style="list-style-type: none"> <li>a. Fish Breeding: All in-stream works at the intake site are prohibited during the peak breeding seasons for Snow Trout (April-June and September-October).</li> <li>b. Wildlife Protection Protocol: All open trenches will be covered or equipped with escape ramps at night to prevent animal entrapment. In the event of a wildlife encounter, work will cease, and the nearest Forest Range Office will be contacted for rescue and release protocols.</li> </ol> </li> </ol>	Entire 21.1km	Included in the Contractor's SEMP implementation costs and the overall civil works contract.	Contractor	PIU, DoFPS, PMU

Subproject Activities / Field	Potential Environmental Impacts	Mitigation Measures	Location	Cost	Implementation	Supervision
		<p>c. Flora Protection: The felling of Illicium (Star Anise) trees is prohibited unless they fall directly within the cleared RoW.</p> <p>3. Worker Conduct and Awareness:</p> <p>a. Worker's Code of Conduct: A mandatory Code of Conduct will be enforced for all personnel, explicitly prohibiting hunting, fishing, poaching, and the collection of any forest products. All workers will receive training on this code and the Forest and Nature Conservation Act.</p> <p>4. Compensation and Restoration:</p> <p>a. Compensatory Afforestation: The project will fully fund a compensatory afforestation program, to be implemented by the DoFPS, to replace all felled trees.</p> <p>b. Full Site Restoration: All disturbed areas will be progressively restored using bioengineering techniques to facilitate the natural regeneration of native vegetation.</p>				
Spread of Invasive Species	<p>Spread of Invasive Alien Species (IAS): The discovery of <i>Solanum viarum</i> (Tropical Soda Apple) near the intake represents a significant threat. Construction activities (soil disturbance, vehicle movement) create ideal conditions for the spread and establishment of this and other potential invasive species. This can lead to the degradation of native habitats within the Biological Corridor, loss of biodiversity, and increased long-term management costs.</p>	<p>A proactive Invasive Species Management Plan will be implemented. The Contractor will be required to:</p> <p>1. Immediate Eradication (Pre-Construction):</p> <p>a. As a measure of Early Detection and Rapid Response (EDRR), the single identified <i>Solanum viarum</i> plant must be carefully uprooted before the commencement of any civil works.</p> <p>b. The entire plant (including roots) must be bagged on-site and disposed of safely (e.g., via controlled burning) to prevent any seed dispersal or regrowth. The immediate area will be monitored for new seedlings.</p> <p>. Prevention of Spread (During Construction):</p> <p>a. Vehicle Cleaning Protocol ("Clean-in, Clean-out"): All vehicles and heavy machinery must be thoroughly washed down at a designated location to remove soil and seeds before entering the Biological Corridor.</p> <p>b. Worker Awareness and Training: All project personnel will be trained to identify <i>Solanum viarum</i> and report any new sightings immediately to the EHS Officer.</p> <p>3. Post-Construction Control:</p> <p>a. Prompt Revegetation: Following construction, all disturbed areas (RoW, camp sites, spoil sites) must be promptly revegetated with fast-growing, native species to provide ground cover and outcompete potential invasive seedlings.</p> <p>b. Long-Term Monitoring: The project RoW, particularly the area near the intake, will be monitored for at least three years post-construction to detect and manage any new IAS outbreaks.</p>	Entire 21.1km but more specifically within Biological Corridor.	Included in the Contractor's SEMP implementation costs and the overall civil works contract.	<p>Contractor (for eradication, vehicle cleaning, training, and revegetation).</p> <p>PIU/Operator (for long-term monitoring).</p>	PIU, DoFPS, PMSC.
Soil Erosion and Sedimentation	<p>Soil Erosion and Sedimentation: Exposed soil from excavation, access paths, and material stockpiles can be easily eroded by rainfall, especially on the project's steep slopes. This can lead to:</p> <ul style="list-style-type: none"> <li>- Slope instability and loss of topsoil.</li> <li>- Sedimentation of the Hetshotsangchhu, degrading water quality and aquatic habitats.</li> </ul>	<p>The Contractor will be required to prepare and implement a site-specific Erosion and Sediment Control Plan (ESCP) as part of their SEMP. This plan must incorporate the following mandatory measures:</p> <p>1. Work Planning and Exposure Minimization:</p> <p>a. The extent and duration of soil exposure will be minimized at all times. Construction will be phased, and disturbed areas will be progressively rehabilitated rather than left exposed.</p> <p>b. Major earthworks will be scheduled to avoid the peak monsoon season where feasible.</p> <p>2. Spoil and Stockpile Management:</p>	All construction sites	Included in the Contractor's SEMP implementation costs and the overall civil works contract.	Contractor	PIU (daily supervision and spot checks), PMU

Subproject Activities / Field	Potential Environmental Impacts	Mitigation Measures	Location	Cost	Implementation	Supervision
		<p>a. The indiscriminate dumping or side-casting of excavated material (spoil) is strictly prohibited. All excess spoil will be transported to pre-approved disposal sites as defined in the Spoil Management Plan.</p> <p>b. Temporary stockpiles will be located away from drainage paths, covered with tarpaulins, and surrounded by silt fences.</p> <p>3. Runoff and Sediment Control Measures:</p> <p>a. Structural controls such as silt fences, check dams, and temporary diversion drains will be installed down-slope of all construction areas to intercept and treat runoff.</p> <p>b. All backfilled trenches will be properly compacted to prevent subsidence and the formation of erosive channels.</p> <p>4. Site Stabilization and Restoration:</p> <p>a. Upon completion of work in any given area, all disturbed surfaces will be promptly stabilized and revegetated with native grasses and shrubs to provide long-term protection against erosion.</p>				
Impact on Air quality	<p>Degradation of Local Air Quality, particularly in a sensitive airshed with poor dispersion:</p> <ul style="list-style-type: none"> <li>- Dust Generation (PM10, PM2.5): Excavation, vehicle movement, and uncovered stockpiles will generate significant dust, impacting workers, communities, and sensitive ecosystems.</li> <li>- Exhaust Emissions (NOx): Machinery emissions will exacerbate the already high baseline NO2 levels, posing a health risk to workers and potentially exceeding WHO guidelines in the vicinity of works.</li> </ul>	<p>Implement a comprehensive Air Quality Management Plan as part of the SEMP, with enhanced measures due to the area's poor air dispersion:</p> <p>1. Dust Control Measures:</p> <p>a. Water Suppression: Use water tankers to spray all active work areas and unpaved roads at least twice daily, and more frequently during dry/windy periods.</p> <p>b. Covering: Ensure all trucks transporting loose materials are fitted with securely fastened tarpaulin covers. All idle soil stockpiles must also be covered.</p> <p>c. Speed Limits: Enforce a strict speed limit of 20 km/h on all unpaved project roads.</p> <p>d. Wheel Washing: Mandate the cleaning of vehicle wheels and undercarriages at designated washing stations before any truck exits a worksite onto public roads.</p> <p>2. Emission Control Measures:</p> <p>a. Regular Maintenance: All vehicles and machinery must be well-maintained and serviced regularly to comply with national (RSTA) emission standards and ensure efficient fuel combustion.</p> <p>b. Reduced Idling: Enforce a strict "no idling" policy, requiring engines be shut off when not in use for more than five minutes.</p>	At all locations but specifically At selected sensitive receptors (3 locations- Intake, Hetshokha Lhakhang & Changkha village)	Included in the Contractor's SEMP implementation costs and the overall civil works contract.	Contractor	PIU (daily supervision and spot checks), PMU
Surface water quality	<p>Degradation of Surface Water Quality: Runoff from construction sites can transport pollutants into the Hetshotsangchhu, leading to:</p> <ul style="list-style-type: none"> <li>- Sedimentation: Increased turbidity from eroded soil, harming aquatic habitats.</li> <li>- Chemical Contamination: Spills of fuel, oils, and lubricants from machinery.</li> <li>- Waste Contamination: Pollution from improper disposal of solid waste and untreated wastewater from camps.</li> </ul>	<p>The Contractor will be required to prepare and implement a comprehensive Water Quality Management Plan as part of their SEMP. This plan must include the following mandatory measures:</p> <p>1. Erosion and Sediment Control:</p> <p>a. Seasonal Scheduling: All major earthworks and in-stream activities shall be scheduled during the dry season to the greatest extent feasible.</p> <p>b. Sediment Barriers: Silt fences, check dams, and other sediment barriers shall be installed and maintained down-slope of all construction areas and stockpiles to intercept runoff.</p> <p>c. Proper Backfilling: All backfilled trenches will be properly compacted in layers to prevent erosion.</p>		Included in the Contractor's SEMP implementation costs and the overall civil works contract.	Contractor	PIU (regular site inspections and review of monitoring data), PMU

Subproject Activities / Field	Potential Environmental Impacts	Mitigation Measures	Location	Cost	Implementation	Supervision
		<p>2. Hazardous Materials and Chemical Management:</p> <p>a. Designated Storage: All fuel, oil, and chemical storage shall be located on an impervious base within a secure, bunded area (110% capacity) at least 50 meters away from any water body.</p> <p>b. Controlled Refuelling: Vehicle and equipment refuelling and maintenance shall occur in a designated, protected area away from water bodies.</p> <p>c. Spill Response: A fully stocked spill response kit will be maintained on-site at all times, and workers will be trained in its use.</p> <p>3. Site and Waste Management:</p> <p>a. Camp and Stockpile Setbacks: Worker camps, toilets, and material stockpiles shall be located at least 50 meters away from any watercourse.</p> <p>b. Waste Disposal: All solid waste and wastewater from camp facilities will be managed and disposed of at approved off-site locations, in accordance with the Camp Management Plan.</p> <p>4. Water Quality Monitoring:</p> <p>a. Regular Monitoring: Water quality monitoring will be conducted as specified in the EMP, with samples taken upstream and downstream of major work areas, particularly after significant rainfall events. Key parameters will include turbidity and pH.</p> <p>b. The final effluent quality must comply with the requirements of Bhutan's Environmental Standards 2020 and the IFC EHS Guidelines, whichever is more stringent.</p>				
Noise and Vibration	<p>Impacts Due to Noise and Vibration: Construction activities will cause a significant, temporary increase in ambient noise and vibration. The baseline data confirms the area is an extremely quiet environment with a high sensitivity to night-time noise. Key impacts include:</p> <ul style="list-style-type: none"> <li>- Disturbance to Wildlife within the Biological Corridor.</li> <li>- Nuisance and sleep disturbance to nearby communities.</li> <li>- Disruption to sensitive receptors like the Hetschokha Lhakhang.</li> </ul>	<p>The Contractor will be required to prepare and implement a comprehensive Noise and Vibration Management Plan as part of their SEMP. This plan must include:</p> <p>a) Work Scheduling and Timing Controls:</p> <p>(i) Strict Daytime Working Hours: All construction activities generating significant noise will be strictly limited to daytime hours (e.g., 08:00 to 18:00). No night-time work is permitted.</p> <p>(ii) Consultation with Sensitive Receptors: The Contractor will coordinate with the caretakers of the Hetschokha Lhakhang and local community leaders to schedule noisy works to avoid periods of religious ceremonies, festivals, or other sensitive occasions.</p> <p>b) Equipment and Source Controls:</p> <p>(i) Well-Maintained Equipment: All machinery and vehicles must be kept in good working order and fitted with effective, manufacturer-recommended exhaust silencers.</p> <p>(ii) Blasting Controls: Conventional blasting is prohibited. Where hard rock removal is necessary, "silent" or "controlled" blasting techniques must be used to minimize noise and vibration.</p> <p>(iii) Prohibition on Unnecessary Horn Use: Vehicle horns shall only be used for essential safety warnings.</p> <p>c) Monitoring and Compliance:</p> <p>(i) Regular Monitoring: The PIU will conduct periodic noise monitoring at sensitive receptor locations during the construction phase to verify compliance with the NEC ES 2020 daytime limit of 65 dBA.</p>	<p>-Intake (Upstream),</p> <p>-Basochhu Reservoir (downstream),</p> <p>-stream near Shingkhay Khatay, &amp; Tengalum stream</p>	Included in the Contractor's SEMP implementation costs and the overall civil works contract.	Contractor	PIU (daily supervision and periodic monitoring), PMU
Community health and safety	<p>Impacts on Community Health and Safety:</p> <ul style="list-style-type: none"> <li>- Physical Hazards: Risks to the public from open trenches, moving machinery, and</li> </ul>	<p>The Contractor will be required to develop and implement a comprehensive Community Health and Safety Plan as part of their SEMP. This plan must be approved by the PIU prior to mobilization and must include:</p>	At all locations but specifically at	Included in the Contractor's	Contractor	PIU (daily supervision and spot

Subproject Activities / Field	Potential Environmental Impacts	Mitigation Measures	Location	Cost	Implementation	Supervision
	<p>general construction activities, especially in and around Hetshokha village.</p> <ul style="list-style-type: none"> <li>- Traffic Safety Risks: The movement of heavy construction vehicles on narrow, unpaved farm roads poses a significant safety risk, particularly to pedestrians and students.</li> <li>- Public Health and Social Risks: The potential for the spread of communicable diseases from the workforce to the community and social friction arising from improper worker conduct.</li> </ul>	<p>a) Traffic and Pedestrian Safety:</p> <ul style="list-style-type: none"> <li>(i) Speed Limits: A strict speed limit of 20 km/h will be enforced for all project vehicles operating near settlements and schools.</li> <li>(ii) Traffic Management: Trained flagpersons will be deployed to manage the safe passage of traffic and pedestrians around active work sites on local roads.</li> <li>(iii) Controlled Parking: Vehicles and machinery will only be parked in pre-designated areas. Parking on narrow road sections or in a manner that obstructs local traffic is strictly prohibited.</li> </ul> <p>b) Site Safety and Hazard Management:</p> <ul style="list-style-type: none"> <li>(i) Site Demarcation: All active work sites will be clearly demarcated with warning signs and safety barricades to prevent unauthorized public access.</li> <li>(ii) Trench Management: In areas near villages or houses, open trenches will be backfilled or securely covered within 48 hours of excavation to minimize hazards. Temporary, safe access (e.g., planks with handrails) will be provided across any open trenches that intersect public footpaths.</li> </ul> <p>c) Public Health and Worker Conduct:</p> <ul style="list-style-type: none"> <li>(i) Worker's Code of Conduct: A mandatory Code of Conduct will be enforced for all project personnel. This code will be a condition of employment and will explicitly prohibit: trespassing, open defecation, littering, firewood collection, and unauthorized interaction with the community.</li> <li>(ii) Public Health Protocols: The Contractor will implement a health plan that includes proper site sanitation and adherence to all national guidelines for preventing the spread of infectious diseases.</li> </ul> <p>d) Community Communication:</p> <ul style="list-style-type: none"> <li>(i) Advance Notification: The Contractor, through the PIU and Gewog administration, will provide the local community with advance notification of all construction schedules and potential temporary disruptions.</li> </ul>	Tonglabji, Hetshokha, Tabchaykha, Shingkhay Khatay & Khamay	SEMP implementation costs and the overall civil works contract.		checks), PMU
Occupational Health and Safety (OHS)	<p>Occupational Health and Safety (OHS) Risks:</p> <p>Construction activities inherently expose workers to a range of risks, including:</p> <ul style="list-style-type: none"> <li>- Physical Hazards: Accidents from moving machinery, excavation on steep terrain, and handling of heavy materials.</li> <li>- Exposure Hazards: Health issues from prolonged exposure to dust, exhaust fumes, and noise.</li> <li>- Health and Sanitation Risks: Spread of communicable diseases due to inadequate sanitation, especially in worker camps.</li> <li>- Worker Fatigue: Increased risk of accidents due to failure to adhere to regulated working hours.</li> </ul>	<p>The Contractor will be contractually required to develop, implement, and maintain a comprehensive Occupational Health and Safety (OHS) Plan for the project. This plan must be approved by the PIU prior to the commencement of any works and must, at a minimum, incorporate the following components:</p> <p>a) Hazard Identification and Site Safety:</p> <ul style="list-style-type: none"> <li>(i) The plan will be based on a Hazard Identification and Risk Assessment (HIRA) specific to the project's activities and site conditions.</li> <li>(ii) All work areas will be properly managed to prevent accidents, including the use of clear signage and barricades around open excavations.</li> </ul> <p>b) Worker Health and Welfare:</p> <ul style="list-style-type: none"> <li>(i) Compliance with Law: The plan must ensure full compliance with Bhutan's Labour and Employment Act of 2007 and the Regulation on Occupational Health, Safety and Welfare 2012.</li> <li>(ii) Sanitation and Hygiene: The Contractor will provide adequate sanitation facilities, clean drinking water, and proper waste management at all work sites and in any established camps.</li> <li>(iii) Infectious Disease Control: A protocol for managing communicable diseases, including any prevailing national guidelines, will be a mandatory part of the plan.</li> </ul>	All construction sites	Included in the Contractor's SEMP implementation costs and the overall civil works contract.	Contractor	PIU (regular site inspections), PMU

Subproject Activities / Field	Potential Environmental Impacts	Mitigation Measures	Location	Cost	Implementation	Supervision
		<p>c) Personal Protective Equipment (PPE):</p> <p>(i) The Contractor will provide all workers with appropriate, task-specific PPE (e.g., helmets, safety boots, gloves, dust masks, hearing protection) free of charge.</p> <p>d) Emergency Preparedness and Response:</p> <p>(i) Emergency Procedures: Clear procedures for responding to accidents and emergencies will be established and communicated to all workers.</p> <p>(ii) First Aid: A fully stocked first-aid station will be readily accessible at every primary worksite.</p> <p>(iii) Emergency Contacts and Transport: A list of emergency contact numbers will be visibly posted, and reliable emergency transport will be available to transfer any injured worker to the nearest medical facility.</p> <p>e) Training, Awareness, and Responsibility:</p> <p>(i) OHS Officer: The Contractor will appoint a dedicated and trained OHS Officer responsible for overseeing the implementation of the OHS Plan.</p> <p>(ii) Induction Training: All workers will receive mandatory OHS induction training, including awareness on site-specific hazards, safe work practices, and social issues such as human trafficking and the prevention of STDs.</p> <p>f) Mandatory Workmen's Compensation: Full compliance with the "Compensation Rules and Regulations for Workmen, 2009." The Contractor must secure and maintain adequate insurance for all personnel covering medical costs, disability, and loss of life. Proof of insurance is a prerequisite for mobilization.</p>				
<b>Post Construction and Operational Phase</b>						
Post-Construction Site Closure and Demobilization	<p>Improper site closure can lead to:</p> <ul style="list-style-type: none"> <li>- Environmental Pollution: From leftover materials, solid waste, excess spoil, and hazardous wastes (e.g., spent oils, lubricants).</li> <li>- Aesthetic Degradation: Un-rehabilitated sites, spoil dumps, and leftover debris creating a visual blight on the landscape.</li> <li>- Long-Term Safety Hazards: From un-restored excavations or unstable spoil piles.</li> </ul>	<p>The Contractor will be required to prepare and implement a comprehensive Site Demobilization and Restoration Plan. Satisfactory completion of this plan will be a condition for the final payment and issuance of the project completion certificate. The plan must include:</p> <p>a) Waste Removal and Disposal:</p> <p>(i) Complete Waste Removal: The Contractor shall remove all construction-related materials and waste from the site, including excess aggregates, scrap materials, and any temporary structures.</p> <p>(ii) Hazardous Waste Management: All hazardous wastes (spent oils, contaminated soil, etc.) must be collected and disposed of at a government-approved facility certified to handle such materials.</p> <p>(iii) Spoil Site Finalization: All approved spoil disposal sites must be properly graded, compacted, and stabilized to ensure long-term stability and prevent erosion.</p> <p>b) Site Rehabilitation and Revegetation:</p> <p>(i) Restoration of Temporary Sites: All areas used for temporary facilities (camps, storage yards) will be fully decommissioned and restored to their pre-project condition.</p> <p>(ii) Rehabilitation of the Right-of-Way (RoW): The construction corridor will be re-contoured to match the surrounding landscape and stabilized using bioengineering techniques (e.g., planting of native grasses and shrubs) to prevent long-term erosion.</p> <p>c) Final Site Inspection and Handover:</p>	All construction sites	Included in the Contractor's SEMP implementation costs and the overall civil works contract.	Contractor	PIU

Subproject Activities / Field	Potential Environmental Impacts	Mitigation Measures	Location	Cost	Implementation	Supervision
		<p>(i) Joint Inspection: A final joint site inspection will be conducted by the PIU, the Contractor, and relevant stakeholders (e.g., DoFPS, Gewog) to verify that all restoration requirements have been met.</p> <p>(ii) Conditional Project Acceptance: The PIU will only issue the final completion certificate after all restoration works have been completed to a satisfactory standard.</p>				
Post-Construction Long-Term Management of the Access Road	Impacts from an Unmanaged Access Road: An unmanaged permanent road, particularly through the Biological Corridor, creates a long-term risk of enabling illegal activities (e.g., poaching, illegal logging), undermining conservation objectives.	<p>The primary and confirmed mitigation measure is the full decommissioning and ecological restoration of the access road section within the Biological Corridor after construction is complete. This will involve:</p> <ol style="list-style-type: none"> <li>Decommissioning and Restoration: <ul style="list-style-type: none"> <li>Ripping the compacted road surface to facilitate water infiltration and root growth.</li> <li>Replanting the corridor with a mix of native tree and shrub species appropriate for the local ecosystem.</li> <li>Installing permanent physical barriers (e.g., earth berms, boulders) at entry points to prevent any future vehicular access.</li> </ul> </li> <li>Documentation of Stakeholder Views (for separate future consideration): During consultations, stakeholders (including the Dzongkhag Administration) proposed a long-term vision to repurpose the route as an eco-trail and a strategic access route for forest fire management. <ul style="list-style-type: none"> <li>It is formally noted that these proposals are outside the scope of this project and its environmental approvals. Any future consideration of these ideas must be initiated independently by the Dzongkhag Administration and will require a new, separate feasibility study, IEE, and all necessary environmental and forest clearances</li> </ul> </li> </ol>	The ~21.1 km access road, with a particular focus on the ~5 km section within the Biological Corridor.	Included in the project's operational and maintenance (O&M) budget.	Dzongkhag Administration (in coordination with DoFPS and local communities)	PMU, DoFPS, Dzongkhag Administration
Operation and Maintenance (O&M) of the Integrated Water Supply Scheme	<ol style="list-style-type: none"> <li>Public Health Risk: Failure to deliver drinking water that meets National Drinking Water Quality Standards (NDWQS) due to source contamination or system failure.</li> <li>Service Disruption: Damage to the intake or pipelines from natural hazards (landslides, flash floods), leading to prolonged water outages.</li> <li>Source Unsustainability: Water shortages and user conflicts due to climate change-induced low flows or demand exceeding projections.</li> <li>Environmental Pollution: Contamination from the improper disposal of solid and hazardous waste generated during maintenance activities.</li> </ol>	<p>The Dzongkhag Administration will develop and implement a comprehensive Operation &amp; Maintenance (O&amp;M) Manual. This manual will include the following mandatory plans and protocols:</p> <ol style="list-style-type: none"> <li>Water Safety Plan (WSP): A risk-management plan covering the entire system from catchment to consumer, including: <ol style="list-style-type: none"> <li>A routine maintenance schedule and water quality monitoring protocol.</li> <li>Strict operational procedures for the disinfection system.</li> </ol> </li> <li>Emergency Preparedness and Response Plan (EPRP): A plan to manage natural hazard risks, including: <ol style="list-style-type: none"> <li>A contingency fund for emergency repairs.</li> <li>Standard Operating Procedures (SOPs) for system shutdown during flood events, linked to the early warning system.</li> <li>A rigorous inspection schedule for critical infrastructure (pre-monsoon, post-event, post-monsoon).</li> </ol> </li> <li>Source Sustainability Management Plan: A plan for long-term resource management, including: <ol style="list-style-type: none"> <li>A Water Resource Management Committee (with Dzongkhag, Gewogs, and DGPC) to oversee water allocation.</li> <li>A strict water allocation protocol with non-negotiable priorities: 1) 30% E-flow, 2) Drinking Water, 3) Irrigation.</li> <li>Continuous flow monitoring and an adaptive management process to address any sustained decrease in source availability.</li> </ol> </li> </ol>	Intake and all other delivery points	Included in the annual Operation and Maintenance (O&M) budget.	Dzongkhag Administration (as the designated operator)	Dzongkhag Administration, Water Resource Management Committee, and relevant regulatory bodies

Subproject Activities / Field	Potential Environmental Impacts	Mitigation Measures	Location	Cost	Implementation	Supervision
		<p>4. O&amp;M Waste Management Protocol: A protocol for the proper handling and disposal of all solid and hazardous waste in compliance with national regulations.</p> <p>5. On-Farm Water Management and User Engagement:</p> <ul style="list-style-type: none"> <li>- Strengthening Water User Associations (WUAs): The PIU and Dzongkhag Administration will build the capacity of local WUAs.</li> <li>- Farmer Training: The JFPR-funded program (Output 4), in coordination with the PIU, will provide training to farmers on efficient irrigation techniques, soil conservation, and the promotion of best practices like Integrated Pest Management (IPM).</li> </ul>				

## **X. MONITORING AND REPORTING**

### **A. Purpose and Objectives of Environmental Monitoring**

398. Environmental monitoring is a mandatory component of project implementation, required by both the ADB SPS and national regulations. Its primary objectives are to:

- Verify the Contractor's compliance with the Environmental Management Plan (EMP).
- Assess the effectiveness of the implemented mitigation measures.
- Identify any unanticipated environmental impacts or non-compliance issues as they arise.
- Provide a basis for implementing corrective actions when necessary.
- Fulfil the reporting requirements of the Royal Government of Bhutan and the ADB.

### **B. Institutional Responsibilities in Monitoring**

399. A multi-tiered monitoring structure will be implemented:

- The Contractor: Is responsible for internal day-to-day monitoring of its own activities to ensure compliance with the approved Site-Specific Environmental Management Plan (SEMP). The Contractor's EHS Officer will lead this effort.
- The Project Implementation Unit (PIU): Is responsible for external compliance monitoring and supervision. The PIU will conduct regular site inspections to verify the Contractor's work and the accuracy of their monitoring reports.
- The Project Management Unit (PMU): Is responsible for overall strategic oversight and reporting. The PMU will review the monitoring reports from the PIU and conduct its own periodic audits to ensure project-wide compliance.

### **C. Reporting Framework**

400. A formal reporting chain will be established to ensure that information flows from the construction site to the ADB in a timely and systematic manner:

*a) Contractor's Monthly Environmental Monitoring Report (MEMR)*

401. The Contractor will submit a Monthly Environmental Monitoring Report to the PIU. This report will include daily monitoring checklists (sample in Appendix 9), a summary of EMP implementation, and details of any incidents or non-compliance issues.

*b) PIU's Quarterly Environmental Monitoring Report (QEMR)*

402. The PIU will consolidate the Contractor's monthly reports and its own site inspection findings (sample checklist in Appendix 10) into a Quarterly Environmental Monitoring Report, which will be submitted to the PMU.

*c) PMU's Semi-Annual Environmental Monitoring Report (SEMR)*

403. The PMU will consolidate the quarterly reports from the PIU into a comprehensive Semi-Annual Environmental Monitoring Report (SEMR). The SEMR (template in Appendix 11) is the primary reporting document that will be submitted to the ADB for review and public disclosure. The submission of SEMRs will continue until the issuance of a Project Completion Report by ADB.

*d) Environmental Monitoring Program*

404. The following Environmental Monitoring Program (Table 27) specifies the parameters to be monitored, the locations, the frequency, and the responsibilities for both implementation and supervision during the project's construction phase. The locations for water and air quality sampling are shown in Figure 45.

Table 27: Environmental Monitoring Plan Matrix

Parameter / Action to be Verified	Location	Implementation Responsibility	Means of Verification	Timing / Frequency	Monitoring Responsibility
1. Statutory Clearances	Entire Project Area	PIU, with oversight from PMU	<ul style="list-style-type: none"> <li>- Environmental Clearance (EC): Review of the official, valid EC from the competent authority.</li> <li>- Forestry Clearance: Review of the official, valid Forestry Clearance (ID: 919151, issued 13 Aug 2025) and all its conditions</li> <li>- Administrative Approvals: Copies of formal approvals from the Dzongkhag and Gewog administrations.</li> </ul>	Prior to Contract Award	PMU, ADB
2. Third-Party Agreements	Project Files / Records	PIU, with oversight from PMU	<ul style="list-style-type: none"> <li>- Water Sharing Agreement: Review of the signed agreement with Druk Green Power Corporation (DGPC).</li> <li>- CFMG Agreements: Review of the final, signed Memoranda of Understanding (MoUs) with all affected Community Forest Management Groups (CFMGs).</li> </ul>	Prior to Contract Award.  (MoUs must be signed before the contractor can mobilize in CF areas).	PMU, ADB
3. Integration of EMP into Contracts	Procurement Process	PMU	<ul style="list-style-type: none"> <li>- Review of the final Bidding Documents to confirm inclusion of the full, updated IEE/EMP as a binding annex.</li> <li>- Confirmation that the Bill of Quantities (BoQ) includes a priced line item for EMP/EHS implementation.</li> </ul>	Prior to issuing the invitation for bids	PMU, ADB
3. Contractor's Site-Specific Environmental Management Plan (SEMP) and Sub-Plans	Project Site	Contractor	<ul style="list-style-type: none"> <li>- Formal written approval by the PIU/PMU of the Contractor's SEMP and all required sub-plans (OHS, Spoil Management, Camp Management, Traffic Management, etc.).</li> <li>- Review of the Contractor's proof of valid workmen's compensation insurance.</li> </ul>	After Contract Award and PRIOR to Mobilization / Commencement of any Civil Works.	PIU, PMU
4. Other Necessary Permits	Project Site	Contractor	Copies of all other necessary permits and licenses required for construction activities (e.g., labour permits, vehicle registrations, etc.).	Prior to Mobilization / Commencement of specific activities.	PIU
Ambient Air Quality (TSP, PM10, PM2.5, SO2, NO2, CO, O3 as per the Department of Environment & Climate Change (DECC)'s Environmental Standard 2020.	At selected sensitive receptor locations along the alignment, particularly near active construction sites and downwind community areas (3 locations-	Contractor (through a qualified third-party monitoring agency/consultant)	Monitoring report with laboratory analysis results, compared against the established baseline data and NEC ES 2020 / WHO AQG 2021 standards.	One-off: before construction activities commence	PMU, PIU, PMU Environment Specialist Consultant

Parameter / Action to be Verified	Location	Implementation Responsibility	Means of Verification	Timing / Frequency	Monitoring Responsibility
	Intake, Hetsbokha Lhakhang & Changkha village)				
Ambient Noise Levels	At selected sensitive receptor locations, particularly near active construction sites and community areas (3 locations- Intake, Hetsbokha Lhakhang & Changkha village)	Contractor (through a qualified third-party monitoring agency/consultant)	Monitoring report with measured Daytime Leq (dBA) values, compared against the established baseline and the NEC ES 2020 standard of 65 dBA.	One-off: before construction activities commence	PMU, PIU, PMU Environment Specialist Consultant
Surface Water Quality	<b>Upstream and downstream</b> of active in-stream construction areas Intake, reservoir of Basochhu Hydropwer, Stream at Phakha, Stream near Delivery point)	PIU (through a qualified third-party monitoring agency/consultant)	Monitoring report with laboratory analysis results, compared against the established baseline data and relevant National Drinking Water Quality Standards (NDWQS) and/or IFC EHS Guidelines. 1. Baseline (Pre-construction) Monitoring: A comprehensive analysis must be conducted before any civil works commence. Parameters will include: • Physical: pH, Turbidity, Total Suspended Solids (TSS), Electrical Conductivity, Temperature. • Chemical: Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO), Total Hardness, Iron, Nitrates, Sulphates. • Bacteriological: Total Coliforms, Fecal Coliforms (or E. coli). 2. Construction Phase Monitoring: Monitoring during construction will focus on key indicators of construction-related pollution. Parameters will include, at a minimum: • pH • Turbidity • Total Suspended Solids (TSS) • Oil & Grease	One-off: before construction activities commence	PMU, PIU, PMU Environment Specialist Consultant
<b>Construction Phase</b>					
Contractor's Compliance with SEMP / EMP (Includes Spoil Management Plan, OHS, Waste Management, etc.)	All active construction sites, camps, and ancillary areas.	Contractor: Daily internal monitoring and record-keeping. PIU: Regular external compliance inspections.	- Regular site inspections and spot checks. - Review of Contractor's Monthly Reports. - Photo documentation. - Completed site monitoring checklists.	Daily (by Contractor EHS Officer) Weekly (by PIU)	PIU, PMU Environment Specialist Consultant
Protection of Hetsbokha Lhakhang (PCR)	50-meter buffer zone around Hetsbokha Lhakhang.	Contractor	- Absence of prohibited equipment (rock breakers, vibratory rollers). - Confirmation of "gradual excavation" and "rolling compaction" methods. - Records of consultation with caretaker.	During all work within this specific section.	PIU, Community Reps
Management of Works on Private Agricultural Land	The affected agricultural plot (TWM-138).	Contractor	- Visual confirmation of separate topsoil stockpiling	Daily during all phases of work on the plot (stripping,	PIU, Landowner

Parameter / Action to be Verified	Location	Implementation Responsibility	Means of Verification	Timing / Frequency	Monitoring Responsibility
			<ul style="list-style-type: none"> <li>- Adherence to the demarcated 3.5m RoW.</li> <li>- Condition of the land after restoration (soil tilth, level).</li> <li>- Signed landowner verification form confirming satisfactory restoration.</li> </ul>	excavation, restoration).	
Protection of Community Water Infrastructure	All identified crossing points for irrigation channels, spring sources, and drinking water pipelines.	Contractor	<ul style="list-style-type: none"> <li>- Visual confirmation that protection measures (e.g., bypass flumes, buffer zones) are in place before excavation begins.</li> <li>- Confirmation of manual excavation near pipelines.</li> <li>- No community complaints regarding water disruption.</li> </ul>	Daily during work in these specific sensitive areas.	PIU, Community Reps
Blasting Controls	Rocky cliff section above Gasetsho-Wom Gewog Centre.	Contractor	<ul style="list-style-type: none"> <li>- Review of the approved, site-specific Blasting Plan.</li> <li>- Confirmation that "controlled blasting" techniques are used.</li> <li>- If feasible Rock breaker is used instead of blasting</li> <li>- Records of advance community notification.</li> </ul>	Prior to and during any blasting event in this area.	PIU, PMSC
Pre-Felling Fauna Survey	All areas with trees to be cleared.	Contractor (Biodiversity Supervisor)	<ul style="list-style-type: none"> <li>- Logbook of pre-felling surveys (trees checked, findings, actions taken, dates).</li> <li>- Visual confirmation of any "No-Cut" buffer zones.</li> </ul>	No more than 48 hours prior to felling in any new section.	PIU, DoFPS
Protocols for works within the Biological Corridor	The 5 km section of the alignment within the Biological Corridor.	Contractor (Biodiversity Supervisor)	<ul style="list-style-type: none"> <li>- Adherence to daylight working hours only.</li> <li>- Visual confirmation of escape ramps in all open trenches at the end of each day.</li> <li>- No evidence of worker camps, waste dumping, or prohibited activities.</li> </ul>	Daily during all work in this area.	PIU, DoFPS
Instrumental Environmental Monitoring - Ambient Air Quality (TSP, PM10, PM2.5, SO2, NO2, CO, O3)	- <b>Air:</b> At selected sensitive receptors (3 locations- Intake, Hetshokha Lhakhang & Changkha village)	Contractor (implemented through an independent third-party monitoring agency, approved by the PIU).	<ul style="list-style-type: none"> <li>- Independent third-party monitoring report submitted by the Contractor.</li> <li>- Results compared against the established IEE baseline and relevant national/ WHO standards.</li> </ul>	Biannually (twice per year) during the construction period.	PIU, PMU Environment Specialist Consultant
Instrumental Environmental Monitoring - Ambient Noise Levels (Daytime & Nighttime Leq in dBA)	- <b>Noise:</b> At selected sensitive receptors (3 locations- Intake, Hetshokha Lhakhang & Changkha village)	Contractor (implemented through an independent third-party monitoring agency, approved by the PIU).	Monitoring report with measured Daytime Leq (dBA) values, compared against the established baseline and the NEC ES 2020 standard of 65 dBA.	Biannually (twice per year) during the construction period.	PIU, PMU Environment Specialist Consultant
Surface Water Quality	- <b>Water:</b> Intake, reservoir of Basochhu Hydropwer, Stream at Phakha, Stream near Delivery point)	Contractor (implemented through an independent third-party monitoring agency, approved by the PIU).	<p>Monitoring report with laboratory analysis results, compared against the established baseline data and relevant National Drinking Water Quality Standards (NDWQS) and/or IFC EHS Guidelines.</p> <p>1. Baseline (Pre-construction) Monitoring: A comprehensive analysis must be conducted before</p>	Biannually (twice per year) during the construction period.	PIU, PMU Environment Specialist Consultant

Parameter / Action to be Verified	Location	Implementation Responsibility	Means of Verification	Timing / Frequency	Monitoring Responsibility
			<p>any civil works commence. Parameters will include:</p> <ul style="list-style-type: none"> <li>• Physical: pH, Turbidity, Total Suspended Solids (TSS), Electrical Conductivity, Temperature.</li> <li>• Chemical: Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO), Total Hardness, Iron, Nitrates, Sulphates.</li> <li>• Bacteriological: Total Coliforms, Fecal Coliforms (or E. coli).</li> </ul> <p>2. Construction Phase Monitoring: Monitoring during construction will focus on key indicators of construction-related pollution. Parameters will include, at a minimum:</p> <ul style="list-style-type: none"> <li>• pH</li> <li>• Turbidity</li> <li>• Total Suspended Solids (TSS)</li> <li>• Oil &amp; Grease</li> </ul>		
Implementation of Chance Find Procedure	All excavation sites.	<b>Contractor:</b> Immediate stop-work and notification. <b>PIU:</b> Formal notification to Department of Culture & Dzongkha Development	<ul style="list-style-type: none"> <li>- Incident Report from Contractor.</li> <li>- Official correspondence between PIU and Dept. of Culture.</li> <li>- Review of worker training records on the procedure.</li> </ul>	As needed (event-based).	PIU, PMU Environment Specialist Consultant
EHS & Safeguards Training for Personnel	All worksites.	Contractor	<ul style="list-style-type: none"> <li>- Training records (attendance sheets, topics covered).</li> <li>- Worker interviews during site inspections.</li> </ul>	<ul style="list-style-type: none"> <li>- Mandatory Induction Training for all new personnel.</li> <li>- Weekly "Toolbox Talks" on specific hazards.</li> </ul>	PIU, PMU Environment Specialist Consultant
OHS Incident Reporting and Record Keeping	All worksites and camps.	Contractor (EHS Officer)	<ul style="list-style-type: none"> <li>- Accident/Incident Logbook.</li> <li>- Incident Investigation Reports.</li> <li>- Summary in Contractor's Monthly Report.</li> </ul>	<ul style="list-style-type: none"> <li>- Reporting of incidents: Immediately.</li> <li>- Review of logs: Monthly.</li> </ul>	PIU, PMU Environment Specialist Consultant
Local Employment	Project area communities.	Contractor	<ul style="list-style-type: none"> <li>- Employment records / muster rolls indicating workers' home Gewog.</li> <li>- Summary statistics in Contractor's Monthly Report.</li> </ul>	Monthly (reporting).	PIU, PMU Environment Specialist Consultant
EHS Conditions at Construction Camps	All approved camp and ancillary sites.	<b>Contractor</b>	<ul style="list-style-type: none"> <li>- Site Inspection Checklists (covering sanitation, waste management, water supply, worker conditions).</li> <li>- Photo documentation.</li> <li>- Worker interviews.</li> </ul>	Weekly (by PIU). Daily (internal checks by Contractor EHS Officer).	PIU, PMU Environment Specialist Consultant
Implementation of the Water Safety Plan (WSP) <i>Ensuring safe drinking water</i>	At the intake (raw water) and at key points in the distribution network (treated water).	Dzongkhag Administration (as the Operator)	<ul style="list-style-type: none"> <li>- Water quality testing reports.</li> <li>- Records of compliance against National Drinking Water Quality Standards (NDWQS).</li> </ul>	Monthly, and as needed in response to events or complaints.	Dzongkhag Health Officials, MOIT
Implementation of the Source Sustainability Management Plan <i>(Ensuring long-term water availability)</i>	Intake site and offtake structures.	Dzongkhag Administration (as the Operator)	<ul style="list-style-type: none"> <li>- Continuous flow monitoring records.</li> <li>- Minutes of the Water Resource Management Committee meetings.</li> <li>- Annual sustainability review reports.</li> </ul>	<ul style="list-style-type: none"> <li>- Continuous (for flow monitoring).</li> <li>- Annual (for review by the Committee).</li> </ul>	Water Resource Management Committee, MOIT

Parameter / Action to be Verified	Location	Implementation Responsibility	Means of Verification	Timing / Frequency	Monitoring Responsibility
Implementation of the Emergency Preparedness and Response Plan (EPRP) <i>(Ensuring infrastructure integrity)</i>	Entire project infrastructure (intake, pipeline, offtakes, etc.).	Dzongkhag Administration (as the Operator)	- Completed inspection logs and checklists. - Maintenance and repair records. - Post-event damage assessment reports.	- Routine Inspections: Pre-monsoon, post-monsoon, and immediately after any extreme weather or seismic event. - Repairs: As needed.	Dzongkhag Engineering Division, MOIT

<sup>a</sup> Baseline data for ambient air quality and noise level for the intake component will be taken at the vicinity or bank of the river where the structures will be built. Baseline data for ambient air quality and noise level for the transmission main and distribution network components will be taken from specific areas with the most sensitive receptors (see map in Figure 45 for these sampling locations). Exact location of monitoring will be selected during the works.

<sup>b</sup> Baseline data for river water quality for the intake component will be taken at the upstream and downstream sections of the intake location (see map in Figure 40 for these sampling locations).

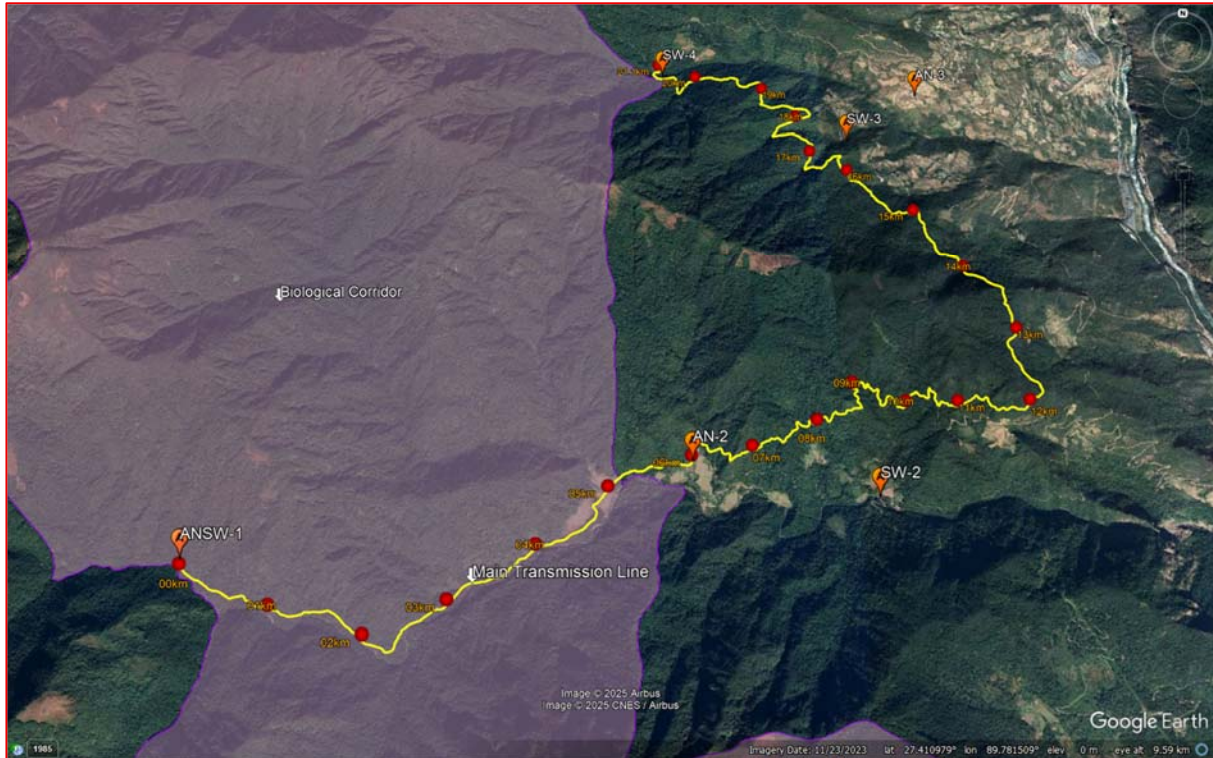
<sup>c</sup> The location of the subproject is within an area with no potential air or noise pollution sources. Air quality sampling or noise level monitoring may not be necessary when construction activities do not generate air pollutants or high noise that are detrimental to the environment, nearby residents, or the workers. Ambient air quality and noise level measurements will be done at the construction sites and other critical areas/points where sensitive receptors exist. Except for the intake component which is site-specific, locations of sampling points for linear works (transmission main) shift as construction activities progress (see map in Figure 40 for these sampling locations).

<sup>d</sup> River water quality measurement for the intake component will be taken at the downstream sections of the intake location (see map in Figure 45 for these sampling locations). For the transmission main and distribution network components, sampling will be done on the downstream of an affected water body.

<sup>e</sup> Monitoring will be initiated by visual observations. When persistent dust generation is observed, sampling for PM10/PM2.5 will be undertaken. When heavy equipment is in use, other ambient air quality parameters will be tested (e.g. SO<sub>x</sub> and NO<sub>x</sub>). The EHS Officer of the contractor will need to provide expert judgment on when to do the sampling or not. If the duration of dust generation/smoke generation is too short of a period, sampling may not be practical and necessary. In this case, visual observation on the effective implementation of dust management measures per EMP would be sufficient as means of monitoring (e.g. regular water sprinkling of construction sites, use of masks and earplugs by workers, etc.).

<sup>f</sup> "As needed" means additional monitoring needed in special circumstances. There are instances that sampling activities may be conducted more than the specified frequency, such as when complaints arise or when an extraordinary event occurs requiring additional sampling or resampling.

Figure 49: Sampling Locations for Ambient Air Quality, Noise Level and River Water Quality (Source: Final Hydraulic Structure Design Report, August 2025 & Field Survey August 2025).



Map Keys:

- ANSW-1 – Air, Noise & Surface Water Quality Monitoring at Intake Site (Sensitive Receptor)
- AN-2 – Air and Noise Quality Monitoring at Hetsbokha Lhakhang (Sensitive Receptor)
- AN-3 – Air & Noise Quality Monitoring at Changkha Village
- SW-2 – Surface Water Quality at Reservoir of Basochhu Hydropower
- SW-3 – Surface Water Quality Monitoring of Stream near Phakha
- SW-4 – Surface Water Quality Monitoring of Stream near Delivery Point

## D. Capacity Building

### 1. Rationale and Objective

405. While the Executing Agency (MOIT) has significant experience with ADB-funded projects, a project-specific capacity building program is essential to ensure that all personnel, including new staff at the PMU and PIU and the Contractor's team, are fully conversant with the specific requirements of this IEE and its Environmental Management Plan (EMP). The objective of this program is to build the technical capacity and awareness necessary for effective safeguard implementation, monitoring, and reporting.

## E. Implementation and Resources

406. The project's Environmental Specialist Consultant will be responsible for designing and delivering the capacity building program. The training will be tailored to the specific roles of the participants and will be delivered in collaboration with external experts where necessary. For specialized modules on biodiversity and forest conservation, resource persons from the Department of Forest and Park Services (DoFPS) and the College of Natural Resources will be engaged.

## F. Target Audiences and Training Modules

407. The training program will be targeted at three main groups, with customized content for each:

a) PMU and PIU Staff:

408. Training for the PMU and PIU will focus on their oversight and supervision responsibilities. Key modules will include:

- In-depth review of ADB's Safeguard Policy Statement (SPS, 2009) and relevant national environmental laws.
- Detailed breakdown of roles and responsibilities under the project's EMP.
- Procedures for reviewing the Contractor's SEMP.
- Best practices for conducting compliance monitoring and site inspections.
- Preparation of quarterly and semi-annual environmental monitoring reports.
- Management of the Grievance Redress Mechanism (GRM).

b) Contractor's Personnel:

409. Training for the Contractor's key management staff and their EHS Officer will be operational and focus on the implementation of the SEMP. Key modules will include:

- Understanding and implementing all mitigation measures in the EMP.
- Developing and executing the Site-Specific Environmental Management Plan (SEMP) and all required sub-plans (e.g., Spoil Management Plan, OHS Plan, Camp Management Plan).
- Daily on-site monitoring techniques and maintaining a site logbook.
- Preparing monthly environmental monitoring reports.
- Implementing the Worker's Code of Conduct and the Chance Find Procedure.

c) Construction Workers and Community Members:

410. Awareness programs will be conducted for the general workforce and local communities. Key topics will include:

- Basic environmental awareness and conservation principles.
- The ecological sensitivity of the Biological Corridor.
- The Worker's Code of Conduct, including the strict prohibition on hunting, fishing, and poaching.
- Occupational Health and Safety (OHS) essentials, including the use of PPE.
- Community safety measures and the purpose of the Grievance Redress Mechanism (GRM).

d) Indicative Training Program

411. The indicative training program is presented in the table below.

*Table 28: Training Modules for Environmental Management*

Module / Focus Area	Frequency of Sessions	Target Participants	Conducting Personnel
<p>1. Executive Induction &amp; Legal Compliance (One-day Mandatory Workshop)</p> <p>Content:            — ADB SPS Requirements and Loan Covenants.            — RGOB Environmental &amp; Labor Laws (FNCA, Water Act, OHS).            — Roles and responsibilities for monitoring and reporting.</p>	Prior to Contract Award and Upon Mobilization (Mandatory for new staff).	PMU/PIU Management and Safeguard Staff, Contractor Project Managers, Contractor EHS Officer/s.	PMSC Environmental Specialist, PMU Safeguard Officer.

Module / Focus Area	Frequency of Sessions	Target Participants	Conducting Personnel
<p>2. EMP Implementation and Site Operations (Two-day Technical Workshop)</p> <p>Content:  — Site-Specific EMP (SEMP) details and requirements.  — Preparation and execution of sub-plans (Spoil Management, Waste Management, Traffic Management).  — OHS Plan review and implementation of safety protocols.  — GRM procedures and complaint logging/resolution.</p>	Once, at Project Commencement (Mandatory for Contractor Site Management).	PIU Site Engineers, Contractor Site Managers, Contractor EHS Officer, Supervising Staff.	PMSC Environmental Specialist (Lead Trainer).
<p>3. Biodiversity and Conservation Awareness (Site Briefings and Specialized Sessions)</p> <p>Content:  — Ecological sensitivity of the Biological Corridor.  — Strict legal prohibitions (hunting, poaching, illegal logging of <i>Illicium</i>, etc.).  — Wildlife Encounter Protocols and Trench Safety.</p>	Once before and during construction	All Construction Workers, PIU Site Staff, Contractor EHS Officer.	PMSC Environmental Specialist; Experts from DoFPS.
<p>4. Compliance Monitoring and Reporting (Hands-on Training)</p> <p>Content:  — Data collection protocols (instrumental monitoring review).  — Monitoring formats, quality assurance, and record-keeping.  — Preparing Quarterly and Semi-Annual Environmental Monitoring Reports (SEMRs) for ADB.</p>	Once during the construction phase.	PMU Safeguard Staff, PIU Environmental Focal Persons.	PMSC Environmental Specialist.

## G. Cost of EMP Implementation and Monitoring

### 1. Cost Allocation

412. The costs for implementing the Environmental Management Plan (EMP) are categorized into two main components:

- **Project Implementation Costs:** These are costs for activities managed directly by the Executing Agency (PMU) and Implementing Agency (PIU), such as capacity building and compensatory afforestation.
- **Contractor's Environmental Management Costs:** These costs are directly related to the Contractor's on-site mitigation and monitoring activities. To ensure these are properly budgeted and implemented, they will be included as a mandatory, priced line item in the Contractor's Bill of Quantities (BoQ).

### 2. Indicative Cost Estimate

413. The following table provides an indicative cost estimate for the key environmental management and monitoring activities. These costs are based on the final project design and the specific mitigation measures detailed in this EMP.

Table 29: Indicative Cost Estimate for Environmental Management and Monitoring

Item No.	Description of Items	Unit	Quantity	Unit Rate (Nu)	Item Total (Nu)
<b>A. Project Implementation Costs (Borne by EA/PMU)</b>					
A.1	Safeguard Capacity Building and Training	Module	3	37,500.00	112,500.00
A.2	Compensatory Afforestation Program (to be implemented by DoFPS)	Hectare	14.7	397,900.00	5,849,130.00
<b>B. Contractor's Environmental Management Costs (to be included in BoQ)</b>					
B.1	Environmental Quality Monitoring <i>(Biannual monitoring for Air, Noise, and Water by an independent third-party)</i>	Lumpsum	1	426,000.00	426,000.00
B.2	EMP Implementation and Site Management <i>(Covers all on-site mitigation measures, including but not limited to):</i> - Site office and camp management - Waste management and disposal - Pollution control (dust, erosion) - Community Health and Safety measures - Occupational Health and Safety (OHS) plan, including PPEs - Post-construction site restoration	Lumpsum	1	2,574,000.00	2,574,000.00
<b>Indicative Total Cost (PMU/PIU)</b>					<b>Nu 5,961,630.00</b>
<b>Indicative Total Cost (Contractor)</b>					<b>Nu 3,000,000.00</b>

Note: The quantity for the Compensatory Afforestation Program (Item A.2) has been revised based on a 2:1 area replacement ratio of the 7.35 ha Right-of-Way (21.1 km x 3.5 m) specified in the final Forestry Clearance. This official figure supersedes earlier estimates.

### 3. ADB Supervision and Monitoring

414. The Asian Development Bank (ADB) will maintain an overall supervision role to ensure the project's compliance with its Safeguard Policy Statement (SPS, 2009) and the loan covenants. ADB's monitoring and supervision activities will be carried out through:

- **Review of Monitoring Reports:** ADB will review the Semi-Annual Environmental Monitoring Reports (SEMRs) submitted by the PMU. This review will verify that safeguard measures are being implemented effectively, assess the adequacy of the mitigation measures, and ensure that any non-compliance issues are being addressed with timely corrective actions.
- **Project Review Missions:** ADB will conduct periodic review missions throughout the project cycle. These missions will include site visits to assess the project's environmental performance on the ground and will involve discussions with the PMU, PIU, and other relevant stakeholders.

415. This supervision will be maintained on an ongoing basis and will conclude with the issuance of a Project Completion Report (PCR), which is typically prepared within 1-2 years after the project is physically completed and becomes operational.

## **XI. CONCLUSION AND RECOMMENDATIONS**

### **A. Overall Conclusion**

416. This Initial Environmental Examination (IEE) for the Hetshotsangchhu Integrated Water Supply Scheme was prepared in accordance with ADB's Safeguard Policy Statement (SPS, 2009) and Bhutan's Environmental Assessment Act, 2000. This report is a comprehensive update to the preliminary IEE from the project processing phase, revised to reflect the final detailed engineering design and incorporating the findings from a final round of site-specific public and stakeholder consultations held in October 2025.

417. The assessment confirms that the project's environmental classification remains Category B for Environment. No new or unanticipated environmental impacts were identified during the detailed design phase. The potential adverse impacts remain largely site-specific and temporary, and can be effectively managed through the implementation of the mitigation measures presented in the updated Environmental Management Plan (EMP). Crucially, the EMP has been significantly strengthened by integrating direct community feedback, leading to more robust, site-specific mitigation measures for the protection of cultural heritage, community water infrastructure, and public safety.

418. The project is poised to generate significant and long-lasting socio-economic benefits by addressing a critical and worsening water crisis, a fact strongly reinforced by communities during the latest consultations. During these discussions, stakeholders, particularly the Wangdue Phodrang Dzongkhag Administration, shared a long-term vision for the area. These suggestions included the potential future repurposing of the access road as an eco-trail, assessing the feasibility of a mini-hydropower component, and using the route for forest fire emergencies. These concepts are recorded as stakeholder aspirations and are formally recognized as being outside the approved scope of this project. The project's firm commitment, as detailed in the EMP, is the full decommissioning and ecological restoration of the access road within the Biological Corridor.

419. The project has received all necessary statutory approvals, confirming that its environmental impacts are considered acceptable and manageable under national law. The Environmental Clearance (EC) was secured from the Department of Agriculture on 24 October 2025, providing the overall legal authorization for the project to proceed. Furthermore, the most significant specific impact; the felling of 774 trees along the 21.1 km main transmission line including temporary construction within a sensitive Biological Corridor - is formally endorsed by the Forestry Clearance (Application ID: 919151) issued by the Department of Forests and Park Services on 13 August 2025. This clearance mandates key mitigation measures, particularly compensatory plantation, which form a core part of the project's EMP. These legal requirements, combined with the project's firm commitment to fully decommission the access road and restore the habitat within the Biological Corridor, ensure that environmental safeguards are both regulatory and project-integrated.

### **B. Recommendations**

420. Based on the findings of this updated IEE and the strong endorsement from all stakeholders, it is recommended that the Hetshotsangchhu Integrated Water Supply Scheme proceed to implementation, subject to the strict adherence to the following mandatory conditions:

421. Full Implementation of the Updated, Community-Informed EMP: The Environmental Management Plan (EMP) detailed in this updated IEE, which now includes specific mitigation measures derived from public consultations, must be included as a binding part of all civil works contracts. The Contractor must be made legally and financially responsible for its full implementation.

1. Finalization of All Pre-Construction Agreements: All pending legal and community-level agreements, most notably the finalization and signing of the Memoranda of Understanding (MoUs) with the Community Forest Management Groups (Refer Appendix 16: Sample MoU) and the Resettlement Plan (to be prepared) for the one affected household, must be completed before the contractor is mobilized in the respective areas.
2. Approval of Contractor's Site-Specific Plans (SEMP): The Contractor must prepare a comprehensive, site-specific EMP (SEMP), including all required sub-plans (e.g., OHS Plan, Spoil Management Plan, and specific protection plans for community infrastructure). No civil works shall be permitted to commence until the SEMP has been formally approved by the PIU and PMU. Refer Appendix 17: Guidance Note on the Preparation of the Contractor's Environmental and Social Management Plan (C-ESMP).
3. Design Review and Integration of Fire Safety Offtakes: In direct response to the community's request to enhance regional disaster resilience, the project's design team is required to conduct a formal technical and financial feasibility assessment for integrating dedicated water offtakes (hydrants) for firefighting purposes at strategic locations along the pipeline. The outcome of this assessment must be finalized and documented prior to the commencement of construction. If deemed feasible, the fire safety offtakes shall be incorporated into the final 'Good for Construction' (GFC) drawings. If not feasible, the justification must be clearly recorded and communicated to the relevant stakeholders.
4. Strengthened and Collaborative Institutional Oversight: The defined institutional roles and responsibilities for monitoring and supervision involving the PIU, PMU, PMSC, and DoFPS, must be strictly followed to ensure rigorous and collaborative oversight of the Contractor.
5. Strict Adherence to All Special Protocols: All construction activities within the Biological Corridor and near sensitive receptors (like the Hetshokha Lhaxhang) must strictly adhere to the "Special Environmental Management Protocols" outlined in the EMP.
6. Continuous Two-Way Community Engagement: The project must maintain the process of continuous, two-way dialogue established during the pre-construction phase, ensuring the Grievance Redress Mechanism (GRM) is fully operational and that the project remains responsive to community needs throughout construction.

# Appendix 1: Rapid Environmental Assessment Checklist

## Appendix 1: Rapid Environmental Assessment Checklist

Rapid Environmental Assessment (REA) Checklist WATER SUPPLY

**Instructions:**  
 The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to the Safeguards Division (SDSS) for endorsement by the Director, SDSS and for approval by the Chief Compliance Officer.  
 (ii) This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB's: (a) checklists on involuntary resettlement and Indigenous Peoples; (b) poverty reduction handbook; (c) staff guide to consultation and participation; and (d) gender checklists.  
 (iii) Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" section to discuss any anticipated mitigation measures.

**Country/Project Title:** Bhutan / Water Flagship Program (Hetsotsamchhu Subproject)

**Sector Division:** SAUW

Screening Questions	Ye s	No	Remarks
<b>Project Siting</b> Is the project area...			
▪ Densely populated?		✓	Wangdue Phodrang town and its immediate vicinities has low density.
▪ Heavy with development activities?		✓	Majority of Wangdue Phodrang district is agricultural areas, and there are only few heavy development activities in the area.
▪ Adjacent to or within any environmentally sensitive areas?			
• Cultural heritage site		✓	
• Protected Area		✓	The closest protected area is the Royal Botanic Park that is more than 70km away.
• Wetland		✓	The closest wetland (bird habitat) is more than 80km away in Phobjikha (Black Necked Crane Habitat)
• Mangrove		✓	There are no coastal areas in Bhutan
• Estuarine		✓	There are no coastal areas in Bhutan
• Buffer zone of protected area		✓	The closest buffer of a protected area is more than 120km away
• Special area for protecting biodiversity	✓		The alignment traverses 5km inside Biological Corridor #26km that connects the Jigme Singye National Park to the Royal Botanic Park
• Bay		✓	

Screening Questions	Yes	No	Remarks
<b>Potential Environmental Impacts</b>			
Will the Project cause...			
• pollution of raw water supply from upstream wastewater discharge from communities, industries, agriculture, and soil erosion runoff?		✓	
• impairment of historical/cultural monuments/areas and loss/damage to these sites?		✓	
• hazard of land subsidence caused by excessive ground water pumping?		✓	
• social conflicts arising from displacement of communities ?		✓	
• conflicts in abstraction of raw water for water supply with other beneficial water uses for surface and ground waters?	✓		The source of the water supply is also an upstream tributary of a river that supplies the requirement of Basochu Hydropower Plant. This is a potential resource conflicts between two users. The subproject will ensure to settle any conflict issues through agreements on resource sharing between these users. Compliance with this agreement will be included as one requirement in the EMP of the subproject.
• unsatisfactory raw water supply (e.g. excessive pathogens or mineral constituents)?		✓	The source was tested and appropriate for drinking water after simple chlorination treatment process. No excessive pathogens or mineral constituents found.
• delivery of unsafe water to the distribution system?	✓		The water treatment will be covered under Package 2 of the subproject. The subproject will convey treated water through the existing distribution network. However, the subproject includes a component on the rehabilitation of this network to ensure drinking water is delivered safe to end users. An O&M manual will be developed to ensure facilities are kept in working condition, including checking and maintenance of distribution network. Any distributed water must comply with the National Drinking Water Quality Standards.
• inadequate protection of intake works or wells, leading to pollution of water supply?	✓		This is a potential impact during construction works at the intake sites. However, mitigation measures will be included in the EMP.
• over pumping of groundwater, leading to salinization and ground subsidence?		✓	Not applicable. The subproject will not involve abstraction of water from underground sources.

Screening Questions	Yes	No	Remarks
<ul style="list-style-type: none"> <li>excessive algal growth in storage reservoir?</li> </ul>	✓		This is potential impact during operation phase particularly with the storage tanks being used in the communities/gewogs. However, an O&M manual will be developed to ensure facilities are kept in working condition, including checking and maintenance of storage tanks.
<ul style="list-style-type: none"> <li>increase in production of sewage beyond the capabilities of community facilities?</li> </ul>		✓	
<ul style="list-style-type: none"> <li>inadequate disposal of sludge from water treatment plants?</li> </ul>		✓	The drinking water supply sedimentation and chlorination treatment is not expected to generate significant amount of sludge. The turbidity level of raw water is very low, and is already within the drinking water quality standards, except for little traces of coliform.
<ul style="list-style-type: none"> <li>inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances and protect facilities?</li> </ul>		✓	Not anticipated. The chlorination tanks are far from residential areas to cause any nuisance. The system will also utilize gravity flow, and pumping, if any, will be very minimal.
<ul style="list-style-type: none"> <li>impairments associated with transmission lines and access roads?</li> </ul>	✓		No impairment associated with transmission lines is expected. However, some portions of the community roads (including access to businesses and houses) may be affected during distribution network rehabilitation works. These impacts including road closures will be avoided by implementing a section-wise approach along the alignments during excavation and/or pipe rehabilitation activities. All other specific measures to avoid and/or minimize disruptions and impairments are included in the EMP.
<ul style="list-style-type: none"> <li>health hazards arising from inadequate design of facilities for receiving, storing, and handling of chlorine and other hazardous chemicals.</li> </ul>	✓		This is a potential impact at the chlorination tanks during operation phase. However, an O&M manual will be developed to ensure facilities are kept in working condition, including checking and maintenance of disinfection facilities and proper storage of chemicals.

Screening Questions	Yes	No	Remarks
<ul style="list-style-type: none"> <li>health and safety hazards to workers from handling and management of chlorine used for disinfection, other contaminants, and biological and physical hazards during project construction and operation?</li> </ul>	✓		This is not applicable during construction phase. This may be possible during operation phase when maintenance works are done. However, an O&M manual will be developed to include guidelines on proper handling of chlorine and other chemicals during maintenance works for the chlorination tanks.
<ul style="list-style-type: none"> <li>dislocation or involuntary resettlement of people?</li> </ul>		✓	No household will be dislocated or resettled by the project. One person will be impacted by the alignment but the family will be compensated as per the resettlement plan.
<ul style="list-style-type: none"> <li>disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?</li> </ul>		✓	Not anticipated. The contractor will be encouraged to hire local workers from the local labor force. Once completed, the subproject will benefit all people in the communities through reliable and continuous supply of clean water.
<ul style="list-style-type: none"> <li>noise and dust from construction activities?</li> </ul>	✓		Yes, but this will only last until the construction is complete. Since the work will be carried out away from the settlement areas (except for about 1-3km) in the forested areas, this will not impact the community. Mitigation measures to reduce dust and noise to wildlife and people will be included in the EMP.
<ul style="list-style-type: none"> <li>increased road traffic due to interference of construction activities?</li> </ul>	✓		Yes, material transportation will be required and staff and worker movement to and from the work sites, but this will be limited to the construction period. Mitigation measures to reduce impacts of traffic and inconvenience to the community will be included in the EMP.
<ul style="list-style-type: none"> <li>continuing soil erosion/silt runoff from construction operations?</li> </ul>	✓		Yes, this will be limited to the 3m wide work corridor only. Mitigation measures to reduce soil erosion and silt runoff will be included in the EMP.
<ul style="list-style-type: none"> <li>delivery of unsafe water due to poor O&amp;M treatment processes (especially mud accumulations in filters) and inadequate chlorination due to lack of adequate monitoring of chlorine residuals in distribution systems?</li> </ul>		✓	This is not part of this phase of the project.

Screening Questions	Ye s	No	Remarks
<ul style="list-style-type: none"> <li>▪ delivery of water to the distribution system, which is corrosive due to inadequate attention to the feeding of corrective chemicals?</li> </ul>		✓	This is not part of this phase of the project
<ul style="list-style-type: none"> <li>▪ accidental leakage of chlorine gas?</li> </ul>		✓	This is not part of this phase of the project
<ul style="list-style-type: none"> <li>▪ excessive abstraction of water affecting downstream water users?</li> </ul>	✓		An MOU has been signed between Druk Green Corporation, the District Administration and the Gewogs and a committee will ensure adequate sharing of water same as above
<ul style="list-style-type: none"> <li>▪ competing uses of water?</li> </ul>	✓		same as above
<ul style="list-style-type: none"> <li>▪ increased sewage flow due to increased water supply</li> </ul>		✓	The water will be used mostly for irrigation purposes, and to supplement drinking water. The project will not increase sewage as the number of Households will continue to remain the same so sewage will not increase due to the project.
<ul style="list-style-type: none"> <li>▪ increased volume of sullage (wastewater from cooking and washing) and sludge from wastewater treatment plant</li> </ul>		✓	The project design does not include wastewater treatment plant
<ul style="list-style-type: none"> <li>▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?</li> </ul>		✓	The Contractor will be encouraged to hire locals. Even if workers from other areas are hired, they will be provided with temporary accommodation away from the village and provided with temporary sanitation facilities, to be constructed at a distance of 15m from water sources. These will be required to be cleaned up upon completion of the work.
<ul style="list-style-type: none"> <li>▪ social conflicts if workers from other regions or countries are hired?</li> </ul>		✓	The Contractor will be required to brief his workers on respecting the social and cultural norms of the village and to avoid mingling with local people. Similarly, the gewog will be responsible to ensure that social conflicts do not arise
<ul style="list-style-type: none"> <li>▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during operation and construction?</li> </ul>	✓		Apart from Hetsokha village, all other villages are at least 200m away from the work sites and therefore will not be at risk. The standard SOPs for transportation, storage and use of explosives will be followed. Fuel storage and spillage measures will be included in the EMP
<ul style="list-style-type: none"> <li>▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?</li> </ul>	✓		The risk of damage to the pipeline due to natural hazards is incorporated in the design and also includes an automation system to detect and stop water from flowing during such emergencies.

**Rapid Environmental Assessment (REA) Checklist**

**IRRIGATION**

**Instructions:**

(i) The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to the Safeguards Division (SDSS) for endorsement by the Director, SDSS and for approval by the Chief Compliance Officer.

(ii) This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB's: (a) checklists on involuntary resettlement and Indigenous Peoples; (b) poverty reduction handbook; (c) staff guide to consultation and participation; and (d) gender checklists.

(iii) Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" section to discuss any anticipated mitigation measures.

**Country/Project Title:** Bhutan / Water Flagship Program (Hetsotsamchhu Subproject)

**Sector Division:** SAUW

Screening Questions	Yes	No	Remarks
<b>A. Project Siting</b> Is the Project area adjacent to or within any of the following environmentally sensitive areas?			
▪ Protected Area		✓	The closest protected area is the Royal Botanic Park that is more than 70km away.
▪ Wetland		✓	The closest wetland (bird habitat) is more than 80km away in Phobjikha (Black Necked Crane Habitat)
▪ Mangrove		✓	There are no coastal areas in Bhutan
▪ Estuarine		✓	There are no coastal areas in Bhutan
▪ Buffer zone of protected area		✓	The closest buffer of a protected area is more than 120km away
▪ Special area for protecting biodiversity	✓		The alignment traverses 5km inside Biological Corridor #26km that connects the Jigme Singye National Park to the Royal Botanic Park
<b>B. Potential Environmental Impacts</b> Will the Project cause...			

Screening Questions	Yes	No	Remarks
▪ loss of precious ecological values (e.g. result of encroachment into forests/swamplands or historical/cultural buildings/areas, disruption of hydrology of natural waterways, regional flooding, and drainage hazards)?	✓		The subproject will not result in loss of precious ecological values. Subproject will enhance irrigation water supply to the existing agricultural lands, and project components will not encroach any, swamp lands, historical or cultural areas, and will not disrupt natural drainage. Transmission main will be laid through forest lands. Pipeline will be mostly buried below the ground, and access road created for construction will be closed and restored with vegetation and tree plantation. Various measures to minimize tree cutting and disturbance in forest areas will be included in the EMP.
▪ conflicts in water supply rights and related social conflicts?	✓		Subproject will enhance the irrigation water supply to the existing agricultural lands and will follow the existing systems to share water, and modalities of water sharing will be prepared by the PMU/PIU in consultation with the farmers and other stakeholders. No conflicts envisaged.
▪ impediments to movements of people and animals?	✓		No new canals are proposed; irrigation water will be provided by pipelines (110 mm diameter), which will be buried underground. No impediments to movement of people and animals envisaged.
▪ potential ecological problems due to increased soil erosion and siltation, leading to decreased stream capacity?	✓		Water will be supplied via pipelines.
▪ Insufficient drainage leading to salinity intrusion?		✓	Hilly topography, and sufficient drainage, unlikely to lead to salinity intrusion.
▪ over pumping of groundwater, leading to salinization and ground subsidence?		✓	No groundwater pumping proposed. Irrigation water supply is from a surface water source
▪ impairment of downstream water quality and therefore, impairment of downstream beneficial uses of water?		✓	Not anticipated
▪ dislocation or involuntary resettlement of people?		✓	Not anticipated; project will only enhance irrigation water supply to existing fields; no issues related to land tenure or land use envisaged.
▪ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		✓	No new canals proposed; water supply is provided via pipelines
▪ potential social conflicts arising from land tenure and land use issues?		✓	Use of standard and well-maintained construction equipment with necessary inbuilt noise barriers will minimize the impact. Noise impact reduction measures will also be included in the EMP.
▪ soil erosion before compaction and lining of canals?	✓		Dust control measures will be undertaken

Screening Questions	Yes	No	Remarks
▪ noise from construction equipment?	✓		Given hilly topography and limited irrigation water supply, no notable water logging envisaged. Smart water management is proposed to avoid excess irrigation. Better farm management practices, including modern and efficient irrigation practices such as sprinkler/drip irrigation methods will be encouraged to improve irrigation efficiency and avoid issues such as water logging.
▪ dust during construction?	✓		Irrigation supply will be as per the requirements and designed with monthly varied supplies as per the crop requirements. Also, efficient irrigation systems like sprinkler / drip will also be encouraged. Therefore, issues related to application of excessive irrigation water will be eliminated. Better farm management practices will also be encouraged.
▪ waterlogging and soil salinization due to inadequate drainage and farm management?		✓	Not anticipated. Water supply will be via pipelines and will provide equitable water supply to the entire command area as per the design.
▪ leaching of soil nutrients and changes in soil characteristics due to excessive application of irrigation water?		✓	This impact is considered low as use of fertilizers and pesticides in agricultural in Bhutan is low. Many farmers practice organic farming.
▪ reduction of downstream water supply during peak seasons?	✓		Better farm practices will be encouraged to avoid soil erosion
▪ soil pollution, polluted farm runoff and groundwater, and public health risks due to excessive application of fertilizers and pesticides?		✓	No new canals are proposed; irrigation water will be provided by pipelines (110 mm diameter), which will be buried underground. No impediments to movement of people and animals envisaged.
▪ soil erosion (furrow, surface)?	✓		Water will be supplied via pipelines.
▪ scouring of canals?	✓		Not applicable. Project involves supply of water by pipelines
▪ clogging of canals by sediments?	✓		Not applicable. Project involves supply of water by pipelines
▪ clogging of canals by weeds?	✓		Not applicable. Project involves supply of water by pipelines
▪ seawater intrusion into downstream freshwater systems?		✓	Project area is not a coastal area
▪ introduction of increase in incidence of waterborne or water related diseases?		✓	Better farm practices, including drip/sprinkled irrigation, will be encouraged to avoid water logging and related issues that may lead to increase in incidence of water borne diseases

Screening Questions	Yes	No	Remarks
<ul style="list-style-type: none"> <li>dangers to a safe and healthy working environment due to physical, chemical and biological hazards during project construction and operation?</li> </ul>	✓		Construction activities and exposure to various occupational hazards at the sites will pose risks to workers. Working in hilly areas can pose risk due to landslides. However, this can be mitigated through the implementation of the EMP, particularly occupational health and safety measures both at work sites and construction camp sites.
<ul style="list-style-type: none"> <li>large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?</li> </ul>		✓	Use of fuel and construction chemicals will be minimal, and transport, storage and application will follow the procedures specified in respective MSDS. Explosives may also be used if there is rock cutting to lay pipelines. Permits will be obtained, and safe blasting techniques will be adopted. Measures will be included in the EMP.
<ul style="list-style-type: none"> <li>social conflicts if workers from other regions or countries are hired?</li> </ul>		✓	Project area is not a coastal area
<ul style="list-style-type: none"> <li>risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?</li> </ul>	✓		Better farm practices, including drip/sprinkled irrigation, will be encouraged to avoid water logging and related issues that may lead to increase in incidence of water borne diseases
<ul style="list-style-type: none"> <li>community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project (e.g., irrigation dams) are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?</li> </ul>	✓		Construction activities and exposure to various occupational hazards at the sites will pose risks to workers. Working in hilly areas can pose risk due to landslides. However, this can be mitigated through the implementation of the EMP, particularly occupational health and safety measures both at work sites and construction camp sites.

### A Checklist for Preliminary Climate Risk Screening

**Country/Project Title:**

**Sector:**

**Subsector:**

**Division/Department:**

	Screening Questions	Score	Remarks <sup>29</sup>
<b>Location and Design of project</b>	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?	1	The intake source is relatively a small stream, flows of which will be likely affected by climate change in the future. The transmission mains will traverse undulating terrain that is prone to landslides, floods, and earthquakes.
	Would the project design (e.g. the clearance for bridges) need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc)?	1	All project components will need to consider various hydro meteorological parameters in the design.
<b>Materials and Maintenance</b>	Would weather, current and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters) likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?	1	The construction materials such as types of pipes, pumps, etc. should be selected to withstand the challenges of climate change in the future.
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s) ?	1	The intakes and the transmission mains are within difficult terrain, where access may be impeded during extreme events, such as for example, landslides that could block access in the future.
<b>Performance of project outputs</b>	Would weather/climate conditions, and related extreme events likely affect the performance (e.g. annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design life time?	1	The level of raw water supply from the source may decline in the future brought about by climate change.

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

<sup>29</sup> If possible, provide details on the sensitivity of project components to climate conditions, such as how climate parameters are considered in design standards for infrastructure components, how changes in key climate parameters and sea level might affect the siting/routing of project, the selection of construction material and/or scheduling, performances and/or the maintenance cost/scheduling of project outputs.

Responses when added that provide a score of 0 will be considered low risk project. If adding all responses will result to a score of 1-4 and that no score of 2 was given to any single response, the project will be assigned a medium risk category. A total score of 5 or more (which include providing a score of 1 in all responses) or a 2 in any single response, will be categorized as high risk project.

**Result of Initial Screening (Low, Medium, High): High**

**Other Comments:** Since the proposed water pipeline (main) passes through steep rocky areas at several places, chances of the pipeline getting damaged due to slides during maintenance cannot be ruled out. However, the buried pipeline system will substantially mitigate this risk.

**Prepared by:** Ministry of Works and Human Settlement





The report is based on IFC Performance Standard 6 (PS6) but applies to World Bank Environmental and Social Standard 6 (ESS6)



### About this report

IBAT provides initial screening for critical habitat values. Performance Standard 6 (PS6) defines these values for critical habitat (PS6, para. 16) and legally protected and internationally recognized areas (PS6, para. 20). PS6 will be triggered when IFC client activities are located in modified habitats containing "significant biodiversity value," natural habitats, critical habitats, legally protected areas, or areas that are internationally recognized for biodiversity. References to PS6 and Guidance Note 6 (GN6) are provided to guide further assessment and detailed definitions where necessary. Please see <https://www.ifc.org/ps6> for full details on PS6 and GN6.

The report screens for known risks within a standard 50km buffer of the coordinates used for analysis. This buffer is not intended to indicate the area of impact. The report can be used to:

- Scope risks to include within an assessment of risks and impacts
- Identify gaps within an existing assessment of risks and impacts
- Prioritize between sites in a portfolio for further assessment of risks and impacts
- Inform a preliminary determination of critical habitat
- Assess the need for engaging a biodiversity specialist
- Identify additional conservation experts or organizations to inform further assessment or planning

**WARNING:** IBAT aims to provide the most up-to-date and accurate information available at the time of analysis. There is however a possibility of incomplete, incorrect or out-of-date information. All findings in this report must be supported by further desktop review, consultation with experts and/or on-the-ground field assessment as described in PS6 and GN6. Please consult IBAT for any additional disclaimers or recommendations applicable to the information used to generate this report.

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### Priority Species

Habitat of significant importance to priority species will trigger critical habitat status (See PS6; para 16). IBAT provides a preliminary list of priority species that could occur within the 50km buffer. This list is drawn from the IUCN Red List of Threatened Species (IUCN RL). This list should be used to guide any further assessment, with the aim of confirming known or likely occurrence of these species within the project area. It is also possible that further assessment may confirm occurrence of additional priority species not listed here. It is strongly encouraged that any new species information collected by the project be shared with species experts and/or IUCN wherever possible in order to improve IUCN datasets.

### IUCN Red List of Threatened Species - CR & EN

The following species are potentially found within 50km of the area of interest. For the full IUCN Red List please refer to the associated csv in the report folder.

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
<i>Manis pentadactyla</i>	Chinese Pangolin	MAMMALIA	CR	Decreasing	Terrestrial
<i>Aythya baeri</i>	Baer's Pochard	AVES	CR	Decreasing	Freshwater
<i>Gyps bengalensis</i>	White-rumped Vulture	AVES	CR	Decreasing	Terrestrial
<i>Sarcogyps calvus</i>	Red-headed Vulture	AVES	CR	Decreasing	Terrestrial
<i>Ardea insignis</i>	White-bellied Heron	AVES	CR	Decreasing	Terrestrial, Freshwater
<i>Gyps tenuirostris</i>	Slender-billed Vulture	AVES	CR	Decreasing	Terrestrial
<i>Cheirostylis sherriffii</i>		LILIOPSIDA	CR	Unknown	Terrestrial
<i>Oreorchis sanguinea</i>		LILIOPSIDA	CR	Unknown	Terrestrial



Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
<i>Onosma griersonii</i>		MAGNOLIOPSIDA	CR	Unknown	Terrestrial
<i>Ailurus fulgens</i>	Red Panda	MAMMALIA	EN	Decreasing	Terrestrial
<i>Quon alpinus</i>	Dhole	MAMMALIA	EN	Decreasing	Terrestrial
<i>Moschus chrysogaster</i>	Alpine Musk Deer	MAMMALIA	EN	Decreasing	Terrestrial
<i>Moschus fuscus</i>	Black Musk Deer	MAMMALIA	EN	Decreasing	Terrestrial
<i>Moschus leucogaster</i>	Himalayan Muskdeer	MAMMALIA	EN	Decreasing	Terrestrial
<i>Panthera tigris</i>	Tiger	MAMMALIA	EN	Decreasing	Terrestrial
<i>Trachypithecus geei</i>	Gee's Golden Langur	MAMMALIA	EN	Decreasing	Terrestrial
<i>Haliaeetus leucoryphus</i>	Pallas's Fish-eagle	AVES	EN	Decreasing	Terrestrial, Freshwater
<i>Aquila nipalensis</i>	Steppe Eagle	AVES	EN	Decreasing	Terrestrial
<i>Ceropegia bhutanica</i>		MAGNOLIOPSIDA	EN	Unknown	Terrestrial
<i>Isodon atroruber</i>		MAGNOLIOPSIDA	EN	Unknown	Terrestrial
<i>Carex nigra</i> subsp. <i>drukylensis</i>		LILIOPSIDA	EN	Unknown	Terrestrial
<i>Strobilanthes accrescens</i> subsp. <i>accrescens</i>		MAGNOLIOPSIDA	EN	Unknown	Terrestrial



Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Tor putitora		ACTINOPTERYGII	EN	Decreasing	Freshwater
Trillium govanianum	Himalayan Trillium	LILIOPSIDA	EN	Decreasing	Terrestrial

#### Restricted Range Species

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Trachypithecus geei	Gee's Golden Langur	MAMMALIA	EN	Decreasing	Terrestrial
Trochalopteron imbricatum	Bhutan Laughingthrush	AVES	LC OR LR/LC	Stable	Terrestrial
Zoothera salimalii	Himalayan Forest Thrush	AVES	LC OR LR/LC	Stable	Terrestrial
Anourosorex schmidti	Giant Mole Shrew	MAMMALIA	DD	Unknown	Terrestrial

### Biodiversity features which are likely to trigger Critical Habitat

#### Protected Areas

The following protected areas are found within 1 km and 10 km and 50 km of the area of interest. For further details please refer to the associated csv file in the report folder.

Area name	Distance	IUCN Category	Status	Designation	Recommendation
Biological Corridor 2	10 km	VI	Established	Biological Corridor 2 (JDNP - JSWNP)	Assess for biodiversity risk
Biological Corridor 1	50 km	VI	Established	Biological Corridor 1 (JKSNR-JDNP)	Assess for biodiversity risk
Biological Corridor 8	50 km	VI	Established	Biological Corridor 8 (Noth Corridor JSWNP-JDNP-WDNP)	Assess for biodiversity risk
Gangtey-Phobji	50 km	Not Reported	Designated	Ramsar Site, Wetland of International Importance	Assess for biodiversity risk
Jigme Dorji National Park	50 km	II	Designated	Jigme Dorji Wildlife Sanctuary	Assess for critical habitat
Jigme Singye Wangchuck National Park	50 km	II	Designated	Jigme Singye Wangchuck National Park	Assess for critical habitat
Khotokha	50 km	Not Reported	Designated	Ramsar Site, Wetland of International Importance	Assess for biodiversity risk

Area name	Distance	IUCN Category	Status	Designation	Recommendation
Royal Botanical Park	50 km	III	Designated	Royal Botanical park	Assess for biodiversity risk
Wangchuck Centennial National Park	50 km	II	Designated	Wangchuck Centennial Park	Assess for critical habitat

### Key Biodiversity Areas

The following key biodiversity areas are found within 1 km and 10 km and 50 km of the area of interest. For further details please refer to the associated csv file in the report folder.

Area name	Distance	IBA	AZE	Recommendation
Ada lake / Puna Tsangchu	50 km	Yes	No	Assess for critical habitat
Chele La	50 km	Yes	No	Assess for critical habitat
Dochu La	50 km	No	No	Assess for critical habitat
Jigme Dorji National Park	50 km	Yes	No	Assess for critical habitat
Jigme Singye Wangchuk National Park	50 km	Yes	No	Assess for critical habitat
Paro wetlands	50 km	Yes	No	Assess for critical habitat
Phopjika and Khatekha valleys	50 km	Yes	No	Assess for critical habitat
Thimphu wetlands	50 km	Yes	No	Assess for critical habitat



Species with potential to occur

Area Taxonomic group	Total assessed species	Total (CR, EN & VU)	CR	EN	VU	NT	LC	DD
MAMMALIA	114	18	1	7	10	12	81	3
AVES	553	15	5	2	8	20	518	0
LILIOPSIDA	77	7	2	2	3	2	62	6
MAGNOLIOPSIDA	123	10	1	3	6	3	99	11
ACTINOPTERYGII	70	1	0	1	0	6	57	6
AMPHIBIA	14	1	0	0	1	1	12	0
REPTILIA	19	3	0	0	3	1	14	1
SORDARIOMYCETES	1	1	0	0	1	0	0	0
MALACOSTRAGA	23	0	0	0	0	3	15	5
GASTROPODA	74	0	0	0	0	0	61	13
INSECTA	97	0	0	0	0	0	92	5
BIVALVIA	46	0	0	0	0	0	39	7
POLYPODIOPSIDA	4	0	0	0	0	0	4	0
AGARICOMYCETES	1	0	0	0	0	0	1	0
ARACHNIDA	3	0	0	0	0	0	3	0

#### Recommended citation

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#### Recommended Experts and Organizations

For projects located in critical habitat, clients must ensure that external experts with regional expertise are involved in further assessment (GN6: GN22). Clients are encouraged to develop partnerships with recognized and credible conservation organizations and/or academic institutes, especially with respect to potential developments in natural or critical habitat (GN6: GN23). Where critical habitats are triggered by priority species, species specialists must be involved. IBAT provides data originally collected by a large network of national partners, while species information is sourced via the IUCN Red List and affiliated Species Specialist Groups. These experts and organizations are listed below. **Please note that this is not intended as a comprehensive list of organizations and experts. These organizations and experts are under no obligation to support any further assessment and do so entirely at their discretion and under their terms. Any views expressed or recommendations made by these stakeholders should not be attributed to the IFC or IBAT for IFC partners.**

#### Birdlife Partners

URL: <https://www.birdlife.org/worldwide/partnership/birdlife-partners>

#### Directory for Species Survival Commission (SSC) Specialist Groups and Red List Authorities

URL: <https://www.iucn.org/commissions/ssc-groups>

## Appendix 3: List of Plant Species Recorded During the Site Visit

Appendix 3: List of plant species recorded during the site visit

#	Name of species	Habit
1	<i>Acer oblongum</i>	Tree
2	<i>Acer sikkimensis</i>	Tree
3	<i>Acer sterculiaceum</i>	Tree
4	<i>Alnus nepalensis</i>	Tree
5	<i>Betula alnoides</i>	Tree
6	<i>Bucklandia populnea</i>	Tree
7	<i>Carpinus spp</i>	Tree
8	<i>Castanopsis hystrix</i>	Tree
9	<i>Cinnamomum glanduliferum</i>	Tree
10	<i>Cinnamomum impressinerrium</i>	Tree
11	<i>Fraxinus floribunda</i>	Tree
12	<i>Gamblea ciliata</i>	Tree
13	<i>Illex depriyana</i>	Tree
14	<i>Juglans regia</i>	Tree
15	<i>Michelia velutina</i>	Tree
16	<i>Prunus nepalensis</i>	Tree
17	<i>Quercus glauca</i>	Tree
18	<i>Quercus griffithii</i>	Tree
19	<i>Quercus lamellosa</i>	Tree
20	<i>Quercus oxyodon</i>	Tree
21	<i>Agapetes serpens</i>	Shrub
22	<i>Ardisia macrocarpa</i>	Shrub
23	<i>Berberis aristata</i>	Shrub
24	<i>Brassaiaopsis mitis</i>	Shrub
25	<i>Colquhounia coccinea</i>	Shrub

#	Name of species	Habit
26	<i>Daphne bholua</i>	Shrub
27	<i>Daphniphyllum chartaceum</i>	Shrub
28	<i>Desmodium spp</i>	Shrub
29	<i>Elaeagnus parvifolia</i>	Shrub
30	<i>Elsholtzia spp</i>	Shrub
31	<i>Erythrina arborescens</i>	Shrub
32	<i>Eurya acuminata</i>	Shrub
33	<i>Flueggea virosa</i>	Shrub
34	<i>Gaultheria fragrantissima</i>	Shrub
35	<i>Ilex crenata</i>	Shrub
36	<i>Indigofera dosua</i>	Shrub
37	<i>Lyonia ovalifolia</i>	Shrub
38	<i>Macaranga pustulata</i>	Shrub
39	<i>Macropanax spp</i>	Shrub
40	<i>Mahonia nepalensis</i>	Shrub
41	<i>Monotropa spp</i>	Shrub
42	<i>Myrica esculenta</i>	Shrub
43	<i>Myrsine semiserrata</i>	Shrub
44	<i>Neolitsea cupola</i>	Shrub
45	<i>Polygala arillata</i>	Shrub
46	<i>Quercus lanata</i>	Shrub
47	<i>R.arboreum</i>	Shrub
48	<i>R.maddenii</i>	Shrub
49	<i>R.vaccinioides</i>	Shrub
50	<i>Rapanea capitellata</i>	Shrub
51	<i>Rhododendron. ralph totem</i>	Shrub

#	Name of species	Habit
52	<i>Rhus spp</i>	Shrub
53	<i>Schefflera elata</i>	Shrub
54	<i>Smilax aspera</i>	Shrub
55	<i>Symplocos dryophila</i>	Shrub
56	<i>Symplocos glomerata</i>	Shrub
57	<i>Symplocos ramosissima</i>	Shrub
58	<i>Symplocus sumantia</i>	Shrub
59	<i>Toricelli's tiliifolia</i>	Shrub
60	<i>Vaccinium nummularia</i>	Shrub
61	<i>Vaccinium vacciniaceum</i>	Shrub
62	<i>Viburnum cylindricum</i>	Shrub
63	<i>Viburnum foetidum</i>	Shrub
64	<i>Viburnum mullaha</i>	Shrub
65	<i>Bulbophyllum bootanensis</i>	Orchid
66	<i>Bulbophyllum reptans</i>	Orchid
67	<i>Bulbophyllum retusiusculum</i>	Orchid
68	<i>Calanthe spp</i>	Orchid
69	<i>Coelogyne corymbosa</i>	Orchid
70	<i>Epigenium spp</i>	Orchid
71	<i>Eria graminifolia</i>	Orchid
72	<i>Oberonia spp</i>	Orchid
73	<i>Otochilus fuscus</i>	Orchid
74	<i>Phalaenopsis mannii</i>	Orchid
75	<i>Vandopsis undulata</i>	Orchid
76	<i>Aconitum ferox</i>	Herb
77	<i>Aconogonum molle</i>	Herb



#	Name of species	Habit
78	<i>Ainsliaea latifolia</i>	Herb
79	<i>Ajuga reptans</i>	Herb
80	<i>Anaphalis adnata</i>	Herb
81	<i>Arisaema flavum</i>	Herb
82	<i>Arisaema jacquemontii</i>	Herb
83	<i>Artemisia</i>	Herb
84	<i>Begonia spp</i>	Herb
85	<i>Boehmeria</i>	Herb
86	<i>Cardiocrinum giganteum</i>	Herb
87	<i>Cyanotis vaga</i>	Herb
88	<i>Cynoglossum furcatum</i>	Herb
89	<i>Didymocarpus aromaticus</i>	Herb
90	<i>Duhalde kappa</i>	Herb
91	<i>Elatostema acuminata</i>	Herb
92	<i>Eupatorium adenophorum</i>	Herb
93	<i>Fragaria nubicola</i>	Herb
94	<i>Galium elegans</i>	Herb
95	<i>Geranium procurrans</i>	Herb
96	<i>Girardinia diversifolia</i>	Herb
97	<i>Hedychium spp</i>	Herb
98	<i>Hydrocotyle nepalensis</i>	Herb
99	<i>Impatiens spp</i>	Herb
100	<i>Juglans regia</i>	Herb
101	<i>Leucas ciliata</i>	Herb
102	<i>Lycopodium spp</i>	Herb
103	<i>Ophiopogon intermedius</i>	Herb

#	Name of species	Habit
104	<i>Persicaria runcinata</i>	Herb
105	<i>Phytolacca acinosa</i>	Herb
106	<i>Pilea scripta</i>	Herb
107	<i>Piper spp</i>	Herb
108	<i>Plantago erosa</i>	Herb
109	<i>Polygonatum spp</i>	Herb
110	<i>Potentilla polyphylla</i>	Herb
111	<i>Pouzolzia hirta</i>	Herb
112	<i>Primula denticulata</i>	Herb
113	<i>Rubia manjith</i>	Herb
114	<i>Rubus calycinus</i>	Herb
115	<i>Rubus ellipticus</i>	Herb
116	<i>Stelleria media</i>	Herb
117	<i>Strobilanthus spp</i>	Herb
118	<i>Swertia chirata</i>	Herb
119	<i>Thalictrum spp</i>	Herb
120	<i>Tupistra nutans</i>	Herb
121	<i>Valeriana jatamansi</i>	Herb
122	<i>Vincetoxicum hirundinaria</i>	Herb
123	<i>Cissus elongata</i>	Climber
124	<i>Dioscorea alata</i>	Climber
125	<i>Ficus hederacea</i>	Climber
126	<i>Ficus pubigera</i>	Climber
127	<i>Hedera nepalensis</i>	Climber
128	<i>Heterosmilax japonica</i>	Climber
129	<i>Holbelia latifolia</i>	Climber

#	Name of species	Habit
130	<i>Hydrangea anomala</i>	Climber
131	<i>Jasminium dispersum</i>	Climber
132	<i>Parthenocissus semicordata</i>	Climber
133	<i>Rubus acuminatus</i>	Climber
134	<i>Thladiantha cordifolia</i>	Climber
135	<i>Thunbergia coccinea</i>	Climber
136	<i>Diplazium esculentum</i>	Fern
137	<i>Drynaria spp</i>	Fern
138	<i>Polystricum spp</i>	Fern
139	<i>Pyrosia spp</i>	Fern

# Appendix 4: Assessment and Confirmation Note of Species by DOFPS

## Appendix 4: Assessment and Confirmation Note of Species by DOFPS

 འབྲུག་རྒྱལ་ཁབ་ཀྱི་རྒྱལ་པོ་ འབྲུག་རྒྱལ་ཁབ་ 

**ROYAL GOVERNMENT OF BHUTAN**  
**MINISTRY OF WORKS & HUMAN SETTLEMENT**  
**DEPARTMENT ENGINEERING SERVICES**  
**THEMPULU, BHUTAN**

*"Construction Industry - Sustainable through innovation and improvement of technology"*

---

MoWHS/DES/WSN/WFP/39/2021-2022/531 15<sup>th</sup> April, 2021

To,  
Chief Forestry Officer,  
Wangduephodrang Forest Division,  
Wangduephodrang.

**Sub: Hembotsam Integrated Drinking Water and Irrigation Scheme - Validation on the presence/absence of species**

Sir,

Within the Water Flagship program, the integrated drinking water and irrigation scheme at Hembotsam is proposed under ADB funding. As required by ADB, environmental assessments are being carried out and for which the presence/absence of the species in the project site needs to be validated.

In this regard, the Department would like to request to kindly validate the presence/absence of species within 1 km of the project sites. The list of priority species (drawn from the IUCN Red List of Threatened Species (IUCN RL)) that could occur within the 1km buffer is attached. Also attached is the map of the site for your kind reference.

Thanking You

Yours Sincerely

  
(Kaema Dingsho)  
Director  
DES

Cc:  
The Hon'ble Secretary, MoWHS for kind information,  
Mrs. Deki Yonten, Environmental registered consultant for necessary action

**Letter of confirmation from CFO**



འབྲུག་རྒྱལ་ཁབ་འབྲུག་རྒྱལ་ཁབ་  
Royal Government of Bhutan  
འབྲུག་རྒྱལ་ཁབ་འབྲུག་རྒྱལ་ཁབ་འབྲུག་རྒྱལ་ཁབ་  
Ministry of Agriculture and Forests, Department of Forests and Park Services  
འབྲུག་རྒྱལ་ཁབ་འབྲུག་རྒྱལ་ཁབ་  
Divisional Forest Office: Wangdue



WFD/NCS/08/2022-2023/10

4<sup>th</sup> July, 2022

The Director,  
Department of Engineering Services,  
Ministry of Works and Human Settlement,  
Thimphu

**Sub: Validation on the presence/absence of species**

Sir,

Please find enclosed herewith the aforementioned subject for your ready reference found within 1km buffer from the project site – Hetshotsam Drinking Water and Irrigation Scheme.

Thanking you,

Yours faithfully,

(Karma Tenpa)  
**Chief Forestry Officer**

CC:

1. RO, Wangdue for information.
2. Office copy

Species list for Heitsotsamcho WFP site (please confirm presence within 1km site)

Birds

Species Name	Common Name	Taxonomic Group	IUCN Category	Yes/No
1 <i>Ardea wiggnis</i>	White-bellied Heron	Aves	Critically endangered	No
2 <i>Aythya haasi</i>	Baer's Pochard	Aves	Critically endangered	No
3 <i>Gyps bengolensis</i>	White-rumped Vulture	Aves	Critically endangered	No
4 <i>Gyps tenuirostris</i>	Slender-billed Vulture	Aves	Critically endangered	No
5 <i>Sarcogyps cobus</i>	Red-headed Vulture	Aves	Critically endangered	No
6 <i>Aquila nipalensis</i>	Steppe Eagle	Aves	Endangered	No
7 <i>Haliaeetus leucorhynchus</i>	Pallas's Fish-eagle	Aves	Endangered	No
8 <i>Arreophila mandelli</i>	Chestnut-breasted Partridge	Aves	Vulnerable	Yes
9 <i>Aythya ferina</i>	Common Pochard	Aves	Vulnerable	No
10 <i>Mulleripicus pulverulentus</i>	Great Slaty Woodpecker	Aves	Vulnerable	No
11 <i>Aceros nipalensis</i>	Rufous-necked Hornbill	Aves	Vulnerable	Yes
12 <i>Gallinago nemaricofa</i>	Wood Snipe	Aves	Vulnerable	No
13 <i>Aquila heliaca</i>	Eastern Imperial Eagle	Aves	Vulnerable	No
14 <i>Sitta formosa</i>	Beautiful Nuthatch	Aves	Vulnerable	No
15 <i>Sterna aurantia</i>	River tern	Aves	Decreasing	No
16 <i>Trochalopteron imbricatum</i>	Bhutan Laughingthrush	Aves	Least concern	Yes
17 <i>Zoothera salimalii</i>	Himalayan Forest Thrush	Aves	Least concern	No

Mammals

Species Name	Common Name	Taxonomic Group	IUCN Category	Yes/No
1 <i>Ailuurus fulgens</i>	Red Panda	Mammalia	Endangered	No
2 <i>Canis alpinus</i>	Dhole	Mammalia	Endangered	Yes
3 <i>Moschus chrysogaster</i>	Alpine Musk Deer	Mammalia	Endangered	No

a

4	<i>Moschus fuscus</i>	Black Musk Deer	Mammalia	Endangered	No
5	<i>Moschus leucogaster</i>	Himalayan Muskdeer	Mammalia	Endangered	No
6	<i>Panthera tigris</i>	Tiger	Mammalia	Endangered	No
7	<i>Trachypithecus geei</i>	Gee's Golden Langur	Mammalia	Endangered	No
8	<i>Budorcas taxicolor</i>	Takin	Mammalia	Vulnerable	No
9	<i>Myotis sclerius</i>	Mandell's Mouse-eared Myotis	Mammalia	Vulnerable	No
10	<i>Neofelis nebulosa</i>	Clouded Leopard	Mammalia	Vulnerable	Yes
11	<i>Panthera pardus</i>	Leopard	Mammalia	Vulnerable	Yes
12	<i>Panthera unica</i>	Snow Leopard	Mammalia	Vulnerable	No
13	<i>Ursus thibetanus</i>	Asiatic Black Bear	Mammalia	Vulnerable	Yes
14	<i>Arctictis binturong</i>	Binturong	Mammalia	Vulnerable	No
15	<i>Aonyx cinereus</i>	Asian Small-clawed Otter	Mammalia	Vulnerable	No
16	<i>Capricornis sumatraensis</i>	Mainland Serow	Mammalia	Vulnerable	No
17	<i>Manis pentadactyla</i>	Chinese Pangolin	Mammalia	Critically endangered	No
18	<i>Anararosoerx schmidti</i>	Giant Mole Shrew	Mammalia	Data deficient	No
19	<i>Rusa unicolor</i>	Sambar	Mammalia	Vulnerable	Yes

**Plants**

	Species Name	Common Name	Taxonomic Group	IUCN Category	Yes/No
1	<i>Carex nigra subsp. drukiensis</i>		Liliopsida	Endangered	No
2	<i>Trillium govatanum</i>	Himalayan Trillium	Liliopsida	Endangered	No
3	<i>Bambusa clavata</i>		Liliopsida	Vulnerable	No
4	<i>Drepanostachyum annulatum</i>		Liliopsida	Vulnerable	No
5	<i>Paris polyphylla</i>	Love Apple	Liliopsida	Vulnerable	Yes

6	<i>Cheirastylis sherriffii</i>		Liliopsida	Critically endangered	No
7	<i>Oreorchis sanguinea</i>		Liliopsida	Critically endangered	No
8	<i>Onosma griersonii</i>		Magnoliopsida	Critically endangered	No
9	<i>Tar putitora</i>		Actinopterygii	Endangered	No
10	<i>Ceropegia bhutanica</i>		Magnoliopsida	Endangered	No
11	<i>Strobilanthes accrescens</i> <i>subsp. accrescens</i>		Magnoliopsida	Endangered	No
12	<i>Isodon atroruber</i>		Magnoliopsida	Endangered	No
13	<i>Corallorhiza cooperi</i>		Magnoliopsida	Vulnerable	No
14	<i>Buddleja bhutanica</i>		Magnoliopsida	Vulnerable	No
15	<i>Pedicularis graminiformis</i>		Magnoliopsida	Vulnerable	No
16	<i>Saxifraga vacillans</i>		Magnoliopsida	Vulnerable	No
17	<i>Beilschmiedia clarkii</i>		Magnoliopsida	Vulnerable	Yes
18	<i>Cinnamomum</i> <i>impressinervium</i>		Magnoliopsida	Vulnerable	No

**Others**

	Species Name	Common Name	Taxonomic Group	IUCN Category	Yes/No
1	<i>Ingerana borealis</i>	Rotung Oriental Frog	Amphibia	Vulnerable	No
2	<i>Oligodon juniper</i>	Walnut Kukri Snake	Reptilia	Vulnerable	No
3	<i>Ophiophagus hannah</i>	King Cobra	Reptilia	Vulnerable	No
4	<i>Python bivittatus</i>	Burmese Python	Reptilia	Vulnerable	No
5	<i>Opliocordyceps sinensis</i>	Chinese Caterpillar Fungus	Soedariomycetes	Vulnerable	No

# Appendix 5: Biodiversity Survey and Assessment Report

## Appendix 5: Full Scale Biodiversity Assessment Report

Final Report

on the

**Biodiversity Assessment of the Water Flagship Project for Wangdue Phodrang  
Dzongkhag, Bhutan**

College of Natural Resources  
Royal University of Bhutan  
Lobesa, Punakha

**Team:**  
Prof. Dr. Dhan Bdr Gurung (Plants and Herpetofauna)  
Mr. Ugyen Dorji (Fish and Water Quality)  
Mr. Karma Sherab (Mammals and Birds)

12 August 2022

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**Biodiversity Assessment of the Water Flagship Project of Wangdue Phodrang  
Dzongkhag, Bhutan**

**Summary**

A section of the Water Flagship Project of Wangdue Phodrang, which is supported by the ADB, passes through a Biological Corridor. As required, the need to conduct Biodiversity Assessment of the Biological Corridor was entrusted to the College of Natural Resources, Royal University of Bhutan, Lobesa, Punakha. A team of experts from the college conducted the survey at the end of June 2022 and prepared this report on behalf of the Consultants. The study focussed on plants, birds, mammals, fish, and herpetofauna including water quality in the project area. Three Endangered species were observed in the realignment section falling in the Biological Corridor. These are Dhole (mammal), Snow trout (fish) and Star Anise (plant). The Endangered species are not harvested, hunted or fished by local communities in the area, and are also found elsewhere in Bhutan. Also, the realignment of water pipeline passing through the project area is small with no potential for substantial or permanent habitat alteration. Therefore, the need to develop management plan for these species in the project area is not felt necessary. However, mitigation measures are provided as recommendations in order to minimise the impact of the project.

## 1. Introduction

This report on the Biodiversity Assessment of the Water Flagship Project under Wangdue Phodrang Dzongkhag provides details of plants and animal species recorded during the survey conducted in between late June and early July 2022. Based on the objectives of the study, it highlights the methodology used, species recorded and provides recommendations. The survey was conducted mainly along the alignment with focus on species found inside the Biological Corridor.

## 2. Study Area

The project area includes two Gewogs – Gasetsho Gom and Gasetsho Wom of Wangdue district. The source of the water project is Hesotsamchhu which falls in a Biological Corridor Number 2 that connects the two National Parks of Bhutan (Figure 1).

### 2.1 Biological Corridor

This Biological Corridor (Number 2) connects the Jigme Dorji National Park in the north and Jigme Singye Wangchuck National Park in the south-east. It has an area of 275.95 km<sup>2</sup> (DoFPS, 2015). It is spread over parts of Thimphu, Punakha and Wangdue districts.

Figure 1: Protected areas (left) and survey points inside the Biological Corridor (right)



## 2.2 National Parks

### 2.2.1 Jigme Dorji National Park

This national park was originally gazetted as a wildlife sanctuary in 1974 and declared as a national park in 1995. It has an area of 4,316 km<sup>2</sup> and is the second largest national park in the country (DoFPS, 2015). It has some prominent high altitude species such as Takin (*Budorcas taxicolor whitel*), Snow leopard (*Panthera uncia*), and Musk deer (*Moschus chrysogaster*).

### 2.2.2 Jigme Singye Wangchuck National Park

This is the third largest protected area in the country and is found in central Bhutan covering Black Mountain range. It has an area of 1,723 km<sup>2</sup>. Some of the main faunal diversity of this park includes Golden langur (*Trachypithecus geei*), Gaur (*Bos gaurus*) and Red Panda (*Ailurus fulgens*). Many species found in this park are from the Indo-Malayan region. All these animals are under Schedule I of the Forest and Nature Conservation Act of Bhutan (DoFPs, 2015).

## 3. Methodology

Methods used in assessing biodiversity depends on several factors such as the objective of the study, target species or ecological communities to be accounted, extent of study or coverage required, levels of assessment needed, time available at hand, and habitat types or geomorphology of the study area among others. This section provides details of the biodiversity assessment methodology employed in assessing biodiversity in this project. The method basically followed the biodiversity assessment standard used in the Biodiversity Monitoring and Social Survey Protocol of Bhutan 2020 (DoFPS 2020a) and the Field Manual - National Forest Inventory of Bhutan 2020 (DoFPS 2020b) that are based on the IFC's Guidance Note 6. The species documented were assessed using the Criterion 1: Critically Endangered and/or Endangered Species; Criterion 2: Endemic and/or Restricted-range Species; Criterion 3: Migratory and/or Congregatory Species; Criterion 4: Regionally unique and/or highly threatened ecosystems; and Criterion 5: Key Evolutionary Processes. Additional information is provided if the species recorded is Endangered or Endemic.

### 3.1 Sampling design and data collection

Initially, the entire re-alignment stretch of the water flagship project, which is about 22 km, was considered for the biodiversity assessment. However, due to insistent rain and parts of alignment passing through cliffs making the survey risky, some sections outside the Biological Corridor were not surveyed. Considering the preliminary observation of the vegetation type noted in the re-alignment stretch, which is dominated by oak forest, survey points were considered at every 500-700 m distance along the alignment. Since different types of animals and plants are assessed using different methods, the methods used in assessing them in this project are described in the following sections.

#### 3.1.1 Plant biodiversity – vegetation survey

The Biodiversity Monitoring Protocol of Bhutan recommends maintaining 20 x 20 m quadrat for tree diversity assessment (DoFPS 2020a) and circular plots with 12.62 m radius for inventory purpose (DoFPS 2020b). However, for general purpose vegetation analysis quadrats or transect size amounting to 200 m<sup>2</sup> is appropriate (Gilson 2006). In this study, given the time constraint, 15 x 15 m quadrats for trees, 5 x 5 m for shrubs and 2 x 2 m for herbs were assessed. The smaller plots – shrub and herb plots were consistently placed at south-west corner of 15 x 15 m plot to reduce biases. Using a standard protocol (DoFPS 2020a), heights, counts and diameter of tree species, heights and counts of shrub species, and cover percentage of herbaceous plant species were recorded for each plot. The data generated were compiled in MS Excel sheet. Lists of trees, shrubs and herbs recorded in the alignment are provided in separate tables.

#### 3.1.2 Mammals

Survey of mammals requires a combination of several techniques. Since many species are difficult to detect during day time, two infrared 'camera traps' were placed along the alignment and footpath inside the Biological Corridor. These traps were placed on 19 June 2022, which was then retrieved on 26 June 2022. Additionally, circular plots of 10 m radius with 1 km interval were systematically established to search for animal signs such as pugmark and scats. Due to insistent rain, no efforts were made to capture small mammals such as rodents.

### 3.1.3 *Bird survey*

The 22 km trail created for establishment of water pipeline from Gasetsho Gom passing through Gasetsho Wom to Hetsotsamchhu intake point was trekked for bird observation. All the birds seen or heard were recorded. Some part outside the Biological Corridor was not considered to avoid risk due to rain and slippery cliffs.

### 3.1.4 *Herpetofauna survey*

Herpetofauna includes 'reptiles' and 'amphibians'. Among several methods of herpetofauna survey available, 'visual encounter survey' was used in this study due to rain and time constraint. This is a type of 'opportunistic survey.' Any herpetofaunal observed during the trek outside the vegetation plots were recorded as incidental if not found in the plot.

### 3.1.5 *Fish and macroinvertebrates*

A combination of seine net and rock flip method was used in capturing fish during the survey. Due to strong water current and high river gradient, attempts to use cast net was not made. The specimens caught were released back alive after examination.

## 3.2 **Water quality sampling**

In this biodiversity assessment, mainly due to swelling rivers, seine net, Global Positioning Systems (GPS) user handheld device, portable water analysis kit PCS Testr, specimen container, formalin, ethanol and camera were used. For microbiological parameters total coliform loads was analyzed in the Bajo Hospital, Wangdue Phodrang. According to EPA (2016), the maximum hold time is 8 hours for source water compliance samples, 30 hours for drinking water samples and 48 hours for coliphage samples. Other parameters such as pH, chlorine, temperature etc. were also measured. Physical parameters were tested in situ on the sampling sites.

## 4. **Data compilation and analysis**

Data were entered in MS Excel spreadsheet. Wherever possible, relative abundance or Importance Value Index (IVI) are provided. The conservation status of all fauna and flora except the herbs are also provided.

## 5. Lists of flora and fauna

### 5.1 Birds

The survey recorded a total of 35 species of birds and all these species falls under the Least Concern (LC) category of IUCN red list data (Table 1). The White-throated Laughing Thrush was the most dominant species (RA=20.83%) found along the entire stretch of the water flagship project alignment. The RA and IVI presented in this document are for the species recorded inside the Biological Corridor only and does not necessarily reflect their status outside the study area.

Table 1: List of bird species and Relative Abundance (RA %)

Sl.	Common name	Count (n)	Relative abundance (n/N*100)	IUCN status
1	Eurasian jay	4	4.17	Least concern
2	Collard owlet	1	1.04	Least concern
3	Yellow-browed warbler	1	1.04	Least concern
4	Ultramarine flycatcher	2	2.08	Least concern
5	Grey-headed canary flycatcher	2	2.08	Least concern
6	White-throated fantail	1	1.04	Least concern
7	Blue-throated barbet	1	1.04	Least concern
8	Scarlet munivet	1	1.04	Least concern
9	Rufous tree pie	1	1.04	Least concern
10	Green-backed tit	6	6.25	Least concern
11	Grandala	1	1.04	Least concern
12	Eurasian Cuckoo	2	2.08	Least concern
13	Common myna	5	5.21	Least concern
14	Mountain bulbull	1	1.04	Least concern
15	Black drongo	8	8.33	Least concern
16	Great barbet	1	1.04	Least concern
17	Fulvous-breasted woodpecker	1	1.04	Least concern

Sl.	Common name	Count (n)	Relative abundance (n/N*100)	IUCN status
18	Chestnut-bellied nuthatch	1	1.04	Least concern
19	Grey Bushchat	1	1.04	Least concern
20	Verditer flycatcher	2	2.08	Least concern
21	Cutia	1	1.04	Least concern
22	White tailed nuthatch	1	1.04	Least concern
23	Wedge-tailed green pigeon	1	1.04	Least concern
24	Bay woodpecker	1	1.04	Least concern
25	Kalij Pheasant	4	4.17	Least concern
26	Crested kingfisher	1	1.04	Least concern
27	White-throated laughing thrush	20	20.83	Least concern
28	Rufous sibia	7	7.29	Least concern
29	Blue whistling thrush	1	1.04	Least concern
30	White-capped water redstart	2	2.08	Least concern
31	Straited laughing thrush	2	2.08	Least concern
32	Ashy drongo	5	5.21	Least concern
33	Black bulbul	4	4.17	Least concern
34	Black eagle	1	1.04	Least concern
35	Oriental turtle dove	2	2.08	Least concern

## 5.2 Mammals

A total of 5 animal species were recorded either through signs, visual and camera traps (Table 2). Scats of Dhole (*Cuon alpinus*) was encountered at two locations, and a total of four individuals were also detected in one camera trap at one occasion, which was captured on 26 June 2022 at 2.53 pm (Figure 2). Wild pig (*Sus scrofa*), Himalayan black bear (*Ursus thibetanus lamiger*), Barking deer (*Muntiacus muntjak*) and Sambar deer (*Rusa unicolor*) were identified through their foot prints, droppings, marks left on trees, and pugmarks. One Himalayan Serow (*Capricornis thar*) was encountered at one occasion along the trail, but outside the Biological Corridor. Of all the species, Dhole is listed as Endangered category in

IUCN red list data, and Himalayan black bear, Sambar deer and Himalayan Serow as Vulnerable (V). However, these animals are widespread in Bhutan and the eastern Himalayan region in general, and may not warrant separate management plan.

**Table 2:** Mammals recorded in the study area

SL.	Species	IUCN status
1	Dhole ( <i>Cuon alpinus</i> )*	Endangered
2	Wild boar ( <i>Sus scrofa</i> )	Least Concern
3	Himalayan black bear ( <i>Ursus thibetanus laniger</i> )	Vulnerable
4	Barking Deer ( <i>Muntiacus muntjak</i> )	Least Concern
5	Sambar deer ( <i>Rusa unicolor</i> )	Vulnerable
6	Himalayan Serow ( <i>Capricornis thar</i> )	Vulnerable

\*Found inside Biological Corridor

**Figure 2:** Four Dholes detected through camera trap on 26 June 2022 at 2.53 pm



### 5.3 List of herpetofauna

Sighting of herpetofauna (reptiles and amphibians) in the alignment was scarce. A Collared Black-headed Snake was observed preying on a Sikkim Ground Skink. Himalayan Toad was sighted in several occasions. Other than these three herpetofauna, no other species was noted. However, this does not mean that other species are not there but simply that they were not detected.

Figure 3: Sikkim Ground Skink (left) and Himalayan Toad (right)



Table 3: List of reptiles and amphibians recorded

Sl.	Species	IUCN status
1	Sikkim Skink ( <i>Azymllepharus sikkimensis</i> )	Not evaluated, common
2	Collared Black-headed Snake ( <i>Sibynophis collaris</i> )	Least Concern
3	Himalayan Toad ( <i>Duttaphrynus himalaeanus</i> )	Least Concern

#### 5.4 List of trees

There were 21 tree species recorded in the alignment (Table 4). Among these, *Quercus oxyodon* was the most common species with an IVI of 63.33 in the area followed by *Rhododendron* sp., which could not be ascertained due to lack of flowers. A plot near the old intake site has *Illicium griffithii*, which is an Endangered species (Figure 4). However, in Bhutan this is a common species and may not warrant a separate management plan.

Table 4: List of tree species recorded along the alignment

Sl.	Species	Total No.	RF	RD	RA	IVI	IUCN Status
1	<i>Quercus griffithii</i>	11	9.52	6.01	3.74	19.28	Least Concern
2	<i>Rhododendron</i> sp.	34	12.70	36.17	8.67	57.54	Data Deficient
3	<i>Quercus lanata</i>	12	4.76	12.77	8.16	25.69	Least Concern
4	<i>Symplocos</i> sp.	14	6.35	14.89	7.14	28.38	Data Deficient

Sl.	Species	Total No.	RF	RD	RA	IVI	IUCN Status
5	<i>Lyonia ovalifolia</i>	20	9.52	21.28	6.80	37.60	Least Concern
6	<i>Ilex</i> sp.	3	1.59	3.19	6.12	10.90	Data Deficient
7	<i>Betula utilis</i>	7	1.59	7.45	14.28	23.32	Least Concern
8	<i>Perzia</i> sp.	1	1.59	1.06	2.04	4.69	Data Deficient
9	<i>Illicium griffithii</i>	3	3.17	3.19	3.06	9.43	Endangered
10	<i>Carpinus viminea</i>	1	1.59	1.06	2.04	4.69	Least Concern
11	<i>Symplocos ramosissima</i>	2	3.17	2.13	2.04	7.34	Least Concern
12	<i>Symplocos dryophila</i>	16	9.52	17.02	5.44	31.99	Least Concern
13	<i>Quercus oxyodon</i>	38	14.29	40.43	8.62	63.33	Least Concern
14	<i>Rhododendron arboreum</i>	11	7.94	11.70	4.49	24.13	Least Concern
15	<i>Daphniphyllum himalense</i>	3	3.17	3.19	3.06	9.43	Not evaluated
16	<i>Acer cappadocicum</i>	1	1.59	1.06	2.04	4.69	Least Concern
17	<i>Sorbus</i> sp.	1	1.59	1.06	2.04	4.69	Data Deficient
18	<i>Quercus glauca</i>	2	1.59	2.13	4.08	7.80	Least Concern
19	<i>Albizia</i> sp.	1	1.59	1.06	2.04	4.69	Data Deficient
	<i>Toxicodendron</i>						
20	<i>succedaneum</i>	1	1.59	1.06	2.04	4.69	Least Concern
21	<i>Docynia indica</i>	1	1.59	1.06	2.04	4.69	Data Deficient

Note: RF=Relative Frequency, RD=Relative Density, RA=Relative Abundance, IVI=Importance Value Index

Figure 4: *Illicium griffithii* in fruit



## 5.5 Shrubs species

Table 5 provides a list of 49 species of shrubs (includes unestablished seedlings of trees) recorded along the alignment. Plots nearer to the village were mostly dominated by *Quercus lanata* (IVI of 20.59) followed by *Myrsine semiserrata* (IVI of 20.27).

Table 5: List of shrub species recorded

Sl.	Species name	Total No.	RF	RD	RA	IVI	IUCN Status
1	<i>Acer oblongum</i>	1	0.95	0.42	1.10	2.47	Least Concern
2	<i>Agapetes seipens</i>	2	0.95	0.85	2.19	3.99	Not evaluated
3	<i>Agapetes</i> sp.	2	1.90	0.85	1.10	3.85	Data Deficient
4	<i>Ageratina adenophora</i>	4	0.95	1.69	4.38	7.03	Not evaluated
5	<i>Albizia</i> sp.	1	0.95	0.42	1.10	2.47	Data Deficient
6	<i>Ardisia macrocarpa</i>	1	0.95	0.42	1.10	2.47	Not evaluated
7	<i>Artemisia</i> sp.	23	3.81	9.75	6.30	19.85	Data Deficient
8	<i>Beilschmiedia gammieana</i>	1	0.95	0.42	1.10	2.47	Not evaluated
9	<i>Berberis aristata</i>	1	0.95	0.42	1.10	2.47	Least Concern
10	<i>Berberis</i> sp.	1	0.95	0.42	1.10	2.47	Data Deficient
11	<i>Carpinus viminea</i>	4	3.81	1.96	2.20	7.69	Least Concern
12	<i>Castanopsis nbuloides</i>	8	4.76	3.39	1.75	9.90	Not evaluated
13	<i>Citrus latipes</i>	1	0.95	0.42	1.10	2.47	Near Threaten
14	<i>Daphne bholua</i>	1	0.95	0.42	1.10	2.47	Not evaluated
15	<i>Daphne zureil</i>	1	0.95	0.42	1.10	2.47	Not evaluated
16	<i>Daphniphyllum chartaceum</i>	1	0.95	0.42	1.10	2.47	Not evaluated
17	<i>Desmodium</i> sp.	18	3.81	7.63	4.93	16.37	Data Deficient
18	<i>Docynia indica</i>	2	0.95	0.85	2.19	3.99	Data Deficient
19	<i>Eurya acuminata</i>	2	1.90	0.85	1.10	3.85	Not evaluated
20	<i>Exbucklandia populnea</i>	10	3.81	4.24	2.74	10.79	Least Concern
21	<i>Gaultheria fragrantissima</i>	4	1.90	1.69	2.19	5.79	Not evaluated
22	<i>Gaultheria</i> sp.	10	1.90	4.24	5.48	11.62	Data Deficient
23	<i>Indigofera</i> sp.	9	1.90	3.81	4.93	10.65	Data Deficient
24	<i>Indigofera dusua</i>	3	2.86	1.27	1.10	5.22	Not evaluated
25	<i>Inula cappa</i>	2	1.90	0.85	1.10	3.85	Not evaluated
26	<i>Ligustrum</i> sp.	1	0.95	0.42	1.10	2.47	Data Deficient
27	<i>Lyonia ovalifolia</i>	15	4.76	6.36	3.29	14.40	Data Deficient

Sl.	Species name	Total No.	RF	RD	RA	IVI	IUCN Status
28	<i>Magnolia lanuginosa</i>	6	3.82	2.54	3.65	10.00	Data Deficient
29	<i>Morella esculenta</i>	4	1.90	1.69	2.19	5.79	Not evaluated
30	<i>Myrsine capitellata</i>	1	0.95	0.42	1.10	2.47	Not evaluated
31	<i>Myrsine semiserrata</i>	24	5.71	10.17	4.38	20.27	Least Concern
32	<i>Phyllanthus clarkii</i>	1	0.95	0.42	1.10	2.47	Not evaluated
33	<i>Phyllanthus sp</i>	8	3.81	3.39	2.19	9.39	Data Deficient
34	<i>Pinus bhutanica</i>	3	1.90	1.27	1.64	4.82	Least Concern
35	<i>Pinus wallichiana</i>	1	0.95	0.42	1.10	2.47	Least Concern
36	<i>Quercus glauca</i>	4	1.90	1.69	2.19	5.79	Least Concern
37	<i>Quercus griffithii</i>	8	3.81	3.39	2.19	9.39	Least Concern
38	<i>Quercus lanata</i>	24	6.67	10.17	3.76	20.59	Least Concern
39	<i>Rhododendron arboreum</i>	8	2.86	3.39	2.92	9.17	Least Concern
40	<i>Rhododendron maddentii</i>	1	0.95	0.42	1.10	2.47	Least Concern
41	<i>Rubus ellipticus</i>	1	0.95	0.42	1.10	2.47	Least Concern
42	<i>Rubus sp</i>	1	0.95	0.42	1.10	2.47	Data Deficient
43	<i>Schima wallichii</i>	2	0.95	0.85	2.19	3.99	Least Concern
44	<i>Symplocos glomerata</i>	1	0.95	0.42	1.10	2.47	Least Concern
45	<i>Symplocos lucida</i>	3	2.86	1.27	1.10	5.22	Least Concern
46	<i>Symplocos ramosissima</i>	1	0.95	0.42	1.10	2.47	Least Concern
47	<i>Symplocos sumatana</i>	1	0.95	0.42	1.10	2.47	Not evaluated
48	<i>Viburnum cylindricum</i>	3	1.90	1.27	1.64	4.82	Not evaluated
49	<i>Ziziphus incurva</i>	1	0.95	0.42	1.10	2.47	Least Concern

Note: RF=Relative Frequency, RD=Relative Density, RA=Relative Abundance, IVI=Importance Value Index

#### 5.6 Herb species

A list of 66 herb species recorded in the area is provided in Table 6. Due to the habit of the plant species, some of the species were recorded in cover percentage, whereas the rest were in count. Therefore, IVI or abundance was not calculated. However, there is *Ageratina adenophora*, which is an invasive species that is native to Mexico. This species invades areas that are open and has mineral soil exposed due to development activities or other natural causes such as landslides.

Table 6: Herbs recorded in the alignment area

Sl.	Species Name	Cover % or number	Remarks
1	<i>Ageratina adenophora</i>	5	Invasive
2	<i>Ainsliaea aptera</i>	30	
3	<i>Anaphalis</i> sp.	5	
4	<i>Anthogonium gracile</i>	22	
5	<i>Arisaema</i> sp.	1	
6	<i>Asteraceae</i> sp.	2	
7	<i>Begonia josephi</i>	7	
8	<i>Bulbophyllum</i> sp.	2	
9	<i>Calanthe plantaginea</i>	3	
10	<i>Calanthe</i> sp.	2	
11	<i>Carex</i> sp.	5	
12	<i>Cantleya spicata</i>	31	
13	<i>Coeloglyne</i> sp.	1	
14	<i>Cryptolepis buchamani</i>	2	
15	<i>Cyanotis vaga</i>	2	
16	<i>Cymbidium erythraeum</i>	3	
17	<i>Cymbidium lancifolium</i>	1	
18	<i>Cyperus</i> sp.	14%	
19	<i>Dendrobium falconeri</i>	0.50%	
20	<i>Dendrobium</i> sp.	0.50%	
21	<i>Desmodium</i> sp.	5	
22	<i>Disporum cantoniense</i>	1	
23	<i>Drepanostachyum intermedium</i>	28%	
24	<i>Dynaria</i> sp.	21	
25	<i>Elatostema obtusum</i>	6	
26	Fabaceae member	5	
27	<i>Ficus pubigera</i>	5	
28	<i>Galium</i> sp.	2	
29	<i>Goodyera</i> sp.	1	
30	<i>Hedera nepalensis</i>	38	

Sl.	Species Name	Cover % or number	Remarks
31	<i>Hedychium densiflorum</i>	65	
32	<i>Hedychium</i> sp.	50	
33	<i>Iris decora</i>	2	
34	<i>Lysimachia evalvis</i>	2	
35	<i>Malaxis acuminatum</i>	1	
36	<i>Ophiopogon wallichii</i>	2	
37	<i>Ophiorrhiza mungos</i>	30	
38	<i>Opismenus compositus</i>	15	
42	<i>Opismenus</i> sp.	25	
15	<i>Osmunda</i> sp.	10	
46	<i>Parthenocissus semicordata</i>	1%	
48	<i>Pericaria</i> sp.	2	
49	<i>Pilea clarkei</i>	5	
50	<i>Pilea umbrosa</i>	3	
51	<i>Piper suipigua</i>	3	
52	<i>Polystichum</i> sp.	7	
53	<i>Preridium</i> sp.	2	
54	<i>Pteris</i> sp.	30	
55	<i>Pyrrosia</i> sp.	5	
56	<i>Rohdea wattii</i>	2	
57	<i>Smilax aspera</i>	2	
58	<i>Smilax myrtilus</i>	1	
59	<i>Strobilanthes frondosa</i>	3	
60	<i>Strobilanthes</i> sp.	24	
61	<i>Synotis wallichii</i>	5	
62	<i>Tetragium serrulatum</i>	24	
63	<i>Theropogon pallidus</i>	4	
64	<i>Valeriana jatamansi</i>	2	
65	<i>Vincetoxicum glaucum</i>	5	
66	<i>Viola bhutanica</i>	7	

### 5.7 Fish

*Schizothorax richardsonii*, which is known as Snow trout, was observed above the river confluence where intake was identified initially (Figure 5). All specimens caught were sexually immature.

Figure 5: *Schizothorax richardsonii*, Snow trout



Table 7: Fish

Sl.	Species name	IUCN Status	Remarks
1	<i>Schizothorax richardsonii</i>	Vulnerable	Common in Hill-stream, rivers and migratory

### 5.9 Macroinvertebrates

There were six species of macroinvertebrates recorded under six families and five orders. *Heterocloeon* sp. under Baetidae family was the most dominant.

Table 8: Macroinvertebrate species diversity

Sl.	Order	Family	Species
1.	Plecoptera	Perlidae	<i>Agnotina</i> sp.
2.	Hemiptera	Gerridae	<i>Gerris</i> sp.
3.	Diptera	Tabanidae	<i>Tabanus</i> sp.
4.	Trichoptera	Hydropsychidae	<i>Arctopsyche</i> sp.
5.	Ephemeroptera	Heptageniidae	<i>Epeorus</i> sp.
6.	Ephemeroptera	Baetidae	<i>Heterocloeon</i> sp.

## 6. Water quality

Water samples from the intake area had a thermotolerant coliform load of 05. The chlorine content was not detected. This indicates that the water is safe for drinking after boiling or chlorine treatment only. Turbidity was 2.00 and pH was 7.0. The turbidity could be due to surface water getting into the river due to rain.

From the bio-indicator perspective, mayfly fauna such as *Heterocloeon* sp. are good for water quality monitoring (Alhejoj *et al.*, 2014). Species under the order Ephemeroptera such as mayflies are very sensitive to pollution, and as such are usually only found at high quality, minimally polluted sites. Along with caddisflies and stoneflies, they are one of the three most commonly used indices of aquatic ecosystem health. Because they are found in a wide variety of habitats and are so widely sensitive to pollution, they are a valuable indicator of water pollution (Voshell, 2002). Their presence in an aquatic ecosystem is a strong indicator of a healthy body of water. Thus, it can be concluded that Hetshotsamchhu river has a good water quality with minimal pollution.

## 7. Details of Endangered Species

### 7.1 Dhole (*Cuon alpinus*)

The Dhole (*Cuon alpinus*) is one of the most widely distributed members of 10 canid species described from South and Southeast Asia and parts of China (Din *et al.*, 2013; Srivathsa *et al.*, 2014; Kamler *et al.*, 2015). They like to live in open areas and are mostly spotted near road, paths and jungles (Srivathsa *et al.*, 2014; Kamler *et al.*, 2015). Globally, the Dhole has been extirpated from ~82% of its original range through human persecution and habitat loss (Wolf and Ripple, 2017). It is currently listed as globally “Endangered” by the IUCN based on an estimated population of 4,500–10,500 individuals comprising <2,500 adults (Kamler *et al.*, 2015). It is under C2a(i) – restricted range with an estimated population size of less than 2,500 mature individuals, and its population is decreasing (Kamler *et al.*, 2015). Although Endangered, the Dhole has received less conservation attention than other charismatic carnivores in Bhutan, but it is distributed across all 20 districts in almost all the habitat types, occurring from 110- 4,980 meter above sea level (Thinley *et al.*, 2021). However, there is no current population estimate for Dholes in Bhutan, but its population is known to be declining

due to blames over persistent livestock depredation (Wang and Macdonald, 2006; Namgyal and Thinley, 2017). Despite being Endangered predator, it is not even listed under the totally protected category represented by Schedule I of the Forest and Nature Conservation Act of Bhutan of 1995. This may be due to its wide distribution in the Country. This perhaps indicates that the Dhole may have recovered its population as compared to that of from 1980s and 1990s.

Dhole usually lives in clans of (3-)5 to 12 and generally breeds in October to January in dens (Dhole – Wikipedia). These are social animals and move in groups for hunting. It is not sure if the Dhole group has breeding dens in the Biological Corridor.

#### 7.2 Snow trout (*Schizothorax richardsonii*)

Snow trout is distributed in the Himalayas covering Bhutan, China, India, Nepal, and Pakistan (Shrestha, 2008). It is listed as Vulnerable under criteria A2acd+3cde+4acde (Vishwanath, 2010). In Bhutan, it is widely distributed from Haa in the west to Trashigang in the east in the sub-tropical and temperate regions (Gurung and Thoni, 2015). This could be the reason as to why this species is not listed in Schedule I of the Forest and Nature Conservation Act of Bhutan of 1995. It is possible that Vishwanath (2010) red listed this Snow trout in the Endangered category based on declining population information available from Indian Himalayan region outside Bhutan. This species is definitely the most abundant species in Bhutan especially in the rivers of mid-Himalayas. However, despite highly restricted fishing regulation in Bhutan, it is likely that the fish is exploited in the accessible river waters in the lower valleys. In this project, if one third of the water volume is left in the river its population will not be affected.

The fish primarily breeds in March to May and September to October (Shrestha, 2008). However, its fingerlings are observed even in November in lower, warmer water of foothills. We have seen fingerlings in the study area by end of June. These basically indicate that the Snow trout breeds sporadically throughout the year with peaks in March to May and September to October.

#### 7.3 Star Anise (*Illicium griffithii*)

Star Anise is distributed in Bangladesh, Bhutan, China, India (Northeast), Myanmar and Vietnam (Pail *et al.*, 2013; IUCN, 2022). It is globally Endangered and placed under A2cd, mainly due to population reduction and over harvesting (Shah *et al.*, 2015). However, in Bhutan, it is not harvested and is common along the cool oak forest zone. It is found Pimakha,

Wangdue, Chhukha, Mongar, Thimphu, Trashigang, Trashy Yangtse, and Samdrup Jongkhar Dzongkhags (Mukhia *et al.*, 2006). It is a small tree or tall shrub growing to about 5 m tall. It flowers in the months of April to May and fruits by June onwards and is distributed at altitude of 1800 – 2460 m above sea level.

It is an aromatic and medicinal plant distributed in cool broadleaved forest. Its fruits are used for treating many ailments including some type of flu such as bird flu (Paul *et al.*, 2013). Its population in Arunachal state of Northeast India is declining mainly due to collection, climate change and habitat destruction (Bapu and Nimasow, 2021). This is however not the case in the project area as it is not harvested even as minor non-timber produces.

#### **8. IFC Guidance Note 6 – Critical Habitat Assessment**

Three Endangered species of plants and animals were observed in the realigned pipeline area of the project. These species were screened using the IFC Guidance Note 6 performance standards for if any management plan needs to be drawn. While the details are provided subsequently herein, in summary there is no need to develop species management Action Plan: a) because Dhole is opportunistic vagrant species not remaining at any place for long duration unless while denning, b) Star Anise is not harvested for any purpose and Snow trout fishing in the area is not done due to religious sentiment. However, one third of water volume in the river may need to be released into the river at all times. This will save the fish population and also water demand for the mini hydro-project downstream. Star Anise is however supposed to be collected in sustainable manner in some eastern parts of the country and there is already a management guideline for its harvesting (Mukhia, 2006).

##### *Details assessment:*

G1 – scientific importance: All species have scientific and biological importance.

G2 – private sector's role: None of the Endangered species are harvested in the project area, so private firms are not involved.

G3i – scale of activities: Scale of project activity is small compared to road & hydropower projects, so major impact is not foreseen.

G3ii – proximity to biodiversity areas: Inside Biological Corridor (BC) but the corridor is wide enough to absorb the small environmental shock that the project may cause.

G3iii – technology: The water has to be transported through pipe buried at least 1 foot deep underground and not open drain, if this is done the environmental damage will be small.

G4 – scale of impact on socio-economic and ecosystem services: Considering the amount for environmental damage expected, no significant impact on ecosystem services is foreseen, however, tapping water may reduce volume of water downstream for the Basochu mini hydro-project. While the hydropower project is a national income generating project, drinking water supply for the local community is a priority.

G5 – assessment and analysis: Detailed analysis is not foreseen since no significant impact on the Endangered species is expected.

G6 – sectors relying on natural resources: This project does not extract resources such as timber and minerals, so its impact on natural resources users is irrelevant.

G7 – project alternatives: Re-alignment has considerably reduced the length of the pipeline, reducing overall impact.

G8 – values of different species: While the Dhole is considered a pest of domestic animals, *Illicium* is not used for any purpose and fishing is not practiced by the local community due to religious sentiments. Therefore, the biological and scientific values of the three species are protected.

G9 – Biodiversity Action Plan: Because of the nature of the project, which is a small scale project, separate Action Plan for each species is not felt necessary. Since Dhole is most often on the move, perhaps they were there looking for easy prey such as domestic animals. Star Anise is not used or harvested by local community for any purpose. Yet, the water pipeline corridor/right of way for laying pipes should be at the minimum possible to minimise damage, 3 m wide and 4 m for vehicle passing at regular interval. And due to religious sentiments, fishing is also not done by the local communities. However, it is advised that the entire river water should not be tapped for water supply scheme. Releasing at least one third of the water volume in the river at any time could be a better option to maintain the fish population.

G10 – private sector development in modified habitat: there is no possibility for the private sector development taking place due to the project. At the most, few temporary shift-shop may erupt which can be easily controlled by concerned authorities – Dzongkhag as well as Gewog administration.

G11 – natural and modified habitats assemblages: The water supply scheme alignment passes through a consistently similar vegetation type – oak forest, with little altitude variation. There is no assemblage of habitats that require special attention in the proposed project area. The only differences in species composition was noted around the settlements with disturbed vegetation that is naturally expected as local communities also collect some natural resources such as timber, firewood etc.

G12 – modified habitat: No modified habitat was noted along the water supply alignment

G13 – natural habitat: Drinking and irrigation water supply to the community is a priority. This project will also not cause major habitat damage. However, the right of way for the alignment as well as access road should not be wide, so the bush clearing width may not be extended beyond 5 m and opening canopy in the forest is to be discouraged as this can encourage invasive species to take over.

G14 – significant conversion and degradation of natural habitat: The project is not foreseen to have significant habitat change or establishment of business in the area.

G15 – mitigation measures: Since no major habitat destruction and socio-economic disruption is foreseen, few mitigation measures are recommended. Even the habitat destruction such as digging to fix water pipeline will be temporary and small. It is expected that the water pipeline will be buried underground to about 1 foot deep in most part of the alignment, except in cliffs and difficult areas such as gorge.

G16 – mitigation measures defined in Action Plan: Since Action Plan is not required due to the nature of the project and types of Endangered species observed in the project area, yet some mitigation measures are specified as necessary precautionary measures – such as maintaining one third water volume in the river

G17, G18 & G19 – Critical Habitat: Since the Endangered species and other species observed in the project area are also found elsewhere in Bhutan (see individual species distribution) and the Biological Corridor is just a passage for wildlife movement, the project area does have critical habitat in reality. There is also no endemic or range restricted species. The project area does not have socio-culturally and economically valuable habitat that sustain any category of local community or biodiversity species. Therefore, protection of critical habitat and its assessment in the project area do not arise.

G20 – Population Reduction of Endangered Species: the proposed project will not reduce the population if some of the recommendations provided are followed.

G21 – Clearance from concerned agency: the project has to engage forest officials and relevant agencies during the project implementation phase.

G22 – tangible benefits to protected area: the project does not involve displacement, movement or settlement of people in the area so as to allow major habitat change. There are no settlements and offices in the BC where the alignment passes through. Peoples' movement and working in the project area will be temporary and the habitat will remain more or less undisturbed once the construction is over, so the question of benefits to the area may not be necessarily raised. However, some invasive species such as *Ageratina adenophora* might move to the alignment

area with the movement of sand and other construction materials from lower area, but this will be temporary as such species will not occupy in dense canopy cover forest area where the alignment is projected.

G23, G24 & G25 – invasive alien species: Invasive species mentioned in G23 has no establishment possibility since such species occur in open areas where forest canopy is low. Some invasive species have habitat specific requirements, and it will be not possible for such species to invade the area at that altitude.

G26 – GMOs: the project is not on agriculture production so GMOs introduction is not foreseen

G27 – natural resources harvest: the area is not used for any natural resources harvesting

G28 – multisector initiative: this project does quality in this category

G29 – degradation of critical habitat: the project area is not a critical habitat

G30 & G31 – purchase of timber and non-timber: none of these forest products are extracted in the study area of due to project implementation

G32 – plantation: no plantation of any kind is involved in the project area

G33 – overharvesting of resources: no resources are harvested except tapping of water

#### 9. Tree removal

Herein, a tree is defined as a plant having at least 10 cm Diameter at Breast Height (DBH). So, all tree species with 10 cm or more DBH were measured as trees in the plots. Tree density in the Biological Corridor was higher (14 trees) than that in outside the Biological Corridor (8 trees). This is considering 6 m width as the right of way (carriage way) for laying pipelines and construction of access road. The average DBH of trees found in the project area was about 28 cm.

There are about 2,240 trees to be cut inside the 6 km stretch of Biological Corridor. However, in the case of outside the Biological Corridor there are 3,413 trees to be cut in the 16 km stretch. In total about 5,653 trees will have to be cut in the entire 22 km stretch. It is encouraged to replace these cut trees through plantation.

#### 10. Conclusion and recommendations

##### 10.1 Conclusion

There are few Endangered species of flora and fauna which are inside the Biological Corridor. *Illicium griffithii*, which is commonly known as Star Anise is globally Endangered and placed

under A2cd, mainly due to population reduction and over harvesting (Shah *et al.*, 2015). However, in Bhutan, it is not harvested and is common along the cool oak forest zone.

In the animal category, four Dholes (*Cuon alpinus*) were photographed in a camera trap. It is evaluated under C2a(i) – restricted range with an estimated population size of about 2,500 mature individuals, and its population is decreasing (Kamler *et al.*, 2015). Three other mammals – Himalayan black bear, Sambar deer, and Himalayan Serow are Vulnerable. These were however noted outside the Biological Corridor.

*Schizothorax richardsonii* is listed as Vulnerable under criteria A2acd+3cde+4acde (Vishwanath, 2010). It is known by the name Snow trout, Asla or Yul nya and is common in the mid-altitude rivers of Bhutan such as Puntasangchhu, Wangchhu, Chamkharchhu, Mangdechhu etc.

A notorious pandemic weed *Ageratina adenophora*, was recorded in the alignment above the last village of Hetsosham. This species occupies areas that open up for developmental activities and is fairly widespread in the area. It mostly spreads in the mid-altitude or temperate region, at 1000 to 2500 m elevation but can go higher up in the open mountain slopes. It is known to be toxic to livestock, especially horses.

Perhaps, it may be necessary to create conservation awareness to protect the Endangered and Vulnerable species. However, a separate management plan may not be necessary since fishing and hunting in the area was not obvious. This was also confirmed by talking to the people accompanying the biodiversity assessment team and some local people in the village.

## 10.2 Mitigation measures recommended

Based on the study conducted, the following recommendations are provided for impact mitigation. Some of these recommendations are mandatory which can be discussed further.

- 1) At least one third of the water flowing in the source river should not be tapped at any time of the year. This to allow the fish population to remain unaffected.
- 2) Use soft engineering structures such as causeways and avoid hard engineering structure such as culverts with high fall that blocks fish movement up and downstream.
- 3) The right of way (carriage way) for access road should not be more than wide.
- 4) No over-burden from access road cuttings should be thrown down the slope or into ravines. Such cut materials should be disposed at designated, pre-identified safe places.
- 5) Inside the biological corridor, blasting of rocks and hard soils should not be encouraged.

- 6) All pipes should be buried at least 1 foot deep in the ground. This will avoid maintenance cost in future as rolling stones and falling trees can damage the over-ground pipelines easily.
- 7) Any type of project work in the Biological Corridor should be avoided during the night - after dark until dawn.
- 8) Extending of floodlight to facilitate overnight works in the Biological Corridor should not be encouraged.
- 9) Work in the source should be discouraged during the peak breeding season of Snow trout – March to May, and September to October.
- 10) Felling of *Illicium* trees in the project area should be avoided unless those falling directly in the right of way for the pipeline and access road.
- 11) Any illegal felling, fishing and hunting during the construction period should be strictly monitored.
- 12) Any construction materials leftover should be removed from the Biological Corridor.
- 13) Conservation awareness education may be provided to the workers and local communities before the project activities start.
- 14) The access road should be closed after the work is complete to avoid illegal extraction of resources later.
- 15) For the number of trees cut due to the project, an equivalent number of tree saplings should be planted after identifying appropriate plantation site.

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**Annexure 1: Laboratory test result of Hetshotsham water**



ROYAL GOVERNMENT OF BHUTAN  
WANGDUE HOSPITAL  
WANGDUEPHODRANG



Ref. No: WAN/Hosp/BJ/13/2021-2022/1965 Date: 28/06/2022

To  
RWSS local person  
Dzongkhag Administration  
Wangdue Dzongkhag

Sub: Submission of water

Sr  
Sir

Please, find enclosed herewith the report on drinking water quality of the Hetshotsham under Wangdue Dzongkhag which is analysed on 27/06/2022.

S.No	Water Scheme	Sample	pH	Chlorine	Turbidity	Thermotolerant coliform
01	Hetshotsham	Stream	7.0	N/A	2.00	05

No colony forming unit (CFU) - Safe Water  
 1 - 10 CFU - Low Health Risk.  
 10 - 50 CFU - Intermediate to high health Risk.  
 More than 50 CFU - Grossly polluted, not suitable for human consumption.

Your's faithfully  
  
 Singye Jambho  
 (Sr. Medical Lab Technician)

**Annexure 2: Bird census data sheet**

Date:

Name of transect:

Locality name:

Sighting ID	Time	Common name	Perpendicular distance	Total individual	Habitat use	GPS location ID


Note: Sighting ID: Point ID along transect; Habitat use: tree branches, tip of twig, flight, rock surface, near stream, etc.

**Annexure 2a: Vegetation Assessment Protocol for Wangdue Water Flagship - Trees**

Site No. .... Date: ..... Time: ..... Collector(s): .....

Dzongkhag: ..... Locality: ..... Aspect: .....

Latitude: ..... Longitude: ..... Altitude: .....

Slope: ..... Plot type (circle): Trees (15 x 15m)

Forest type (circle): sub-tropical, warm broadleaved, cool broadleaved, temperate, sub-alpine

Forest canopy cover% (circle): open, partial shade, closed

Species	Height (m)	DBH (cm)	Remarks*

Notes: Any other notes:

**Annexure 2b: Vegetation Assessment Protocol for Wangdue Water Flagship - Shrubs**

Site No. .... (Shrubs – 5 x 5 m)

Species	Height (m)	Number	Remarks

**Annexure 2c: Vegetation Assessment Protocol for Wangdue Water Flagship - Herbs**

Site No. .... (Herbs – 2 x 2m)

Species	Cover %	OR number	Remarks

**Annexure 3: Ichthyological Assessment Protocol for Wangdue Water Flagship - Fish**

Site No. .... Date: ..... Time: ..... Collector(s): .....

Dzongkhag: ..... Locality: ..... Water body name: .....

Latitude: ..... Longitude: ..... Altitude: .....

Water body type (circle): seasonal stream, river, lake, spring water, dam, ditch, swamp, cave water

Water bed/substrate (circle): boulder, cobble, sand, mud, vegetable matter, other (name): .....

Water reach type (circle): riffle, pool, cascade, run, other (name) .....

Water characteristics (circle): clear, turbid, muddy, sandy. Water temp.: .....

pH: ..... Conductivity: ..... TDS: ..... Salinity: .....

Stream depth: ..... Stream width: ..... Capture depth: ..... Capture method: .....

Weather (circle): sunny, rainy, cloudy, partly cloudy, windy Water velocity: .....

Forest type (circle): sub-tropical, warm broadleaved, cool broadleaved, temperate, sub-alpine

Cover over water body (circle): open, partial shade, closed, other (name): .....

Fixation in: ..... Preservation in: .....

Species	Length (cm)	Weight (g)	No. if juvenile	Remarks

**Annexure 4: Samples of filled data sheets used in the field survey**

Vegetation Survey Protocol for Forest, ADB Water Fragility Project, Wajir District, Kenya Sheet 1

Site No. 12 Date 14/04/11 Time 1:00 Collector(s)

Dunglog Locality Aspect

Latitude Longitude Altitude

Soil Phytosociology Type (1-5) (6)

Climate type (1-6) = 1-tropical, warm, humid; 2-tropical, warm, humid; 3-tropical, warm, humid; 4-temperate, sub-alpine; 5-temperate, sub-alpine; 6-temperate, sub-alpine

Forest canopy cover (%) open, partial shade, closed

Species	Height (m)	DBH (cm)	Remarks*
<i>R. alboreum</i>	10	20	
R	6	10	
<i>B. guffelii</i>	21	22	
<i>Pinus k. bhutanica</i>	26	29	
<i>Q. laurata</i>	14	30	
<i>F. sibirica</i>	12	22	
<i>Pinus bhutanica</i>	29	32	
<i>R. alboreum</i>	3	27	
R	7	13	
<i>Q. laurata</i>	17	23	
<i>R. alboreum</i>	11	19	
<i>Q. laurata</i>	23	35	
<i>R. alboreum</i>	7	13	
<i>S. guffelii</i>	25	37	
<i>R. alboreum</i>	12	18	
<i>B. guffelii</i>	22	46	
<i>B. laurata</i>	24	43	

Note: \*DB, diameter



## Appendix 6: Sample Guidance Note in Responding to COVID-19

### COVID-19 Health and Safety Guidance

COVID-19<sup>30</sup> most commonly spreads between people who are in close contact through respiratory droplets or small particles produced when an infected person coughs, talks, or breathes. Growing evidence shows that droplets can remain suspended in the air and travel distances beyond six feet. Indoor environments with poor ventilation increase the risk of transmission.

The COVID 19 pandemic can have major impacts that can be far reaching and devastating for the project. The immediate risks would be community transmission from the construction workers to local communities or vice versa. Should this happen, the impact will be the immediate suspension of the ongoing. This would jeopardize the project progress and impact on the project period ultimately. Therefore to prevent and mitigate the spread or contain the pandemic, priority must be to take all precautionary measures during project implementation. There are already preventive guidelines advocated and implemented by the government in the country and these need to be strictly complied with. Therefore, the project needs to develop and implement Health and Safety Protocols in line with the current guidelines. These guidelines must be updated as and when new guidelines are issued by the government.

To prevent infection and to slow transmission of COVID-19, the Contractor needs to ensure that his workers comply with the followings:

- Wash their hands regularly with soap and water, or clean them with alcohol-based hand rub.
- Cover your mouth and nose with a mask when in public settings or around others.
- Maintain at least six feet distance between you and people coughing or sneezing.
- Avoid touching your face.
- Cover your mouth and nose when coughing or sneezing.
- Stay home if you feel unwell.
- Refrain from smoking and other activities that weaken the lungs.
- Practice physical distancing by avoiding unnecessary travel and staying away from large groups of people.
- Everyone should have had received 2 doses of vaccines. Ensure that all the workers have been vaccinated and ensure everyone goes for additional doses, if the government requires to do so in future.
- All the workers at site must be given awareness on the COVID-19 pandemic protocols. A periodic testing for COVID-19 virus should be liaised with medical/relevant organizations.
- Keep updated on the latest COVID-19 situation always and follow government's SOP on this pandemic.

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<sup>30</sup> According to World Health Organisation

# Appendix 7: Minutes of Meeting with Representative of the Community Forest Groups for the Hetshotsangchhu Water Project

## 1. Stakeholder and Public Consultations Carried out June 2022

Date: 3 June 2022, Venue: Gewog Office, Gasetsho wom

### Participants:

1. Miguel Diangan, ADB International Environmental Consultant
2. Saroj K Nepal, ADB Social safeguards Consultant
3. Deki P Yonten, ADB Environmental Safeguards Consultant
4. Sonam Tshering, Mangmi
5. Pema Gyaltshen, Tsogpa
6. Dawa Gyeltshen, CF member
7. Dorji Gyeltshen, CF member
8. Tandin Tshering, CF member
9. Pemba Tshering, CF member
10. Namgay A, CF member
11. Namgay B, CF member
12. Kinley Tshoki, CF member
13. Sonam Tobgay, CF member
14. Sangay Tshering, CF member
15. Lhaden, CF member

Topic	Discussion
Introduction	<ul style="list-style-type: none"> <li>• Introduction of the Participants and the ADB representatives</li> </ul>
Background and Objectives of the Project and impact on CF	<ul style="list-style-type: none"> <li>• Explanation on the Background and Objectives of the meeting and discussion on the alignment of the water transmission mains</li> <li>• It was explained that the exact distance of the CF traversed is not clear and that the Divisional Forest Office has been consulted to seek them advice on the length.</li> <li>• The project will share the revised updated alignment with the Divisional Forest Office and in turn seek their input to determine the distance through CF.</li> <li>• Representatives (Chairman, secretary and treasurers) from three Chiwogs attended the meeting along with other participants from Shingkhey Khatoe (includes Phaka) and Shingkhey Khamey, Tabchakha and Hetsokha</li> <li>• The total number of members within their CF is as follows; Shingkhey Khatoe (15) and Shingkhey Khamey (12), Tabchakha (7) and Hetsokha (12).</li> <li>• All the Community Forests are from within Gasetsho Wom gewog.</li> </ul>
Compensation for trees felled	<ul style="list-style-type: none"> <li>• In terms of compensation- If the forestry Department imposes compensation, then they should also be compensated. However, if the compensation is to be used for tree planting then once the alignment is cleared for the irrigation channel, there will be no room to replant new trees, so the community would not be able to use that fund to replant as is being done by the Forest Department.</li> <li>• Meeting agreed that they should keep felled trees and if compensatory afforestation is taken up by the project but not compulsory. Rather the community does not want to do the plantation because the maintenance requires a lot of work.</li> <li>• If the trees are given to the community for their own use, and the funds for replantation are from loan, the community does not desire it. However, if the funds are from grant money, they would like to seek some compensation for afforestation.</li> </ul>
Discussion on the procedures for tree removal	<ul style="list-style-type: none"> <li>• The community feels that the DOFPS has the marking hammer and receipt books are with the DOFPS.</li> </ul>

Topic	Discussion
	<p>However, the CF is allowed to retain the trees after felling.</p> <ul style="list-style-type: none"> <li>• They CF follows the prescription and rules of Forestry and their own by-laws</li> </ul>
Project impacts	<ul style="list-style-type: none"> <li>• Though the project will impact the Community Forest, the communities will definitely benefit from the water project, so therefore, they have no objection to the project</li> </ul>
Construction access	<ul style="list-style-type: none"> <li>• The access that is required to create the trenches and carry the pipes should be blocked after the project and the community will insist that use of this will be restricted. The member informed that they would include this as a clause in their clearance document</li> </ul>
Project affected households	<ul style="list-style-type: none"> <li>• The community members identified Ms. Kinley Situ, from Hetsokha village as a potential Affected Persons and shared her mobile number with the consultants for further follow up meetings and discussion</li> </ul>
Grievance Redress Mechanism	<ul style="list-style-type: none"> <li>• The consultants explained the GRM mechanism and informed the meeting on the process and explained how the community could address emerging impacts from the construction process</li> </ul>
Potential impacts to the community	<ul style="list-style-type: none"> <li>• The community said that care must be taken when working on the cliff above Tapchakha village and that the contractor must take care or boulders will fall on the village and canals when cliffs are being blasted.</li> <li>• Also, concern was expressed on identifying a muck dumping site as the rains will wash all the excavated soil down slope onto the village if dumped carelessly.</li> <li>• It was agreed that both points would be included in the EMP and as a requirement for the contractor to follow up on.</li> </ul>
No objection letter from the community	<ul style="list-style-type: none"> <li>• A no objection was sought from the community to allow the transmission main to traverse through the Community Forest. The representatives were requested to discuss and seek the clearance from 80% of the CF members</li> <li>• The CF representatives said that since the project was going to be for the benefit of their community, they will secure not just the 80% but get the consensus of the entire community</li> </ul>

Topic	Discussion
	<ul style="list-style-type: none"> <li>• The community representatives assured the meeting that within the week, they will inform all their CF members and send the consensus letter to the gewog for onward submission to the District and Project Management</li> </ul>



**LIST OF PARTICIPANTS FOR CONSULTATIONS, WFP, WANGDUE**

FOCUS GROUP DISCUSSIONS | COMMUNITY FOREST MEMBERS | GASETSHO WANGDUE

No	Name	Contact No.	Male/female	Organization	Designation	Signature
1	Miguel Diangon	7059178889288	Male	ADB	Consultant	
2	Saroj K Nepal	17624568	Male	ADB	Consultant	
3	Deki Yonten	77110028	Female	ADVS	Consultant	
4	Sonam Tsering	77618120	Male	TACHUKHONG ADB	Munguni	
5	Pema Gyeltson	17737492	Male	SUNGPA ADB	Tsugpa	
6	Dawa Gyeltson	77402563	Male	HETSHOKHONG ADB	CF member	
7	Dorji Gyeltson	77423449	Male	SUNGPA ADB	CF member	
8	Tandin Tsering	77582003	Male	TACHUKHONG ADB	CF member	
9	Pemba Tsering	17456379	Male	TACHUKHONG ADB	CF member	
10	Namgay A	17677092	Male	TACHUKHONG ADB	CF member	
11	Namgay B	17737003	Male	TACHUKHONG ADB	CF member	
12	Kinley Tshuki	77314522	Female	HETSHOKHONG ADB	CF member	
13	Sonam Tobgay	17706390	Male	SUNGPA ADB	CF member	
14	Sangay Tsering	77640984	Male	HETSHOKHONG	CF member	
15	Inaden	77421453	Female	HETSHOKHONG	CF member	

Date: 03/06/2022

Place: GASETSHO WANGDUE Pg.1  
GEWOG CENTRE

Date: 2 June 2022

Venue: Dzongkhag, Wangduephodrang

Participants: See participant list

Topic	Discussion summary
Introduction	<ul style="list-style-type: none"><li>• Welcome and vote of thanks by the Gup of Gasetsho Wom to the participants. He says that the representatives from the chiwogs have been invited to share their views at the meeting.</li><li>• Mangiap expressed great gratitude to ADB for supporting the project and taking the time to walk to the intake site.</li></ul>
Clarification was sought on whether the issue was lack of water or difficulties in water management	<ul style="list-style-type: none"><li>• It is not that there is no water, but the single source is divided into four channels</li><li>• The rainfall is irregular (climate change) and not on time as in the past- delay in rainfall</li><li>• The water is not adequate and not equitably shared because it is based on old traditional systems. Therefore, there is a need to review the existing water sharing system which is not very efficient or equitable.</li><li>• Water associations differ from village to village.</li></ul>
Challenges being faced in the community	<ul style="list-style-type: none"><li>• The villages do have a command source and intake sites and most houses also have individual small sources</li><li>• In earlier times, there was a water committee but this faced difficulties in sustaining the irrigation channels. They are still working as volunteers to ensure water supply to the villages</li><li>• 50% of the land is being left fallow and most of this belongs to the poorer community due to lack of water.</li><li>• During the 4-5 Bhutanese months- this leads to lots of fighting between the community for water. Even after social conflicts and fighting for water.</li><li>• Without adequate water- the yield is also affected and highly reduced compared to other villages in Punakha and Paro</li></ul> <p><b>Drinking water</b></p> <ul style="list-style-type: none"><li>• Individual houses have various water sources that are tapped but this is a problem- more so when it does not rain.</li><li>• The water taps outside the houses are not functional as the water sources are not reliable</li><li>• Currently water is stored in water tanks or ponds by different houses</li><li>• The establishment of the schools, the gewog office, the Basic Health Unit and the Renewable Natural Resource (RNR) offices have added to the demand for water resulting in the water shortage</li></ul>

Topic	Discussion summary
Existing system	<ul style="list-style-type: none"> <li>• Water rotation happens in a 24-hour period and each farmer gets their turn in 24 hours, so a farmer spends hours to go check the water source and have to keep waiting for their turn and ensure that water is not diverted elsewhere. Sometimes, the water does not adequately cover all the plots of land in the 24 hours.</li> <li>• Increasingly, more people are buying imported rice rather than being able to grow paddy</li> <li>• When land is sold, the water right is not necessarily sold to the buyer so that results in water shortage.</li> <li>• The existing water canals are both a combination of cemented canals and natural drains and not lined with lots of seepage</li> <li>• The community contractors are paid by the gewog to repair and maintain through annual budget provisioning (prioritized based on community needs)</li> </ul>
Future plans	<ul style="list-style-type: none"> <li>• Gup: Once the project is operational, the 2 gewogs in discussion must come up with a water association and in order to sustain that, tax or a form of payment should be collected from the community to pay the community/labor working for the community- to sustain this system. Not sure at this point whether this will be acceptable to the community yet, so this will be discussed within the community first.</li> </ul>
Expectations	<ul style="list-style-type: none"> <li>• The project will greatly benefit the 8 chiwogs and 2 gewogs. The community has very high expectations that they will become prosperous and economically developed once the project comes on board</li> <li>• Hope to strengthen the water association and further improve water management</li> <li>• Maintenance: Automation can be learnt by the community if given adequate training by mobilizing the youth from the community. It will take the community 1-1.5 years to learn, rather than have an outsider take care of the maintenance.</li> <li>• If water was available, all types of crops could actually grow due to the climatic conditions but cannot do so now. If they get adequate water, then they can hope to be self-sufficient as well as sell the produce (both cereals and fruit trees too)</li> <li>• Hope that this will encourage youth to come back to the village to become farmers</li> <li>• Also aspire to expand to livestock rearing</li> <li>• Want to replace the old traditional water sharing system with the Water Act.</li> <li>• Land right should be tied with the water right</li> </ul>

Participant list- Meeting with the Community Representatives

Luca Di Mario (ADB)		
Gopala Krishna Bhat (ADB)		
Robert Raut (ADB)		
Miguel (ADB)		
Saykanta (ADB)		
Saran Am (ADB)		
Indra K. Chhetri (ADB)	Geological specialist	
Tshering Dendup	Executive Engineer	
Sigme Dorji	St. planning officer	
Donyang	ADAO	

Meeting for Water Flagship Program: ADB Pre-Fact/ Finding Mission on 02/06/2022(Integrated Drinking and under Gasetshogom & Gasetshowom)

Sl.No	Name	Designation	Signature
01	Dachen Dorji	Chief Engineer Basochhi HEP	
02	Ugyen Wangchuk	DZO. Eng. O	
3	Sangay Norbu	Dy. CFO	
4	Sang K. Nepal	Consultant (ADB)	
5	Debi P. Yonker	Consultant (ADB)	
6	Karma	Tshogpa Member	
7	Tshering Pelmo	"	
8	Yangka	"	
9.	Chador Nangay	Tshogpa	
10.	Pema Dorji	"	
11.	Kinley Dendup	"	
12.	Kinley Wangchuk	Manngmi	

Photo: Meeting with the Community Representatives



## 2. Attendance Sheet of Stakeholder and Public Consultations Carried out 13-14 October 2025

















Attendance Sheet of Stakeholder Consultations with Dzongkhag Administration, Wangdue

Date 13/10/2025

**Attendance Sheet for the Courtesy Call to DASHO DZONGDAG and Brief Meeting on HETSHOTSAMCHU INTEGRATED WATER SUPPLY SCHEME**

Sl. No	Name	Designation	Signature
1.	Phub Rinzin	Dzongdag	
2.	Choki Wangchuk	Offtg.DAO	
3.	Rinzin Wangchuk	Planning Officer	
4.	Nidup Tsh	JE	
5.	Sherab Dorji	LRO	
6.	Singay Dorji	AE	
7.	Rajesh Pradhan	Social Safeguard Specialist	
8.	Karma Choegyel	Environmental Expert	
9.	Manju Giri	Social Development and Gender Expert	

Attendance Sheet of Public Consultations at Hetshokha, Gasetsho-Wom, Wangdue

Public Consultation								
Participants list at <u>Gasetsho Wom, Hetshokha, Wangdue</u> DZONGKHAG								
Gewog <u>Gasetsho Wom</u> DZONGKHAG <u>Wangdue Phodang</u>								
Water Flagship Program Support Project								
ADB TA-PROJECT No. 42173-017								
Date: <u>12/10/2015</u> Venue: <u>Outside Hetshokha Khatang</u>								
Sl No.	Name	Age	Sex	CID number	Village	Gewog	Contact Number	Signature/Thumb impression
1	Pasang Wangmo	24	F	11907000562	Hetyshokha	Gasetsho Wom	77669068	
2	Kinley Dem	67	F	11907000488	Hetyshokha	Gasetsho Wom	77272704	
3	Pema	73	M	11907000606	Hetyshokha	Gasetsho Wom	77454938	
4	Phub Sithub	67	F	11907000589	Hetyshokha	Gasetsho Wom	77881089	
5	Kinley Choden	35	F	11407000532	Hetyshokha	Gasetsho Wom	77610748	
6	Bakhu	66	M	11907000581	Hetyshokha	Gasetsho Wom	77367682	
7	Zam	66	F	11907000511	Hetyshokha	Gasetsho Wom	77652542	
8	Chethaem	65	F	11907000590	Hetyshokha	Gasetsho Wom	77823963	
9	Sangay Dema	56	F	11907000542	Hetyshokha	Gasetsho Wom	77258961	
10	Zangmo	51	F	11907000565	Hetyshokha	Gasetsho Wom	77429171	
11	Kezang Choden	35	F	11907000504	Hetyshokha	Gasetsho Wom	77301123	
12	Deki Pew				Gewog Ngai	Gasetsho Wom	17671153	
13	Sonam Tshomb	42	M	11907000555	Mangmei	Gasetsho Wom	77619120	
14	Dawa Gyeltshan	55	M	11907000545	Hetyshokha	Gasetsho Wom	77402563	
15	Yeshey	37	M	10208000113	Halkshokha	Gasetsho Wom	17740108	
16	Sangay Dorji	42	M	10310001027	DAW	Wangdue	17951295	
17	Nanta Gini	-	F	11210001213	-	Gender & Social Expert PHSC		
18	Karma Chogyel	-	M	11604011855	-	Env. Specialist	17785489	
19	Rejini Pracha	-	M	11203004135	-	Senior Deputy ASST.	7703461	
20	Singye Khandak	44	M	11507000201	-	Senior Ad. Exp.	77711809	

Attendance Sheet of Public Consultations at Tabcheykha, Gasetsho-Wom, Wangdue

Public Consultation  
 Participants list at Tabcheykha, Wangdue, DZONGKHAG  
 Gewog: Tabcheykha, Dzongkhag: Wangdue  
 Water Flagship Program Support Project  
 ADB TA-PROJECT No. 42173-017  
 Date: 14/10/2020 Venue: In Gasetsho Conference Hall

Sl. No.	Name	Age	Sex	CID number	Village	Gewog	Contact Number	Signature/Thumb impression
1.	Pemba Tshering	41	male	1080600047	Tapchakha	Toko-wom	17956338	
2.	Namgay	65	"	11907000994	"	"	17677092	
3.	Namgay	50	"	-	"	"	17737008	
4.	Tshaktar Tashi	37	"	11607002208	"	"	17849314	
5.	Dezji Wangdi	68	"	12004003596	"	"	17691820	
6.	Dezji	74	"	11907000614	"	"	-	

7.	Chado Lham	51	f/male	-	Tapchakha	Tsho-wom	17480741	
8.	Pimbu Om	62	"	-	"	"	17852827	
9.	Wangchuk	50	male	11907000978	"	"	17900020	
10.	Pen Zam	43	f/male	-	"	"	77367781	
11.	Tawaleu	36	male	-	"	"	77276479	
12.	Wangmo	46	f/male	11907000018	"	"	17501032	
13.	Ugyen Om	45	"	-	-	-	17944060	

14.	Pen Zam.	57	f/male	11907001009	Tapchakha	Tsho-wom	77297929 17	
15.	Tandin Tshering	46	male	11907001096	"	"	17882603	
16.	Singye Dangi	42	male	10310701027	DPAO	Wangchuk	17351295	
11.	Wangdi		F	11214001213	-	Gender & Social expert PNSC		
17.	Karma Chogyel		F	11604001585	-	Env. Specialist	17765487	
18.	Rajul Pradhan		M	112050014155	-	Social Expert	17203611	
19.	Singye Chogyel	40	M	11504002241	-	S.S.I. Social and Guide	22711889	



14	Yashin Dorji	50	M	11901000116	Kluchoed	Case Tutor	17629239	
15	Pem Gyeltshen	60	M	11907000775	-	-	177333492	
16	Kencho Zam	60	F	11907000128	-	-	17266745	
17	Nima	48	F	11907000251	-	-	17717587	
18	Kencho Dama	45	F	11907000751	-	-	17462590	
19	Lekey	49	F	11907000851	-	-	17257620	
20	Chado Zam	42	F	11907000878	-	-	77353716	
21	Nangay Zam	46	F	11907000747	-	-	17491577	

22	<del>Phubs</del> Pema Thinley	31	M	11907000857	Kluchoed	Case Tutor	17966548	
23	Singay Dorji	42	M	10310001027	DAW	Wangdue	17851295	
24	Nangin Gi	-	F	11214001213	-	Gender & Social Expert. UNCC		
25	Karna Chojjel	-	M	11604001585	-	ENV. Specialist	17765489	
26	Rajita Pradhan	-	M	11203004135	-	Social Expert	17603661	
27	Sigye Wangchuk	44	M	11504002041	-	Asst. Sen/and/Env	37711809	

Attendance Sheet of Stakeholder Consultations with Gasetho-Gom Administration, Wangdue

Stakeholder Consultation  
 Participants list at Gewog Gasetho Gom Wangdue DZONGKHAG  
 Water Flagship Program Support Project  
 ADB TA-PROJECT No. 42173-017  
 Date: 14/10/2023 Venue: Gewog Gasetho Gom Hall

Sl No.	Name	Age	Sex	CID number	Village	Gewog	Contact Number	Signature/Thumb impression
1.	Chado	41	Male	11906000443	Khamina	Gasetho Gom	17627375	
2.	Kintey Wangchuk	46	Male	11906000412	Khamina	Gasetho Gom	17629636	
3.	Tshering Penjor	28	Male	1100500278	Gangay Ath.	Gasetho Gom	77637357	
4.	Kintey Deudup	49	Male	11910700135	Changkhā Pasakha	Gasetho Gom	17776719	
5.	Chadho Nangay	56	Male	11906000257	Drapelkhā	Gasetho Gom	77329252	
6.	Penā Klunday	37	Male	11906000510	Khamayā	Gasetho Gom	17935953	

7.	Singye Wangmo	32	F	11906000653	Khamina	Gasetho Gom	17700773	
8.	Karma	52	M	11906000867	Hoteykhā	Gasetho Gom	77610685	
9.	Jantun Tshering	44	M	11104002761	RNR-EC	Gasetho Gom	17342557	
10.	Singye Norbu	27	M	1151400203 23	RNR-EC	Gasetho Gom	17416705	
11.	Singay Dangi	42	M	10310000029	DABO	Wangdue	17351295	
12.	Manji Gi		F	11214001213		Gender & Social Dept. PHCC		
13.	Karma Chogyel		M	11604001835	PHSC	Env. Specialist	17765489	

14.	Rajin Pradhan	-	M	11203064935		Govt Dept.	17603661	
15.	Singye Wangchuk	44	M	11504002041		Govt. Sec/Ad. Govt.	77711009	

## Appendix 8: Sample Grievance Registration Form

The MOWHS welcomes complaints, suggestions, queries, and comments regarding the project implementation. We encourage any person or group with a grievance to provide their name and contact information to get in touch with you for clarification and feedback.

Should you choose to include your details but want that information to remain confidential, please inform us by writing/typing **\*(CONFIDENTIAL)\*** above your name. Thank you.

Date		Place of registration				
<b>Contact Information/Personal Details</b>						
Name		Gender	Male	Female	Age	
Home Address						
Village / Town						
District						
Phone no.						
E-mail						
<b>Complaint/Suggestion/Comment/Question</b>						
Please provide details of the grievance (who, what, where, and how):						
_____ <b>*Note: You may attach a document, letter, or note in the grievance form.</b>						
How do you want us to reach you for feedback or updates on your comment/grievance?						

### OFFICIAL USE ONLY

Registered by: (Name of official registering grievance)	
If – then mode:	
<ul style="list-style-type: none"> <li>▪ Note/Letter</li> <li>▪ E-mail</li> <li>▪ Verbal/Telephonic</li> </ul>	
Reviewed by: (Name, Signature, Position)	
Action Taken:(Date, Venue of Meeting, Other details)	
Whether Action Taken Disclosed:	<ul style="list-style-type: none"> <li>▪ Yes</li> <li>▪ No</li> </ul>
Means of Disclosure:	

### GRIEVANCES RECORD AND ACTION TAKEN

Sr. No.	Date	Name and Contact No. of Complainant	Type of Complaint	Place	Status of Redress	Remarks

# Appendix 9: Sample Environmental Site Inspection Form

## SAMPLE MONITORING SHEET FOR CONTRACTORS

(Note: This checklist is indicative which can be further enhanced depending on the project circumstances.)

[NAME OF ADB PROJECT]

Contractor Monitoring Sheet

Name of Subproject: \_\_\_\_\_

Location: \_\_\_\_\_

Supervising PIU: \_\_\_\_\_

Contractor: \_\_\_\_\_

Contractor EHS Supervisor (or equivalent): \_\_\_\_\_

Date of monitoring: \_\_\_\_\_

### Summary of Findings

Monitoring Item	Status	Remarks
<b>1. Compliance with Local Permit Requirements</b>	<b>(Obtained / Application Submitted / Not Applicable)</b>	
<i>Location/zoning permits</i>		
<i>Permit to construct</i>		
<i>Building permit</i>		
<i>Transport / hauling permits</i>		
<b>2. Compliance with IEE Requirements</b>	<b>(Approved / Under Preparation / Submitted to PMU for Approval / Not Applicable)</b>	
<i>Site-specific EMP (SEMP)</i>		
<i>Corrective Action Plan, if any</i>		
<b>3. Compliance with SEMP</b>		
<b>Construction Site</b>	<b>(Satisfactory / Needs Improvement / Not Implemented/Not Applicable)</b>	
- Conduct of toolbox talk		
- Use of PPE		
- Rest areas for male and female workers		
- Toilets for male and female workers		
- Medical kits		
- Drinking water supply		
- Dust control		
- Noise control		
- Solid waste management		
- Wastewater management		
- Chemicals storage (fuel, oil, etc.)		
- Siltation or erosion control		
- Heavy equipment staging / parking area		
- Barricades around excavation sites		
- Access to residential houses/shops/businesses		
- Traffic routing signages		
- Lightings at night		
- Trench shoring / landslide protection		
<b>Construction Workers' Camp Site</b>	<b>(Available / Needs Improvement / Not Available / Not Applicable)</b>	

Monitoring Item	Status	Remarks
- Quarters for male and female workers		
- Sleeping utilities (e.g., beds, pillows, blankets, mosquito nets, etc.)		
- Power/Electricity supply		
- Drinking water supply		
- Toilets for male and female workers		
- General purpose water supply (cooking, washing, bathing)		
- Cooking facilities and areas		
- Solid waste management		
- Wastewater management		
- Pest control		
<b>4. Implementation of GRM</b>	<b>(Yes / No or None / Under Resolution)</b>	
<i>Complaints</i>		
<i>Complaints resolution</i>		
<b>5. Environmental Quality Measurement</b>	<b>(Passed / Failed / Not Applicable)</b>	
<i>Ambient air quality sampling</i>		
<i>Noise level measurement</i>		
<i>Receiving water quality sampling</i>		

Other Issues: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**Attachments:**

1. Copies of new permits obtained, if any.
2. Photos taken at worksites, if any.  
(photos attached in previous monitoring sheets should not be used again).
3. Laboratory results of environmental quality measurements, if any.

Prepared by: \_\_\_\_\_  
 Name, Designation and Signature

# Appendix 10: Sample Inspection Checklist for PMU/PIU

## SAMPLE INSPECTION CHECKLIST FOR PROJECT MANAGEMENT UNIT AND PROJECT IMPLEMENTATION UNITS

(Note: This checklist is indicative which can be further enhanced depending on the project circumstances.)

### [NAME OF ADB PROJECT] SITE INSPECTION CHECKLIST

Subproject / Location: \_\_\_\_\_

Date: \_\_\_\_\_

MONITORING/INSPECTION QUESTIONS		FINDINGS			COMMENTS / CLARIFICATIONS
1.	Supervision and Management On-Site	Yes	No	NA	
	a. Is an EHS supervisor available?				
	b. Is a copy of the SEMP available?				
	c. Are daily toolbox talks conducted on site?				
2.	The Facilities	Yes	No	NA	
	a. Are there a medical and first aid kits on site?				
	b. Are emergency contact details available on-site?				
	c. Are there PPEs available? What are they?				
	d. Are the PPEs in good condition?				
	e. Are there firefighting equipment on site?				
	f. Are there separate sanitary facilities for male and female workers?				
	g. Is drinking water supply available for workers?				
	h. Is there a rest area for workers?				
	i. Are storage areas for chemicals available and with protection? in safe locations?				
3.	Occupational Health and Safety	Yes	No	NA	
	a. Are the PPEs being used by workers?				
	b. Are excavation trenches provided with shores or protection from landslide?				
	c. Is breaktime for workers provided?				
	d. How many for each type of collection vehicle is in current use?				
4.	Community Safety	Yes	No	NA	
	a) Are excavation areas provided with barricades around them?				
	b) Are safety signages posted around the sites?				
	c) Are temporary and safe walkways for pedestrians available near work sites?				
	d) Is there a record of treated wastewater quality testing/measurement?				
5.	Solid Waste Management	Yes	No	NA	

MONITORING/INSPECTION QUESTIONS		FINDINGS			COMMENTS / CLARIFICATIONS
	a. Are excavated materials placed sufficiently away from watercourses?				
	b. Is solid waste segregation and management in place?				
	c. Is there a regular collection of solid wastes from work sites?				
6.	<b>Wastewater Management</b>	Yes	No	NA	
	a) Are there separate sanitary facilities for various types of use (septic tanks, urination, washing, etc.)?				
	b) Is any wastewater discharged to storm drains?				
	c) Is any wastewater being treated prior to discharge?				
	d) Are measures in place to avoid siltation of nearby drainage or receiving bodies of water?				
	e) Are silt traps or sedimentation ponds installed for surface runoff regularly cleaned and freed of silts or sediments?				
7.	<b>Dust Control</b>	Yes	No	NA	
	a. Is the construction site watered to minimize generation of dust?				
	b. Are roads within and around the construction sites sprayed with water on regular intervals?				
	c. Is there a speed control for vehicles at construction sites?				
	d. Are stockpiles of sand, cement and other construction materials covered to avoid being airborne?				
	e. Are construction vehicles carrying soils and other spoils covered?				
	f. Are generators provided with air pollution control devices?				
	g. Are all vehicles regularly maintained to minimize emission of black smoke? Do they have valid permits?				
8.	<b>Noise Control</b>	Yes	No	NA	
	a) Is the work only taking place between 7 am and 7 pm, weekdays?				
	b) Do generators operate with doors closed or provided with sound barrier around them?				
	c) Is idle equipment turned off or throttled down?				
	d) Are there noise mitigation measures adopted at construction sites?				
	e) Are neighboring residents notified in advance of any noisy activities expected at construction sites?				
9.	<b>Traffic Management</b>	Yes	No	NA	

MONITORING/INSPECTION QUESTIONS		FINDINGS			COMMENTS / CLARIFICATIONS
	a) Are traffic signages available around the construction sites and nearby roads?				
	b) Are re-routing signages sufficient to guide motorists?				
	c) Are the excavation sites along roads provided with barricades with reflectors?				
	d) Are the excavation sites provided with sufficient lighting at night?				
10.	<b>Recording System</b>	Yes	No	NA	
	a) Do the contractors have recording system for SEMP implementation?				
	b) Are the daily monitoring sheets accomplished by the contractor EHS supervisor (or equivalent) properly compiled?				
	c) Are laboratory results of environmental sampling conducted since the commencement of construction activities properly compiled?				
	d) Are these records readily available at the site and to the inspection team?				

**Other Issues:** \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**Prepared by:** \_\_\_\_\_  
 Name, Designation and Signature

**Appendix 11: Semi-annual Environmental Monitoring Report  
Template**

## Appendix 11: Semi-annual Environmental Monitoring Report Template

### INTRODUCTION

- Overall project description and objectives
- Environmental category as per ADB Safeguard Policy Statement, 2009
- Environmental category of each subproject as per national laws and regulations
- Project Safeguards Team

Name	Designation/Office	Email Address	Contact Number	Roles
1. PMU				
2. PIUs				
3. Consultants				

- Overall project and sub-project progress and status
- Description of subprojects (package-wise) and status of implementation (preliminary, detailed design, on-going construction, completed, and/or O&M stage)

Package Number	Components/List of Works	Contract Status (specify if under bidding or contract awarded)	Status of Implementation (Preliminary Design/Detailed Design/On-going Construction/Completed/O&M) <small><sup>31</sup></small>	If On-going Construction	
				% Physical Progress	Expected Completion Date

#### Compliance status with National/State/Local statutory environmental requirements<sup>32</sup>

<sup>31</sup> If on-going construction, include %physical progress and expected date of completion

<sup>32</sup> All statutory clearance/s, no-objection certificates, permit/s, etc. should be obtained prior to award of contract/s. Attach as appendix all clearance obtained during the reporting period. If already reported, specify in the "remarks" column.

Package No.	Subproject Name	Statutory Environmental Requirements <sup>33</sup>	Status of Compliance <sup>34</sup>	Validity if obtained	Action Required	Specific Conditions that will require environmental monitoring as per Environment Clearance, Consent/Permit to Establish <sup>35</sup>

**Compliance status with environmental loan covenants**

No. (List schedule and paragraph number of Loan Agreement)	Covenant	Status of Compliance	Action Required

**Compliance status with the environmental management plan (refer to EMP TABLES in APPROVED IEE/S)**

- Confirm if IEE/s require contractors to submit site-specific EMP/construction EMPs. If not, describe the methodology of monitoring each package under implementation.

**Package-wise IEE Documentation Status**

Package Number	Final IEE based on Detailed Design				Site-specific EMP (or Construction EMP) approved by Project Director? (Yes/No)	Remarks
	Not yet due (detailed design not yet completed)	Submitted to ADB (Provide Date of Submission)	Disclosed on project website (Provide Link)	Final IEE provided to Contractor/s (Yes/No)		

- For each package, provide name/s and contact details of contractor/s' nodal person/s for environmental safeguards.

**Package-wise Contractor/s' Nodal Persons for Environmental Safeguards**

Package Name	Contractor	Nodal Person	Email Address	Contact Number

<sup>33</sup> Specify (environmental clearance? Permit/consent to establish? Forest clearance? Etc.)

<sup>34</sup> Specify if obtained, submitted and awaiting approval, application not yet submitted

<sup>35</sup> Example: Environmental Clearance requires ambient air quality monitoring, Forest Clearance/Tree-cutting Permit requires 2 trees for every tree, etc.


- With reference to approved EMP/site-specific EMP/construction EMP, complete the table below

**Summary of Environmental Monitoring Activities (for the Reporting Period)<sup>36</sup>**

Impacts (List from IEE)	Mitigation Measures (List from IEE)	Parameters Monitored (As a minimum those identified in the IEE should be monitored)	Method of Monitoring	Location of Monitoring	Date of Monitoring Conducted	Name of Person Who Conducted the Monitoring
<b>Design Phase</b>						
<b>Pre-Construction Phase</b>						
<b>Construction Phase</b>						
<b>Operational Phase</b>						

<sup>36</sup> Attach Laboratory Results and Sampling Map/Locations

## Overall Compliance with SEMP/ EMP

No	Sub-Project Name	EMP/ SEMP Part of Contract Documents (Y/N)	SEMP/ EMP Being Implemented (Y/N)	Status of Implementation (Excellent/ Satisfactory/ Partially Satisfactory/ Below Satisfactory)	Action Proposed and Additional Measures Required

**Approach and methodology for environmental monitoring of the project**

- Briefly describe the approach and methodology used for environmental monitoring of each sub-project.

**Monitoring of environmental IMPACTS on PROJECT SURROUNDINGS (ambient air, water quality and noise levels)**

- Discuss the general condition of surroundings at the project site, with consideration of the following, whichever are applicable:
  - Confirm if any dust was noted to escape the site boundaries and identify dust suppression techniques followed for site/s.
  - Identify if muddy water is escaping site boundaries or if muddy tracks are seen on adjacent roads.
  - Identify type of erosion and sediment control measures installed on site/s, condition of erosion and sediment control measures including if these are intact following heavy rain;
  - Identify designated areas for concrete works, chemical storage, construction materials, and refueling. Attach photographs of each area in the Appendix.
  - Confirm spill kits on site and site procedure for handling emergencies.
  - Identify any chemical stored on site and provide information on storage condition. Attach photograph.
  - Describe management of stockpiles (construction materials, excavated soils, spoils, etc.). Provide photographs.
  - Describe management of solid and liquid wastes on-site (quantity generated, transport, storage and disposal). Provide photographs.
  - Provide information on barricades, signages, and on-site boards. Provide photographs in the Appendix.
  - Indicate if there are any activities being undertaken out of working hours and how that is being managed.
- Briefly discuss the basis for environmental parameters monitoring.
- Indicate type of environmental parameters to be monitored and identify the location.
- Indicate the method of monitoring and equipment used.
- Provide monitoring results and an analysis of results in relation to baseline data and statutory requirements.

*As a minimum the results should be presented as per the tables below.*

**Air Quality Results**

Site No.	Date of Testing	Site Location	Parameters (Government Standards)

			PM10 µg/m <sup>3</sup>	SO <sub>2</sub> µg/m <sup>3</sup>	NO <sub>2</sub> µg/m <sup>3</sup>

Site No.	Date of Testing	Site Location	Parameters (Monitoring Results)		
			PM10 µg/m <sup>3</sup>	SO <sub>2</sub> µg/m <sup>3</sup>	NO <sub>2</sub> µg/m <sup>3</sup>

#### Water Quality Results

Site No.	Date of Sampling	Site Location	Parameters (Government Standards)					
			pH	Conductivity µS/cm	BO D mg/L	TSS mg/L	TN mg/L	TP mg/L

Site No.	Date of Sampling	Site Location	Parameters (Monitoring Results)					
			pH	Conductivity µS/cm	BO D mg/L	TSS mg/L	TN mg/L	TP mg/L

#### Noise Quality Results

Site No.	Date of Testing	Site Location	L <sub>Aeq</sub> (dBA) (Government Standard)	
			Day Time	Night Time

Site No.	Date of Testing	Site Location	L <sub>Aeq</sub> (dBA) (Monitoring Results)	
			Day Time	Night Time

#### Grievance Redress Mechanism

- Provide information on establishment of grievance redress mechanism and capacity of grievance redress committee to address project-related issues/complaints. Include as appendix Notification of the GRM (town-wise if applicable).

**Complaints Received during the Reporting Period**

- Provide information on number, nature, and resolution of complaints received during reporting period. Attach records as per GRM in the approved IEE. Identify safeguards team member/s involved in the GRM process. Attach minutes of meetings (ensure English translation is provided).

**SUMMARY OF KEY ISSUES AND REMEDIAL ACTIONS**

- Summary of follow up time-bound actions to be taken within a set timeframe.

**APPENDIXES**

- Photos
- Summary of consultations
- Copies of environmental clearances and permits
- Sample of environmental site inspection report
- All supporting documents including signed monthly environmental site inspection reports prepared by consultants and/or contractors
- Others

**SAMPLE ENVIRONMENTAL SITE INSPECTION REPORT**

Project Name  
Contract Number

NAME: \_\_\_\_\_ DATE: \_\_\_\_\_  
TITLE: \_\_\_\_\_ DMA: \_\_\_\_\_  
LOCATION: \_\_\_\_\_ GROUP: \_\_\_\_\_

WEATHER CONDITION:  
\_\_\_\_\_

INITIAL SITE CONDITION:  
\_\_\_\_\_

CONCLUDING SITE CONDITION:  
Satisfactory \_\_\_\_\_ Unsatisfactory \_\_\_\_\_ Incident \_\_\_\_\_ Resolved \_\_\_\_\_ Unresolved \_\_\_\_\_

INCIDENT:  
Nature of incident:  
\_\_\_\_\_

Intervention Steps:  
\_\_\_\_\_

Incident Issues

Resolution	Project Activity Stage	Survey	
		Design	
		Implementation	
		Pre-Commissioning	
		Guarantee Period	

**Inspection**

Emissions	Waste Minimization		
Air Quality	Reuse and Recycling		
Noise pollution	Dust and Litter Control		
Hazardous Substances	Trees and Vegetation		
Site Restored to Original Condition	Yes	<input type="checkbox"/>	No <input type="checkbox"/>

Signature  
\_\_\_\_\_

**Sign off**

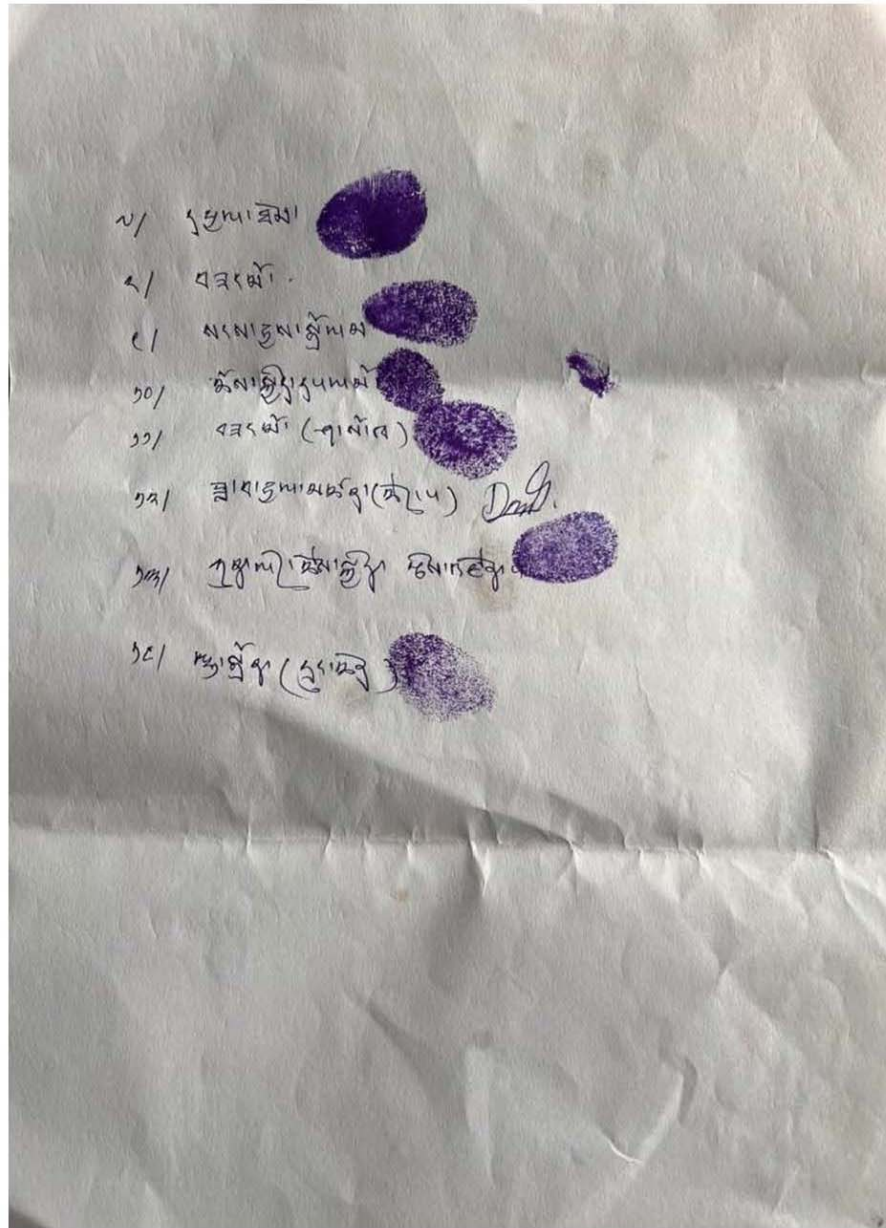
\_\_\_\_\_  
Name  
Position

\_\_\_\_\_  
Name  
Position









# Appendix 13: Memorandum of Understanding Among Wangdue Phodrang PIU, Gewog Stakeholders and Druk Green Power Corporation Limited on the Water Sharing with Hetshotsangchhu River.





དཔལ་ལྷན་འབྲུག་གཞུང་།  
རྒྱལ་ཁབ་བདག་སྐྱོང་དབང་འདུས་མོ་བླང་།  
ROYAL GOVERNMENT OF BHUTAN  
DZONGKHAG ADMINISTRATION  
Wangduephodrang: BHUTAN



**Memorandum of Understanding between the Dzongkhag Administration, Wangduephodrang, the two Gewogs of Gasetsho-Gom and Gasetsho-Wom, and Basochhu Hydropower Plant, Druk Green Power Corporation Limited (DGPC) on the use of Heso-tsham Chu as an additional Irrigation Water Source for the two Gewogs**

**Purpose of the MoU:**

The Wangduephodrang Dzongkhag Administration considers that water shortage is the main constraint for crop production in the two Gewogs of Gasetsho-Gom and Gasetsho-Wom under Wangdue Dzongkhag. The settlement areas are situated in relatively smaller catchments and the water yields from these catchments are insufficient and highly vulnerable even when there are slight delays with the monsoon rains. There are existing irrigation schemes that feed the two Gewogs but the water yields have been determined to be not sufficient for crop husbandry, especially during the paddy plantation season. In view of the water shortage for crop husbandry in the above two Gewogs, the Wangdue Dzongkhag and Gewog (Gasetsho-Gom and Gasetsho-Wom) Administrations have surveyed and are desirous to partially divert the Heso-tsham Chu to meet the additional irrigation water requirement for the two Gewogs.

While the diversion of water from the Heso-tsham Chu will impact generation at the downstream Basochhu hydropower plant, in public interest, Basochhu Hydropower Plant, DGPC will permit the partial diversion of Heso-tsham Chu to meet the additional irrigation water requirement of the two Gewogs.

The partial diversion of the Heso-tsham Chu is to be implemented through a statutory water sharing plan that comply with the sustainable use of the Heso-tsham Chu for the benefit of the two Gewogs as well as generation at the downstream Basochhu hydropower plant.

**Statutory Water Sharing Plan for Heso-tsham Chu**

- (i) Wangdue Dzongkhag shall construct the new pipeline irrigation scheme using Heso-tsham Chu as a source with a maximum discharge capacity of 500 liters per second (through use of two number of 315mm HDPE pipe) for providing additional irrigation water in the gross command area estimated to be about 1270 acres. Except for the peak requirement of irrigation water for paddy plantation (May – August), the maximum diversion for all other months is expected to be below 250 liters per second.



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 རྫོང་ཁག་བདག་སྐྱོང་དབང་འདུས་ཡོ་ཟུང་།  
 ROYAL GOVERNMENT OF BHUTAN  
 DZONGKHAG ADMINISTRATION  
 Wangduephodrang: BHUTAN



- (ii) Notwithstanding the provision under (i) above, the Wangdue Dzongkhag and Gewog (Gasetsho-Gom and Gasetsho-Wom) Administrations shall ensure the maintenance of the existing irrigation systems and water from Heso-tsham Chu shall be diverted only when the water yields from the existing irrigation schemes are not sufficient to meet the irrigation demand in the command area.
- (iii) The Dzongkhag and Gewog Administrations shall ensure the efficient use of the Heso-tsham Chu water with minimal wastage that is verifiable through the establishment of a Water Sharing Committee.
- (iv) In the infrastructure design and investment to be made by the Dzongkhag Administration, it shall be ensured that enough provisions are created in the water transfer systems to minimize water wastage and generation loss in the operation of the Basochhu hydropower plant.

**Dispute Settlement**

Any disputes arising from this arrangement shall be mutually settled between the Parties that are signatory to this MoU.

**Application and Term of the MoU**

The MoU shall come into force with effect from the date of signatures of the authorized representatives of the Dzongkhag Administration, Gasetsho-Gom and Gasetsho-Wom Gewog Administrations, and the Basochhu hydropower plant, DGPC. The MoU shall remain in force unless replaced through mutual consent of the Parties that are signatory to this MoU.

On behalf of Dzongkhag Administration, Wangdue

Name: Dasho Sonam Jamtsho  
Position: Dzongdag

Signature:  
Date:

*[Handwritten Signature]*  
12/09/2019

Dzongdag  
Dzongkhag Administration  
Wangdue Phedrang

*[Handwritten Signatures]*




དབལ་ཕྱན་འབྲུག་གཞུང་།  
 རྒྱལ་ཁབ་བདག་སྐྱོང་དབང་འདུས་པོ་བླང་།  
 ROYAL GOVERNMENT OF BHUTAN  
 DZONGKHAG ADMINISTRATION  
 Wangduephodrang: BHUTAN




On behalf of Gewog Administration, Gasetsho-Gom & Gasetsho-Wom

Name: Mr. Kinley Gyeltshen  
Position: Gup, Gasetsho-Gom

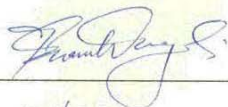
Name: Mr. Kinzang Thinley  
Position: Gup, Gasetsho-Wom

Signature:   
Date: 20/10/2019

Signature:   
Date: 12/9/19

On behalf of Basochu Hydropower Plant, Druk Green Power Corporation Limited

Name: Mr. Sonam Wangdi  
Position: Superintendent Engineer, Basochu Hydropower Plant

Signature:   
Date: 12/9/19


**Superintending Engineer**  
 Druk Green Power Corporation Limited  
 Basochu Hydropower Plant  
 Runichu, Wangdue





# Appendix 14: Issuance of Agreement by Druk Green Power Corporation Limited on Additional Water Withdrawal by Subproject from Hetshotsangchhu River.

འབྲུག་རྒྱུ་ལས་ལྷན་ཁག་ལུ་འབྲུག་གི་ལྷན་ཁག་གི་ལས་ལུ་  
Druk Green Power Corporation Limited  
(a DGI company)



འབྲུག་རྒྱུ་ལས་ལྷན་ཁག་གི་ལས་ལུ་  
DrukGreen

---

06/DGPC/BHP/MD/2022/ June 15, 2022

Dasho Dzongdag  
Dzongkhag Administration  
Wangduephodrang

**Subject: Issuance of Clearance for Additional Water from Source**


Dasho,

This has reference to Dasho's letter No. DAW/DES-21/2021-2022/13025 dated 3<sup>rd</sup> June 2022 requesting for clearance of an additional 108 lps of water (in addition to the already agreed to 500 lps) to be drawn from the Hesotshamchhu [the water source for the Basochhu Hydropower Plant (BHP)] for the proposed Integrated Water Project for Gasetsho-Gom and Gasetsho-Wom gewogs.

Recognizing the need and priority right to water for irrigation for the residents of Gasetsho-Gom and Gasetsho-Wom gewogs, DGPC had already entered into a Memorandum of Understanding (MOU) with the relevant stakeholders on 9<sup>th</sup> September 2019 for the 500 lps of water. **Further to this MOU, it is to inform the Dzongkhag Administration that DGPC hereby accords the clearance for the additional 108 lps of water to be drawn from the Hesotshamchhu for the Integrated Water Project**

However, while giving this clearance, DGPC would like to highlight the provision in the earlier MOU for putting in place a Water Sharing Committee with representatives from the Dzongkhag, the Gasetsho-Gom and Gasetsho-Wom Gewogs and BHP to ensure the optimal usage of water throughout the year as any spillage/wastage by the down the line end-users would have significant impact on the generation and revenues accruing to BHP. We would be grateful if this Committee could be formally put in place with a proper Terms of Reference at the earliest. In this regard, DGPC will be represented by the Head of Plant, BHP.

Yours sincerely,



(Chho Wang Rinzin)  
**Managing Director**

Copy to:

1. Head of the Plant, Basochhu Hydropower Plant, Wangduephodrang for necessary action.

---

OFFICE OF MANAGING DIRECTOR  
CORPORATE OFFICE: Post Box 1351, Thimphu, Bhutan. PABX +975-2-336413/4 Fax # +975-2-336342 Web: [www.drukgreen.bt](http://www.drukgreen.bt)

# Appendix 15: New Forestry Clearance.



དཔལ་ལྷན་འབྲུག་གཞུང་། ལྷན་ཁྲུག་པ་དང་རང་བཞིན་ལོ་ན་སྐྱོད་ལྷན་ཁྲུག་། ལྷན་ཁྲུག་ཚལ་དང་རྒྱུ་རྒྱུ་ལྷན་ཁྲུག་། ལྷན་ཁྲུག་ཚལ་དང་རྒྱུ་རྒྱུ་ལྷན་ཁྲུག་།



Royal Government of Bhutan  
 Ministry of Energy & Natural Resources  
 Department of Forests & Park Services

Application ID: 919151

13 August 2025

**FORESTRY CLEARANCE FOR IRRIGATION CHANNEL**

This forestry clearance is issued for **Irrigation Channel** measuring **21,000.00 m X 3.50 m** under **Thedtsho** Gewog, **Wangdue Phodrang** Dzongkhag for the following applicant:

Name	CID	Household Number	Thram Number	Village	Gewog	Dzongkhag
Dzongkhag Administration						

The proposed area contains:

Trees	
DBH (cm)	Volume
Castinopsis=108pcs	98.682 m3
OBL=66Pcs	78.851 m3
Q.Grifitnii=534Pcs	758.77 m3
Q.Lanata=66pcs	194.572 m3

**Specific Terms and Conditions**

- 1. Approved based on field and technical recommendations.

**General Terms and Conditions**

- 1. This clearance is limited to the forestry perspective as per the detailed field report.
- 2. This clearance is not transferable.
- 3. This clearance shall not be liable for any dispute arising during the implementation of activity.
- 4. Any damage caused to public/private property shall be borne by the holder of this clearance.
- 5. Any waste generated from the activity should be properly disposed of as per existing Waste Prevention & Management Regulations.
- 6. The SRF Land shall be release only after the proper handing taking note is signed by both entities.
- 7. The existing forest produce shall be disposed/removed only after physical demarcation of the land.
- 8. Only those trees/poles which are marked shall be removed.
- 9. Compensatory plantation shall be required as per Section 70 of the Act.
- 10. The legal status of the land for the transmission line/road/ridge/water pipeline/irrigation channel/cabne crane line shall remain unchanged and on any occassion, the land shall not be converted to private ownership.
- 11. This clearance shall not restrict easement
- 12. The clearance shall be revoked without any liability on the part of the Government, if the holder of this clearance violates any of the above terms and conditions.

- 13. The forestry clearance shall remain valid for a period of project or activity or the FC shall be revoked after one year if the proposed activity is not commenced from the date of issuance.
- 14. The applicant shall be responsible for any illegal activity within the vicinity of the proposed activity site.

Therefore, this clearance is **issued** based on the field inspection report submitted by: **[Dawa Gyeltshen (FR II)] [Penjor (Sr.FR III)] [Tshencho Tshering (Sr.FR I)] [Gyeltshen (FR II)] [Namgay Wangdi (Sr.FR III)] [Pema Thinley (FR II)]** dated **04 Aug 2025** on the aforementioned conditions.

# Appendix 16: Air & Noise Quality Monitoring Result & Wind Condition



**ENGEO Consultancy**  
 Laboratory Services for conducting Ambient Air, Noise,  
 Soil and Water Quality Monitoring

Upper Changbangdu, Thimthrom,  
 Thimphu, Bhutan  
 Contact #: 77741809  
 Whatsapp # 77741809  
 Email: [sengyelk@gmail.com](mailto:sengyelk@gmail.com)

## TEST REPORT

**Sample Location: Tonglobji Village (Biological Corridor)**

### Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

**Report Code:** ENGEO/2025/21 **Issued Date:** 18/08/2025  
**Issued To (Client Name):** Project Management Unit (PMU) for Water Flagship Program Support Project [L-4281/G-0874/G-9233] Contract No. CS-01, DOID, MOIT  
**Sampling Conducted by** : ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)  
**Sampling No. & Location** : Tonglobji Village\_Biological Corridor  
**Sampling Duration** : 16/08/2025 (10:45:00) To 17/08/2025 (10:45:00)  
**Sampling Instrument used** : AQM-09 (Oceanus) Real Time Sampler  
**Ambient Temperature** : 23.09 (° C)  
**Relative Humidity** : 75.90 (%)  
**Weather Condition** : Sunny  
**Altitude** : 1894 m

#### AIR QUALITY RESULTS

S.No	Parameters	Test Methods <sup>1</sup>	Results	Unit	ES2020, NEC <sup>2</sup>	WHO AQG 2021 <sup>3</sup>
1	Total Suspended Particulate Matter	Light scattering technique	8.24	µg/m <sup>3</sup>	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	7.42	µg/m <sup>3</sup>	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	5.83	µg/m <sup>3</sup>	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO <sub>2</sub>	Electrochemical sensor or UV photometry	56.53	µg/m <sup>3</sup>	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O <sub>3</sub>	UV photometry	7.27	µg /m <sup>3</sup>	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO <sub>2</sub>	UV fluorescence or electrochemical sensor	0.00	µg/m <sup>3</sup>	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.00	µg/m <sup>3</sup>	2000(8 hr mean)	4 (8 hr mean)

#### NOISE LEVEL MEASUREMENTS

S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 <sup>4</sup>
1	Sound Pressure Level (SPL)	SLM continuous recording	48.33	dB	65 (Day)	85 (8-hour exposure for occupational setting).
			46.14		55 (Night)	

<sup>1</sup> EQUIPMENT USED - The AQM-09 system integrates continuous, automatic real-time monitoring with light scattering techniques for particulate matter and electrochemical or optical methods for gaseous pollutants. It also features remote data transmission via 4G LTE/GPRS/, allowing real-time monitoring.

<sup>2</sup> ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

<sup>3</sup> WHO AQG 2021 – WHO Average Air Quality Guideline 2021 ([WHO global air quality guidelines: particulate matter \(PM2.5 and PM10\), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide](#))

<sup>4</sup> WHO 2018 - [WHO Environmental Noise Guidelines \(2018\)](#).

ENGEO Consultancy: Committed to a cleaner & brighter Bhutan

Note: At the request of the Environmental Specialist from PMSC, ENGEO Consultancy generously carried out air, noise, and surface water quality sampling on August 17–18, 2025, at no cost. This voluntary support reflects ENGEO's commitment to environmental stewardship and collaborative project development.

Their contribution provided valuable baseline data essential for assessing site conditions and informing mitigation strategies, strengthening the technical foundation of the project's environmental safeguards.



**ENGEO Consultancy**  
*Laboratory Services for conducting Ambient Air, Noise,  
Soil and Water Quality Monitoring*

*Upper Changbangdu, Thimthrom,  
Thimphu, Bhutan  
Contact #: 77711809  
Whatsapp # 77711809  
Email: [sengyelk@gmail.com](mailto:sengyelk@gmail.com)*

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**HOURLY WIND CONDITIONS**

Year	Month	Day	Hour	Wind speed (m/s)	Wind direction (°)
2025	8	16	11	4	174
2025	8	16	12	3.3	176
2025	8	16	13	3.2	178
2025	8	16	14	3.1	155
2025	8	16	15	2.6	163
2025	8	16	16	1.7	150
2025	8	16	17	1.9	170
2025	8	16	18	0.3	183
2025	8	16	19	0.2	133
2025	8	16	20	0.2	84
2025	8	16	21	0.4	138
2025	8	16	22	0.1	75
2025	8	16	23	0.1	209
2025	8	17	0	0.1	238
2025	8	17	1	0.1	201
2025	8	17	2	0.1	154
2025	8	17	3	0.2	209
2025	8	17	4	0.3	211
2025	8	17	5	0.3	252
2025	8	17	6	0.3	177
2025	8	17	7	0.6	179
2025	8	17	8	1.2	178
2025	8	17	9	0.7	161
2025	8	17	10	0.8	179
2025	8	17	11	2.5	175
2025	8	17	12	3.4	172

Test conducted and Reports  
Prepared by:

Singye Wangchuk

Field Inspection and Test  
Reports Verified by:

Karma Chogyel

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*ENGEO Consultancy: Committed to a cleaner & brighter Bhutan*

Figure 1: NO<sub>2</sub> Levels over 24 Hours Monitoring

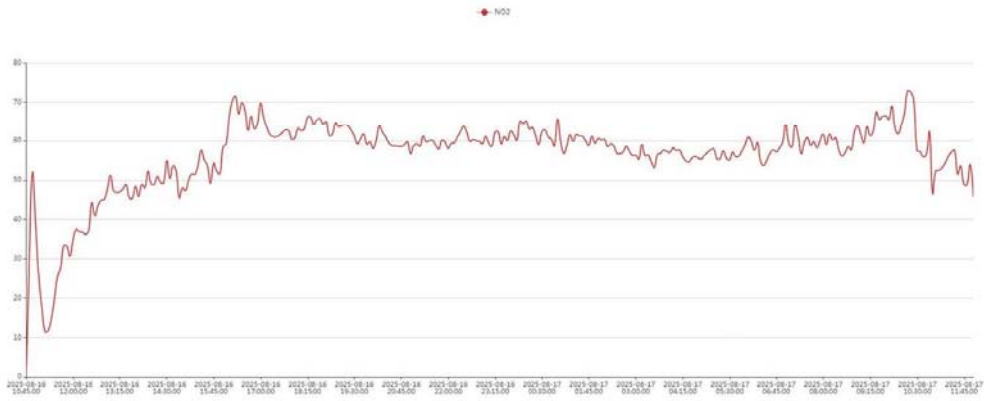


Figure 2: CO Levels over 24 Hours Monitoring

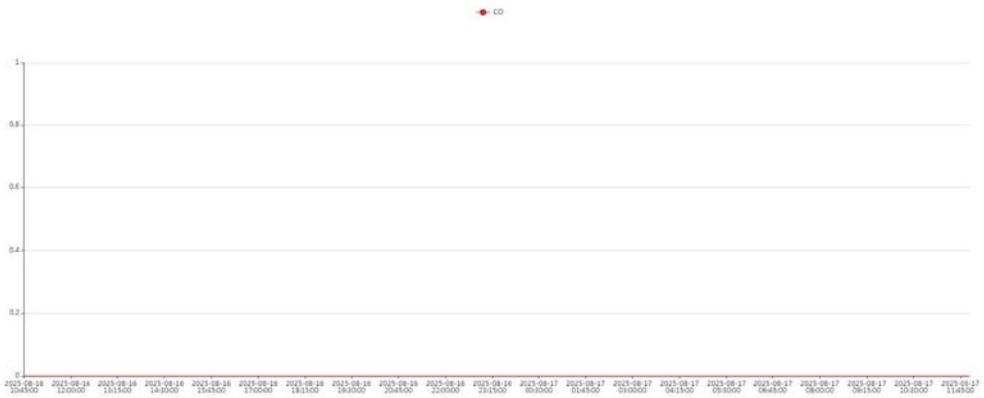


Figure 3: O<sub>3</sub> Levels over 24 Hours Monitoring

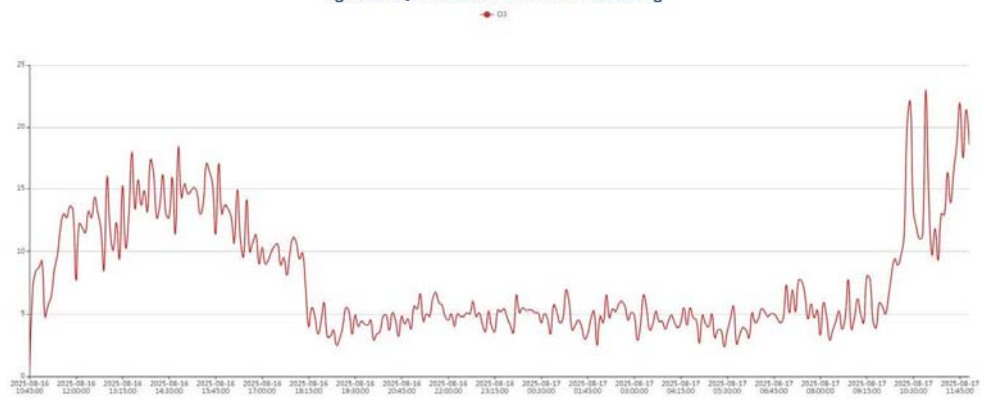


Figure 4: SO<sub>2</sub> Levels over 24 Hours Monitoring

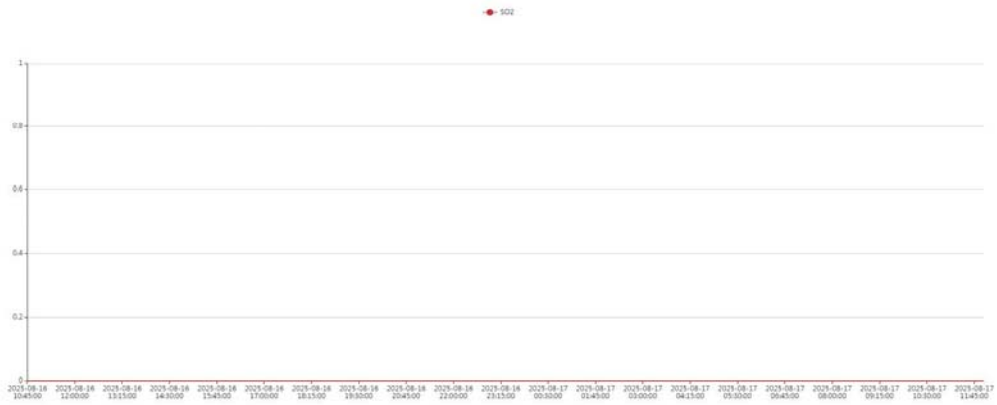


Figure 5: PM<sub>2.5</sub> Levels over 24 Hours Monitoring

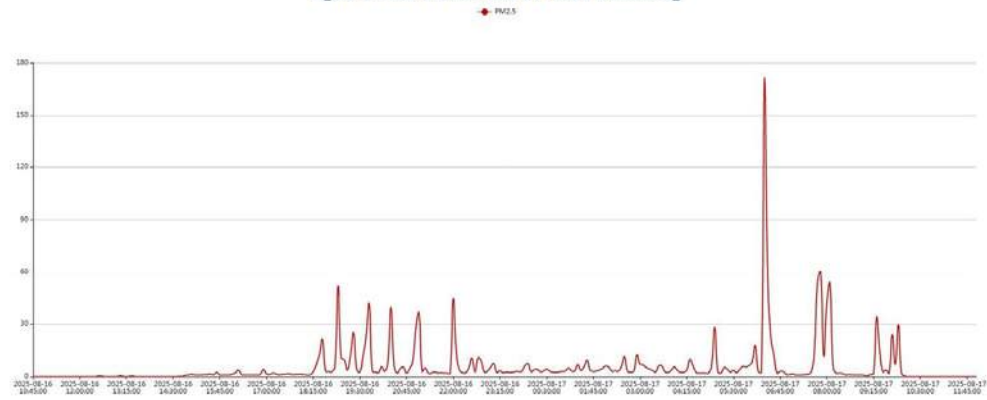


Figure 6: PM<sub>10</sub> Levels over 24 Hours Monitoring

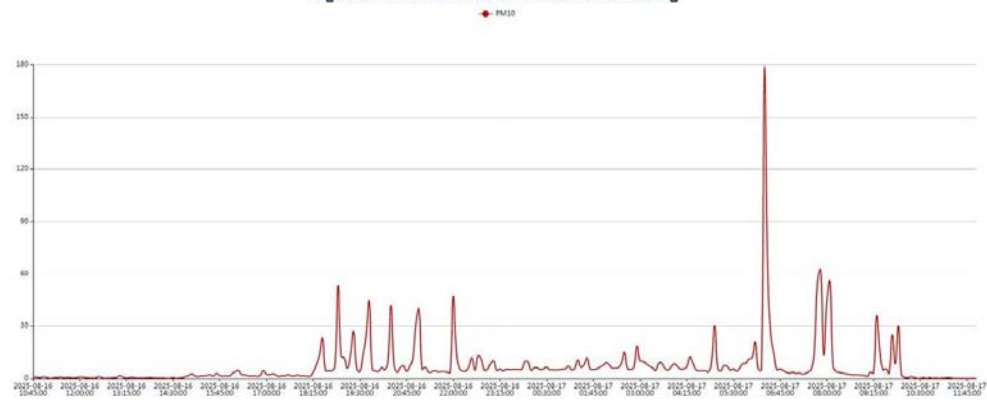


Figure 7: TSP Levels over 24 Hours Monitoring

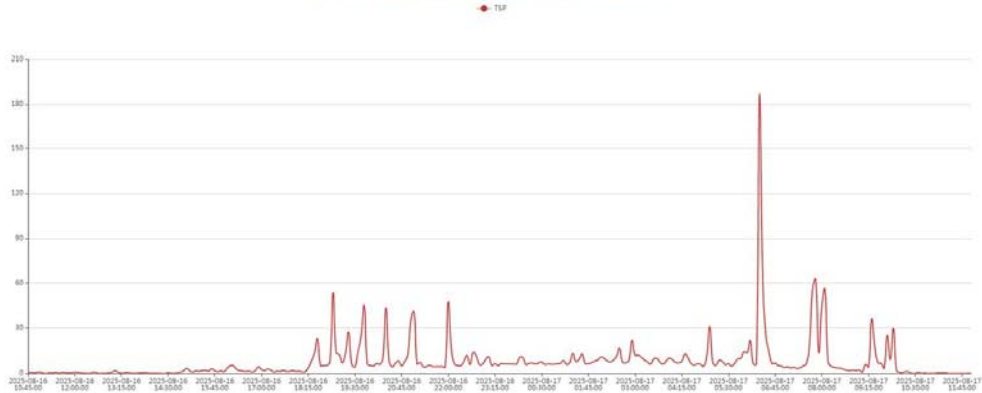


Figure 8: Wind Direction

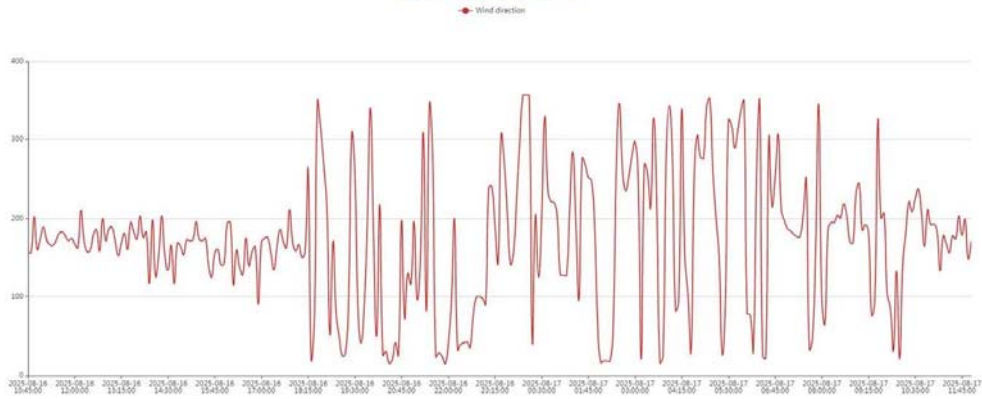
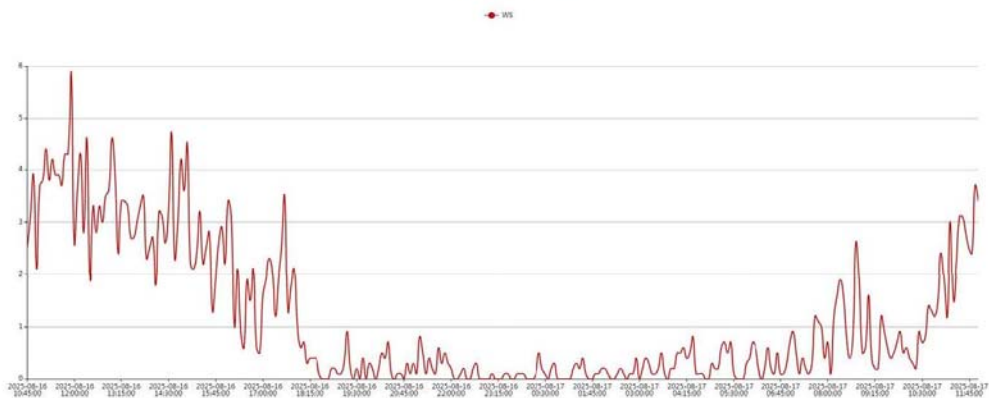


Figure 9: Wind Speed



# Appendix 16: Sample Memorandum of Understanding (MoU)

## MEMORANDUM OF UNDERSTANDING (MoU)

BETWEEN

THE PROJECT IMPLEMENTATION UNIT (PIU), WANGDUE PHODRANG DZONGKHAG  
ADMINISTRATION  
FOR THE HETSHOTSANGCHHU INTEGRATED WATER SUPPLY SCHEME

AND

THE HETSHOKHA MANAGEMENT GROUP (CFMG)

This Memorandum of Understanding (MoU) is entered into on this **[Date, e.g., 25th day of October, 2025]**.

### PARTIES:

1. The **Project Implementation Unit (PIU)**, Wangdue Phodrang Dzongkhag Administration, representing the Hetshotsangchhu Integrated Water Supply Scheme (hereinafter referred to as "the Project").
2. The **[Name of Community Forest] Management Group (CFMG)**, representing the community members of **[Name of Village/Gewog]** and the legal custodians of the **[Name of Community Forest]** (hereinafter referred to as "the CFMG").

### PREAMBLE:

**WHEREAS** the Project is a high-priority national initiative under the Water Flagship Program, financed by the Royal Government of Bhutan and the Asian Development Bank, to provide reliable drinking and irrigation water to the communities of Gasetsho Gom and Gasetsho Wom Gewogs;

**WHEREAS** the final detailed engineering design of the project's main water transmission pipeline requires it to traverse a portion of the **[Name of Community Forest]**, which is under the management of the CFMG;

**WHEREAS** the CFMG, through consultations and the issuance of a No Objection Certificate dated June 2022, provided its in-principle consent for the Project to proceed based on the understanding that community benefits would be maximized and environmental impacts would be mitigated;

**NOW, THEREFORE**, this MoU is established to formalize the agreement and detail the specific roles, responsibilities, mitigation measures, and compensation mechanisms based on the final project design, ensuring a collaborative and mutually beneficial partnership during the construction phase.

## **ARTICLE 1: SCOPE OF PROJECT WORKS WITHIN THE COMMUNITY FOREST**

1.1. The CFMG hereby grants the Project the right of access to construct the water transmission pipeline through the **[Name of Community Forest]** along the alignment officially demarcated by the Project and the Department of Forest and Park Services (DoFPS).

1.2. The total length of the pipeline alignment within the **[Name of Community Forest]** is approximately **[Length of alignment in CF, e.g., 1.459]** kilometers.

1.3. The construction activities will be strictly confined to a **Right-of-Way (RoW) of 3.5 meters** in width.

1.4. It is understood that this work will require the felling of approximately **[Number of trees to be felled in this specific CF]** trees that fall within the demarcated RoW.

## **ARTICLE 2: RIGHTS AND RESPONSIBILITIES OF THE CFMG**

2.1. **Grant of Access:** To provide the Project and its appointed Contractor access to the demarcated RoW for all necessary construction activities.

2.2. **Right to Felled Timber:** To take full ownership and possession of all timber and firewood from the trees felled within the boundaries of their Community Forest, as per the protocol in Article 4.1.

2.3. **Monitoring Role:** To appoint representatives to participate in the joint marking of trees for felling with DoFPS and the Project, and to monitor the Contractor's activities to ensure compliance with the terms of this MoU.

2.4. **Reporting:** To promptly report any non-compliance, environmental damage, or safety issues caused by the Contractor to the PIU's on-site supervisor and the Grievance Redress Mechanism.

## **ARTICLE 3: RESPONSIBILITIES OF THE PROJECT (PIU)**

3.1. **Contractor Compliance:** To ensure that the appointed Contractor is contractually bound by all terms of this MoU and fully complies with the mitigation measures outlined in Article 4.

3.2. **Timber Handover:** To facilitate and oversee the formal handover of all felled timber and firewood to the CFMG, ensuring the process is transparent and documented.

3.3. **Information and Consultation:** To maintain open communication with the CFMG, providing advance notification of construction schedules and addressing any concerns in a timely manner.

3.4. **Grievance Redress:** To ensure the Project's Grievance Redress Mechanism (GRM) is accessible to all CFMG members.

3.5. **Compensatory Afforestation:** To provide the full budget to DoFPS for the implementation of the Compensatory Afforestation Program to ensure no net loss of forest cover, as required by law.

## **ARTICLE 4: MANDATORY MITIGATION MEASURES & CONTRACTOR OBLIGATIONS**

The PIU shall enforce the following mandatory obligations upon its Contractor for all works within the **[Name of Community Forest]**:

### **4.1. Timber Handover Protocol:**

- a) Only trees officially marked by DoFPS in the presence of CFMG representatives shall be felled.
- b) All felled trees shall be de-limbed and stacked at locations mutually agreed upon with the CFMG, ensuring they are easily accessible for collection by the community.
- c) A formal handover document, quantifying the timber by volume or count, shall be signed by the Contractor, PIU, and the CFMG representative upon completion of felling in a given section.

#### **4.2. Spoil and Muck Management:**

- a) The indiscriminate dumping or side-casting of excavated soil, rock, and other debris is **strictly prohibited**.
- b) All surplus excavated material shall be collected and transported to a pre-approved and engineered disposal site located **outside** the Community Forest boundaries.

#### **4.3. Prohibited Activities:**

- a) The establishment of worker camps, equipment yards, material storage depots, or any other temporary facilities within the Community Forest is **strictly forbidden**.
- b) Contractor personnel are prohibited from engaging in hunting, poaching, fishing, or unauthorized collection of any forest products.

#### **4.4. Site Restoration:**

- a) Upon completion of pipeline installation, the Contractor shall clear the RoW of all construction debris and waste.
- b) The RoW shall be re-contoured to match the surrounding landform and stabilized using bioengineering measures to prevent erosion and facilitate natural regeneration.

### **ARTICLE 5: TERM AND VALIDITY**

5.1. This MoU shall come into effect upon the date of its signing by both parties and shall remain valid until all construction, site restoration, and handover activities described herein are certified as complete by the PIU.

### **ARTICLE 6: DISPUTE RESOLUTION**

6.1. Any disputes arising from the interpretation or implementation of this MoU shall first be addressed amicably through direct discussion between the PIU and the CFMG.

6.2. If a resolution cannot be reached, the matter will be formally channelled through the Project's established three-tiered Grievance Redress Mechanism (GRM).

**IN WITNESS WHEREOF**, the undersigned, being duly authorized representatives of their respective organizations, have signed this Memorandum of Understanding.

**For the Project Implementation Unit (PIU):**

**[Name of PIU Focal]**

Project Manager, PIU  
Hetshotsangchhu Integrated Water Supply Scheme  
Wangdue Phodrang Dzongkhag Administration

**Witness:**

Name:

Title:

**For the [Name of Community Forest] Management Group (CFMG):**

**[Name of CFMG Chairperson]**

Chairperson, CFMG

# Appendix 17: Guidance Note on the Preparation of the Contractor's Environmental and Social Management Plan (C-ESMP)

## 1.0 INTRODUCTION AND PURPOSE

This Guidance Note is provided to assist the appointed Civil Works Contractor in preparing the **Contractor's Environmental and Social Management Plan (C-ESMP)** for the Hetshotsangchu Integrated Water Supply Scheme.

The project's Initial Environmental Examination (IEE) and its associated Environmental Management Plan (EMP) are the primary safeguard documents. The C-ESMP is the Contractor's own detailed, site-specific plan that describes how they will implement the mandatory mitigation and monitoring measures outlined in the project's EMP.

The submission of a satisfactory C-ESMP, to be reviewed and approved by the Project Implementation Unit (PIU), is a mandatory prerequisite before any construction activities can commence. A copy of the approved C-ESMP must be maintained on-site at all times.

## 2.0 STRUCTURE AND CONTENT OF THE C-ESMP

The C-ESMP must be a comprehensive document containing both overarching management plans and specific sub-plans as detailed below.

### PART A: GENERAL MANAGEMENT PLANS

#### 1. Contractor's EHS Policy and Organization

- A signed Environmental, Health, and Safety (EHS) policy statement for the project.
- An organizational chart detailing the EHS management structure, including the names and contact details of the EHS Officer and the Biodiversity Supervisor/Forestry Expert.

#### 2. Roles and Responsibilities

- A clear description of the EHS roles and responsibilities for all key personnel, from the Project Manager to site supervisors and workers.

#### 3. Training Plan

- A schedule and outline for the mandatory EHS induction training for all staff and the weekly "toolbox talks."

### PART B: SPECIFIC MANAGEMENT SUB-PLANS

The C-ESMP must include the following detailed, site-specific sub-plans. Each sub-plan must include specific methodologies, site layouts/maps, schedules, and resource allocations.

#### 1. Camp, Storage, and Ancillary Facilities Management Plan

- **Site Layout Plan:** A map showing the approved locations and layout of the worker accommodation camp, offices, material storage yards, and equipment maintenance areas.

- **Accommodation and Welfare:** Details on worker housing, water supply (potable and non-potable), sanitation (septic tanks), and cooking facilities, ensuring compliance with IFC standards on workers' accommodation.
- **Waste Management:** Procedures for the segregated collection, storage, and disposal of solid waste and wastewater. Include copies of agreements with approved disposal sites.

## 2. Spoil, Muck, and Construction Waste Management Plan

- **Spoil Disposal Sites:** A map identifying the approved locations for all spoil and muck disposal sites.
- **Haulage Plan:** A description of the routes and methods for transporting spoil from the excavation sites to the disposal sites (end-hauling).
- **Disposal Site Management:** A plan for the management of the disposal sites, including measures for slope stabilization, compaction, drainage control, and final revegetation.

## 3. Erosion and Sediment Control Plan (ESCP)

- **Site-Specific Measures:** Drawings and descriptions of the specific erosion control measures to be used (e.g., silt fences, check dams, diversion drains).
- **Implementation Schedule:** A plan showing the phased implementation of erosion controls, ensuring they are installed *before* major earthworks begin in any area.
- **Stockpile Management:** Procedures for locating and managing soil stockpiles to prevent erosion.

## 4. Air Quality and Dust Management Plan

- **Dust Suppression Schedule:** A schedule for water sprinkling on unpaved roads and active work areas.
- **Vehicle and Equipment Management:** Procedures for enforcing speed limits, ensuring trucks are covered, and mandating the cleaning of vehicle wheels at designated washing stations before entering public roads.

## 5. Noise and Vibration Management Plan

- **Work Scheduling:** Confirmation of restricted working hours (daytime only for noisy activities).
- **Sensitive Receptor Management:** Specific procedures for working near the Hetsokha Lhakhang, including the protocol for community consultation and the planned use of **manual labour methods** within the buffer zone.
- **Blasting Plan (if applicable):** A detailed plan for any required controlled blasting, including procedures for community notification, safety protocols, and vibration control.

## 6. Community Health and Safety Plan

- **Traffic Management Plan:** A detailed plan showing traffic management around worksites, including the placement of flagpersons, signage, and enforcement of speed limits.
- **Community Access Management Plan:** A plan detailing how temporary disruptions to local footpaths will be managed, including procedures for community notification and the provision of safe alternative routes and crossing points.

- **Worker Code of Conduct:** A signed copy of the project's Worker Code of Conduct, which will be a mandatory part of all employment contracts.

## 7. Occupational Health and Safety (OHS) Plan

- **HIRA and Procedures:** The site-specific Hazard Identification and Risk Assessment (HIRA) and associated safe work procedures.
- **Emergency Preparedness and Response Plan (EPRP):** Detailed procedures for responding to medical emergencies, fires, and environmental spills. Include a list of emergency contact numbers and the location of first-aid stations.
- **Accident Reporting Protocol:** A clear procedure for the immediate reporting, investigation, and documentation of all accidents and near-misses, and the development of corrective and preventive actions.
- **Insurance:** A copy of the **valid workmen's compensation insurance certificate** covering all project personnel.

## 8. Biodiversity Management Plan

- **Protocols for Sensitive Areas:** Detailed procedures for implementing the "Special Environmental Protocols" for all works within the Biological Corridor.
- **Pre-Felling Survey Protocol:** A specific plan and schedule for conducting the pre-felling fauna surveys to identify and protect active nests or dens.

## Appendix 18: New Environmental Clearance



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**DEPARTMENT OF AGRICULTURE**  
Ministry of Agriculture and Livestock  
Royal Government of Bhutan  
Tashichhodzong, Thimphu: Bhutan



DoA/PD/PSP-04/2025-26/ 4 37

24 Oct 2025

**Subject: Environmental Clearance for Hetsho Tsamchu Integrated Irrigation, Gasetshogom and Gasetshowom Gewogs, Wangdue Phodrang.**

Exercising the powers granted under Article 33.1 of the EA Act, the Department of Agriculture (DoA), Ministry of Agriculture & Livestock hereby issues Environmental Clearance (EC) for the construction/renovation of **Hetsho Tsamchu Integrated Irrigation, Gasetshogom and Gasetshowom Gewogs, Wangdue Phodrang Dzongkhag** with the following terms and conditions:

1. The channel construction must be in line with the National Irrigation Policy;
2. The original alignment should be followed and no deviations must be made without prior DoA approval;
3. The gross abstraction of water from the source should not exceed 608 litres per second;
4. Wherever the soil structure is weak the channel must be lined with cement or HDPE pipe to prevent soil erosion and that the channel bed-slope must not exceed 1:100;
5. To avoid landslides and instability the channel alignment must conform to the technical survey report;
6. Structures like Drop/cascade, retaining walls and aqueducts must be constructed as per the plan/design specifications;
7. Waste materials (timber, soil, stones etc.) must be disposed off in designated areas and as per the Forest & Nature Conservation Act, 1995;
8. Occupational Health and Safety measures must be strictly maintained at all times and
9. Any disputes arising due to the construction of the channel shall be the responsibility of the project proponent.

Non-compliance of any of the above conditions shall constitute an offence under the EA Act 2000. This shall result in annulment of the EC without any liability on the part of the DoA. This EC is valid for a period of 12 months from the date of issue. In case of non-completion of the activity within the given period, the EC must be renewed one month prior to the date of its expiry.

***This EC is issued based on the field inspection reports/documents and Forestry Clearance ID 919151 submitted by the Dzongkhag administration.***

Yonten Gyamtsho  
**Director.**

Department of Agriculture PABX: 322228, 331316; Fax No. 323562; Director: 322805; Chief Agriculture Officer: 321291; Chief Engineer: 329122; Chief Horticulture Officer: 336946; Horticulture Division PABX: 323183,323184 Fax No: 325837