

Environmental and Social Impact Assessment

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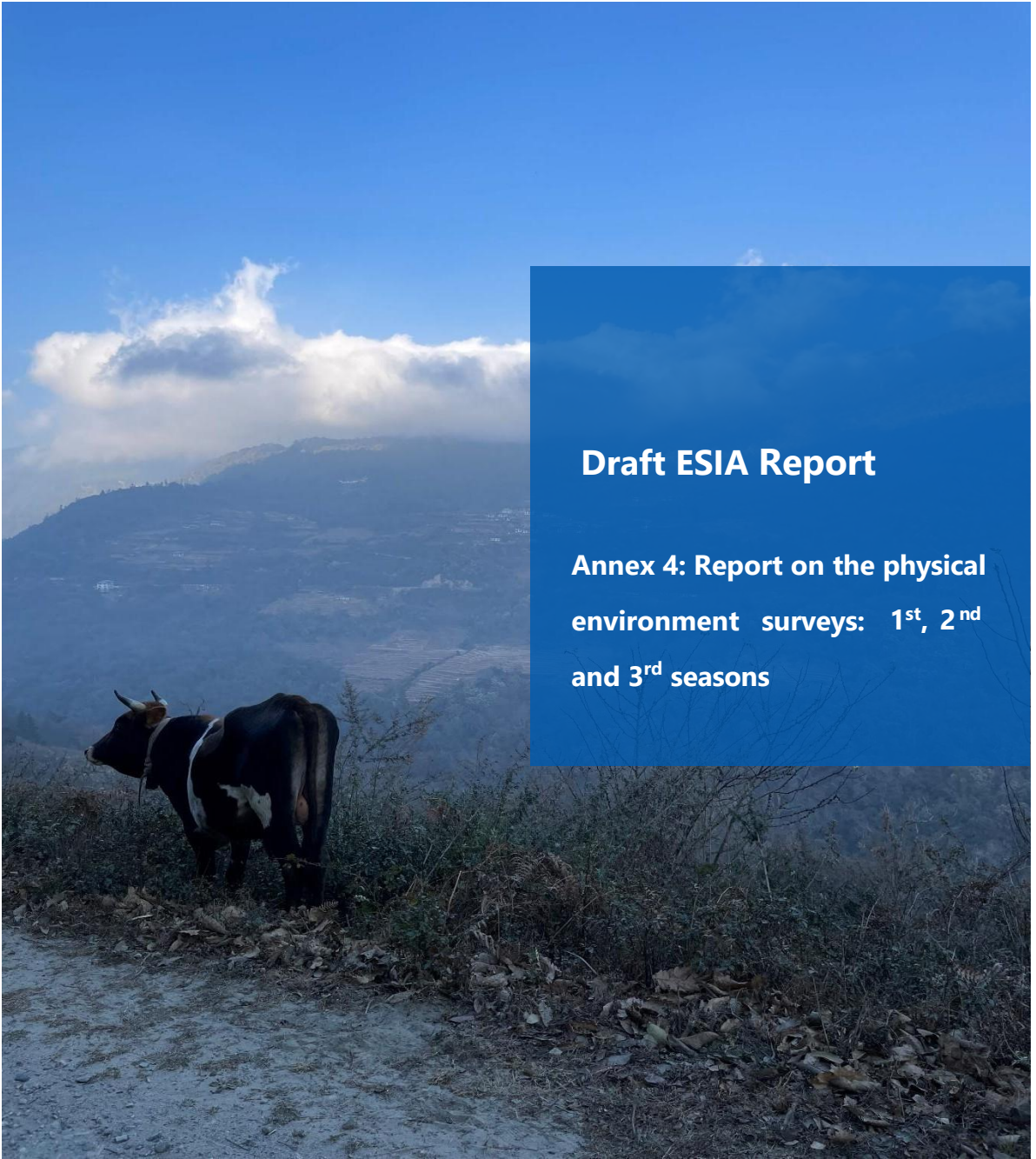
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Bhutan: Bunakha Green Power Development Project

Annex 4 Report on the Physical Environment Survey

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Draft ESIA Report

**Annex 4: Report on the physical
environment surveys: 1st, 2nd
and 3rd seasons**

Druk Green Power Corporation Ltd.

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List of Abbreviations

ADB	Asian Development Bank
ANSP	Air and Noise Sampling Points
APHA	American Public Health Association
CCME	Canadian Council of Ministers of the Environment
DECC	Department of Environment and Climate Change
EEA	European Environment Agency
EMEP	European Monitoring and Evaluation Programme
JV	Joint Venture
NEC	National Environment Commission
PCS	Phuensum Consultancy Services
THDC	Tehri Hydro Development Corporation Limited
WAPCOS	Water and Power Consultancy Services
WHO	World Health Organization
AoI	Area of Influence
BAT	Best Available Techniques
DPR	Detailed Project Report
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
GIIP	Good International Industry Practice
HEP	Hydropower Project
HSE	Health, Safety, and Environment
PRF	Project Readiness Financing
TOR	Terms of Reference
ANSP	Air and Noise Sampling Point
AQM	Ambient Air Quality Monitoring
BDL	Below Detection Limit
SSP	Soil Sampling Point
SW	Surface Water (Sampling Point)
AQG	Air Quality Guidelines
BOD	Biological Oxygen Demand
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen

Leq	Equivalent Continuous Noise Level
NO ₂	Nitrogen Dioxide
NO _x	Oxides of Nitrogen
O ₃	Ozone
PAH	Polynuclear Hydrocarbons
PCBs	Polychlorinated Biphenyls
PM _{2.5}	Particulate Matter (2.5 micrometers or less)
PM ₁₀	Particulate Matter (10 micrometers or less)
PPE	Personal Protective Equipment
RCC	Roller Compacted Concrete
SO ₂	Sulphur Dioxide
TPH	Total Petroleum Hydrocarbons
TSP	Total Suspended Particulate
TSS	Total Suspended Solids
TWA	Time-Weighted Average

1 Introduction

The ESIA formally stipulate a multi-season data collection program. Specifically, the TOR require four-season surveys for water quality (dry, pre-monsoon, wet/monsoon, and post-monsoon) and biodiversity. For other physical parameters such as air quality, noise, and soil quality, the TOR and standard practice call for surveys during the two most distinct seasons: dry and wet.

Accordingly, this Baseline Survey Report documents:

- **ambient air quality, noise, and soil quality** conditions observed during the dry season (April 2025) and the wet/monsoon season (July 2025).
- **water quality** conditions from three seasons: dry (April 2025), wet/monsoon (July 2025), and post-monsoon (Nov 2025).

The fourth season monitoring (winter) was deferred to ensure the ESIA reporting meets the critical 120-day disclosure deadline required by ADB. From a technical perspective, this omission is low-risk, as winter water quality parameters typically show little deviation from dry season conditions¹. Consequently, the pending water quality winter survey shall be undertaken by the contractor prior to construction, while the current comprehensive dataset serves as a valid basis for the ESMP and impact assessment.

¹ Bhutan's climate is characterized by a dry winter, meaning winter conditions closely resemble the typical "dry season."

2 Scope of the Physical Baseline Assessment

This report provides a baseline characterization and a comparative seasonal analysis across the following environmental and social components:

- **Physical Environment:** A detailed assessment of ambient air quality, background noise levels, surface and spring water quality, and soil quality.
- **Traffic and Emissions:** A baseline of vehicular traffic volume and composition, including an estimation of associated air emissions.
- **Sensitive Receptors:** The identification and mapping of key human settlements, cultural and religious heritage sites, and other sensitive receptors within the Project Area of Influence (Aol).

2.1 Geographical Scope - Project Area of Influence (Aol)

The geographical scope of this baseline study is defined by the Project Area of Influence (Aol). As shown on the map (Figure 1), the Aol is composed of a direct Aol and an indirect Aol, each delineated into smaller zones. The direct Aol for the Bunakha HPP is delineated by applying a 5-kilometer buffer around the Project's main components, and the indirect Aol by applying a 10-kilometer buffer. This results in an extensive study area centered on the river valley, spanning multiple administrative Gewog boundaries.

The direct Aol encompasses:

- **Direct Impact Zone (DIZ):** consists of the direct project footprint. The DIZ is delineated by applying a 500-meter buffer around the footprints of several high-impact project components, including the dam, quarry, batching plants, worker camps, and other key ancillary facilities. The DIZ therefore represents the area where the most intense and direct physical impacts are anticipated.
- **Social Area of Influence:** Encompasses communities affected by land acquisition, resettlement, livelihood changes, and cultural impacts. Includes both physically displaced and economically affected persons
- **Upstream and Downstream River Systems:** to assure consideration of hydrological changes (e.g., flow regime, sediment transport, fish migration) that may occur up and downstream of the dam
- **Environmental Area of Influence:** included in all three above.

The indirect Aol encompasses:

- The direct Aol
- The remaining buffer area: Metap, Shapa, Mewang, Genye, and Bongo Gewogs

This buffered approach encompasses key geographical features and communities:

- **Gewogs:** The Aol covers parts of several Gewogs, including Chapcha, Bongo, and Geling in the south, and extends north to include parts of Doga and Shapa.
- **Upstream communities:** The 5 km buffer extends far upstream to include settlements such as Chapcha and Dawakha.
- **Downstream communities:** The Aol includes the key downstream settlements of Tsimasham and Tsimalakha.

- Communities within the DIZ: The core project area and its 500m buffer are located near the communities of Chanachen, Bunakha, and Nayakha.

The delineation of the Aol and DIZ based on these specified buffer distances ensures that all potentially affected communities and sensitive environmental receptors are systematically captured in the baseline assessment. All monitoring and survey locations discussed in this report are situated within these defined zones. Specifically, monitoring was focused on a network of strategically selected sampling locations representing key Project components, sensitive receptors, and upstream/downstream conditions. This includes:

- Ten (10) wind, air and noise sampling points (Air & Noise Sampling Point (ANSP)-1 to ANSP-10)
- Ten (10) water quality sampling points (Surface Water (SW) Sampling Point SW-1 to SW-10)
- Eight (8) soil quality sampling points (SSP-1 to SSP-8)
- Traffic counting at Bunakha Junction.

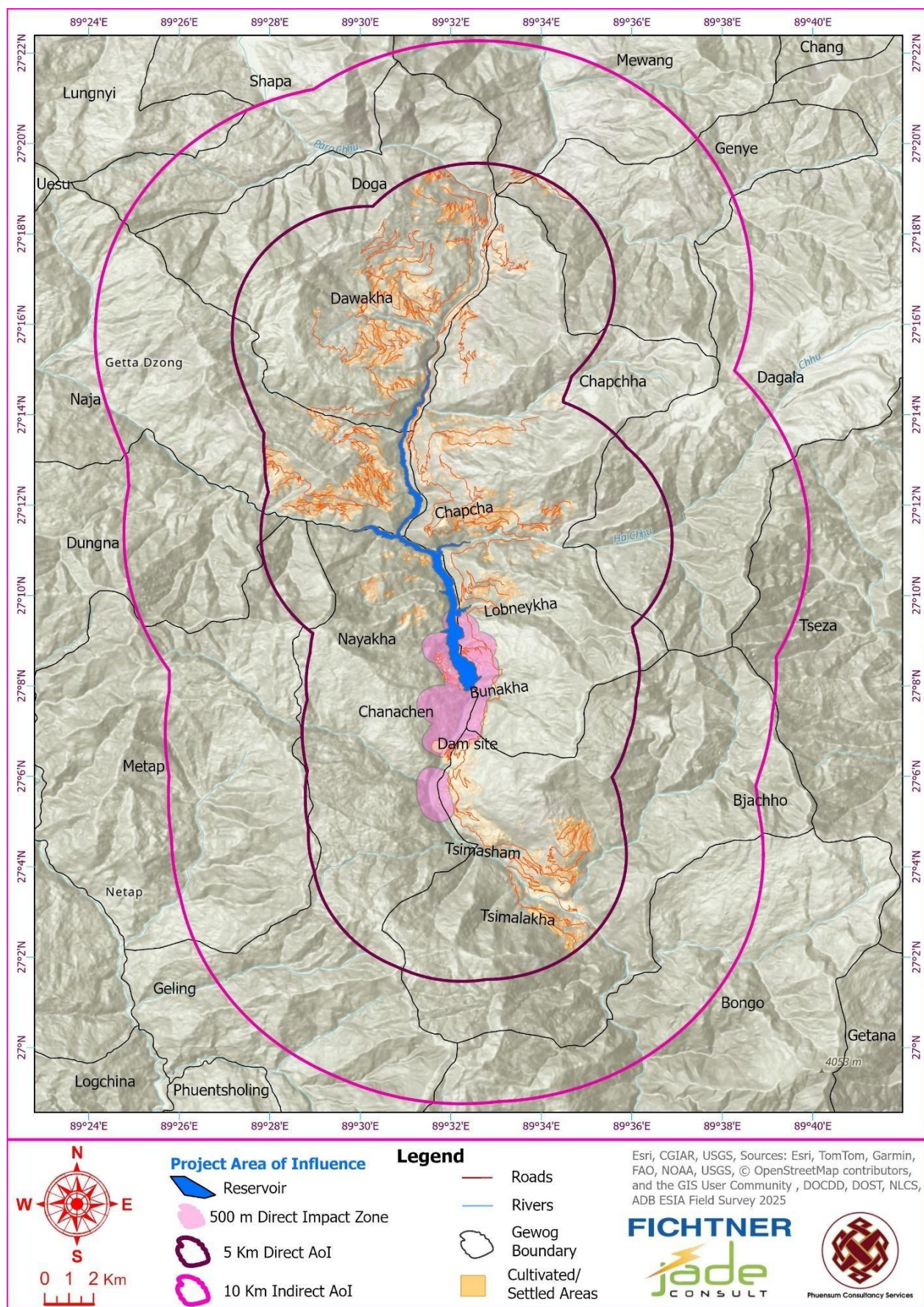


Figure 1: The Bunakha HPP's Area of Influence (AoI)

2.2 Temporal Scope

Physical environment data was collected during three seasons to capture environmental conditions at their extremes. The specific data collection periods for each environmental component are as follows:

- **Wind, Air Quality and Noise:**
 - Dry Season: April 14-23, 2025
 - Wet/Monsoon Season: July 21-28, 2025
- **Water Quality:** The TOR for the Consultancy stipulates a comprehensive four-season monitoring program. To adhere to the project's critical timeline and the ultimate 120-day disclosure requirement, this report presents findings from three of the four required surveys, covering the following periods:
 - Dry Season: April 14-23, 2025
 - Wet (Monsoon) Season: July 21-28, 2025
 - Post-Monsoon Season: November 24-27, 2025

The fourth (Winter) season monitoring was deferred, as waiting for these results would significantly delay the ESIA reporting and the mandatory disclosure period. Technically, this deferral poses minimal risk, as water quality characteristics during the winter season do not differ significantly from the dry season conditions already captured. Consequently, the current dataset is considered robust for baseline assessment. The final winter season survey will be conducted by the contractor prior to the commencement of construction works to complete the full annual baseline as required by the TOR.

- **Soil Quality:** The baseline soil sampling was conducted progressively across two survey periods. The TOR does not specify a mandatory multi-season sampling requirement for soil; the objective was to establish a definitive pre-construction baseline at all finalized Project locations. The sampling was executed as follows:
 - Dry Season (April 14-23, 2025): An initial survey was conducted at four preliminary locations (Soil Sampling Point (SSP); SSP-1 to SSP-4).
 - Wet (Monsoon) Season (July 21-28, 2025): Following the finalization of Project component layouts, the sampling plan was expanded. Four new additional locations (SSP-5 to SSP-8) were sampled to establish a critical baseline at the finalized footprints of the main workshop, labour camp, and batching plant areas.
- **Traffic Count Survey:** To account for potential seasonal variations in traffic volume and composition, surveys were conducted during both seasons on Asian Highway 48 (AH48) at Bunakha Junction:
 - Dry Season: April 23, 2025
 - Wet (Monsoon) Season: July 24-26, 2025

3 Methodology

3.1 Monitoring and Sampling Locations

A network of monitoring locations was strategically established across the Aol to assess the baseline conditions for air, noise, water, and soil. The selection of these sites was based on their proximity to proposed Project components (dam, batching plants, workshops, camps), their representation of sensitive environmental and social receptors (villages, temples, heritage sites), and their ability to capture upstream and downstream conditions.

Detailed descriptions, coordinates, and the specific rationale for each monitoring location are presented in their respective sections later in this report.

Wind, Air, and Noise Quality

Ten monitoring stations (ANSP-1 to ANSP-10) were established to measure local wind conditions (speed and direction), ambient air quality, and background noise levels (Figure 2). These locations include sensitive receptors like the Bunakha Lhakhang (ANSP-4) and the villages of Nayakha (ANSP-9) and Chanachen (ANSP-10), as well as sites for proposed project infrastructure such as the damsite (ANSP-3) and the consolidated batching plants (ANSP-10).

Water Quality

A network of ten water quality sampling points (SW-1 to SW-10) was established to characterize the Project area's hydrological systems (Figure 3). To ensure clarity in impact assessment, these stations are strictly divided into two functional categories: Rivers/Tributaries (assessed against Class B River standards) and Community Drinking Water Sources (assessed against stricter National Drinking Water standards).

The monitoring plan was implemented progressively:

- Dry Season (Phase 1): Eight locations (SW-1 to SW-8) were sampled during the first season. These sites were selected to monitor the main Wangchhu River upstream (SW-1) and downstream (SW-2) of the proposed dam, key tributaries including Jhililumchhu (SW-3, SW-4), Motolumchhu (SW-6), and Zanteylum chhu (SW-8), as well as two previously identified community drinking water sources (SW-5 and SW-7).
- Wet/Monsoon Season and Post Monsoon (Phase 2 & 3): Following the finalization of Project component locations near Chanachen, the network was expanded to ensure comprehensive coverage of all critical community water sources. Two new sites were added:
 - Nayakha Chhu (SW-9): A key stream directly utilized by Nayakha village as a drinking water source.
 - Chanachen Village Spring Water (SW-10): A primary drinking water source for the highly sensitive Chanachen community.

Summary of Sampling Purposes:

- Rivers and Tributaries (6 sites): Sampled via SW-1, SW-2, SW-3, SW-4, SW-6, and SW-8.
- Community Drinking Water Sources (4 sites): Sampled via SW-5, SW-7, SW-9, and SW-10.

Soil Quality

Eight soil sampling points (SSP-1 to SSP-8) were identified to assess the pre-construction soil quality (Figure 4). The sampling was conducted progressively across two non-overlapping phases to adapt to major layout optimizations during design:

- Initial Campaign (Dry Season / April 2025): Locations SSP-1 to SSP-4 were sampled exclusively during this period. At the time of this initial survey, the proposed concrete batching plants and other major infrastructure were planned for the left bank of the Wangchhu River (Bunakha side). These samples established the baseline for that original footprint. Because soil chemistry does not fluctuate seasonally in the same manner as water or air, these sites were *not* re-sampled during the wet season.
- Revised Footprint Campaign (Wet Season / July 2025): As the design progressed, the layout was optimized, shifting high-impact facilities like the concrete batching plants and aggregate crusher plants to the right bank of the river (Chanachen side). Consequently, four entirely new sampling locations (SSP-5 to SSP-8) were established and sampled exclusively during the July survey to capture the pre-construction baseline of these newly finalized, footprints. These specifically target:
 - Labour camps (SSP-5): potential for contamination from domestic wastewater and improper waste disposal.
 - Main workshop area and vehicle maintenance yards (SSP-6): risk of contamination from hydrocarbons (e.g., fuel, oil, lubricants) and solvents.
 - RCC/CVC batching plants and aggregate crusher plants (SSP-7 and SSP-8): risk of soil alkalization from cement and concrete additive spills.

Traffic count

The traffic count surveys were done on the Asian Highway 48 (AH48) at the Bunagu Junction (Figure 5).

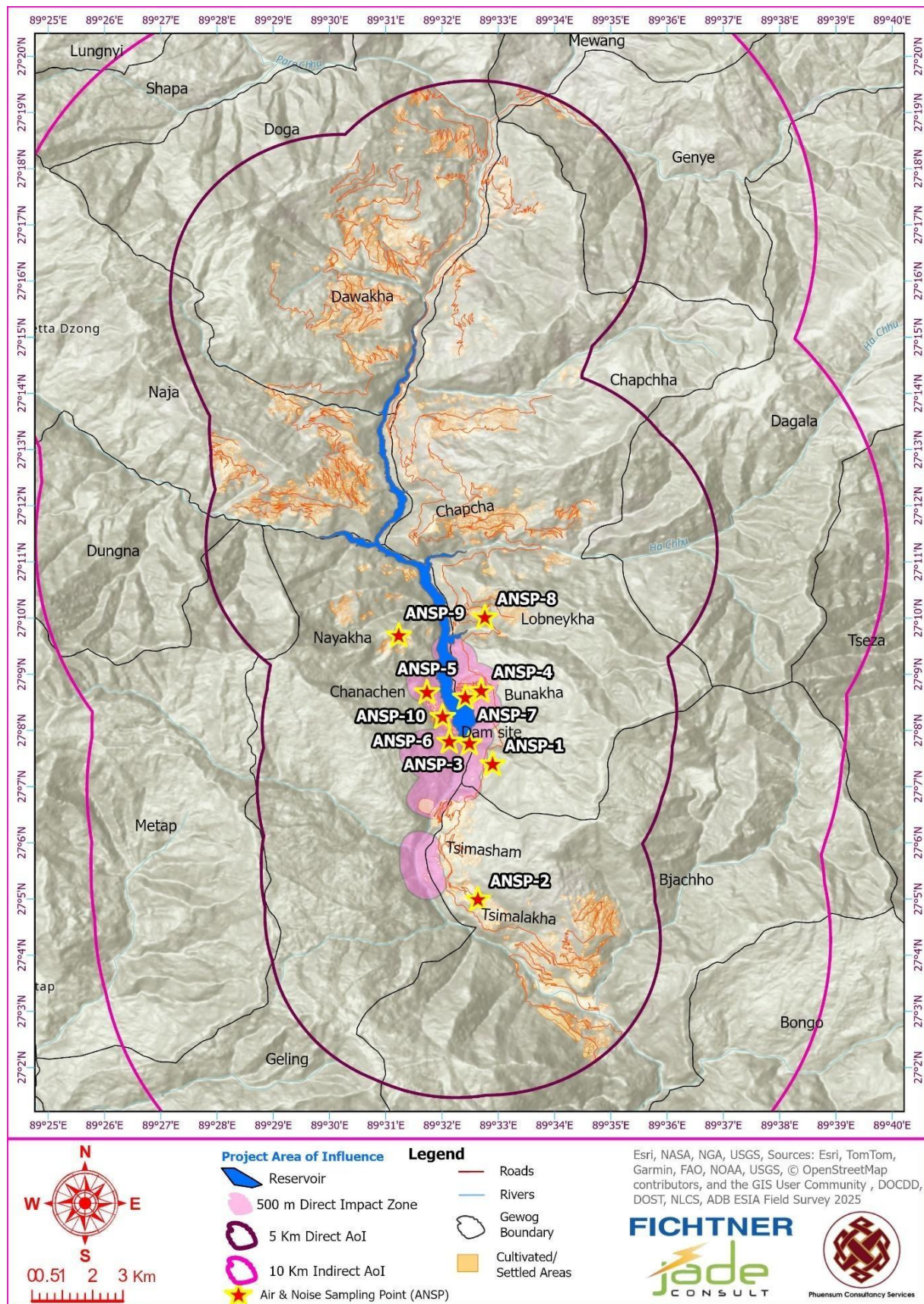


Figure 2: Wind, air and noise sampling points (ANSP) within the Bunakha HPP' AoI - dry and wet seasons

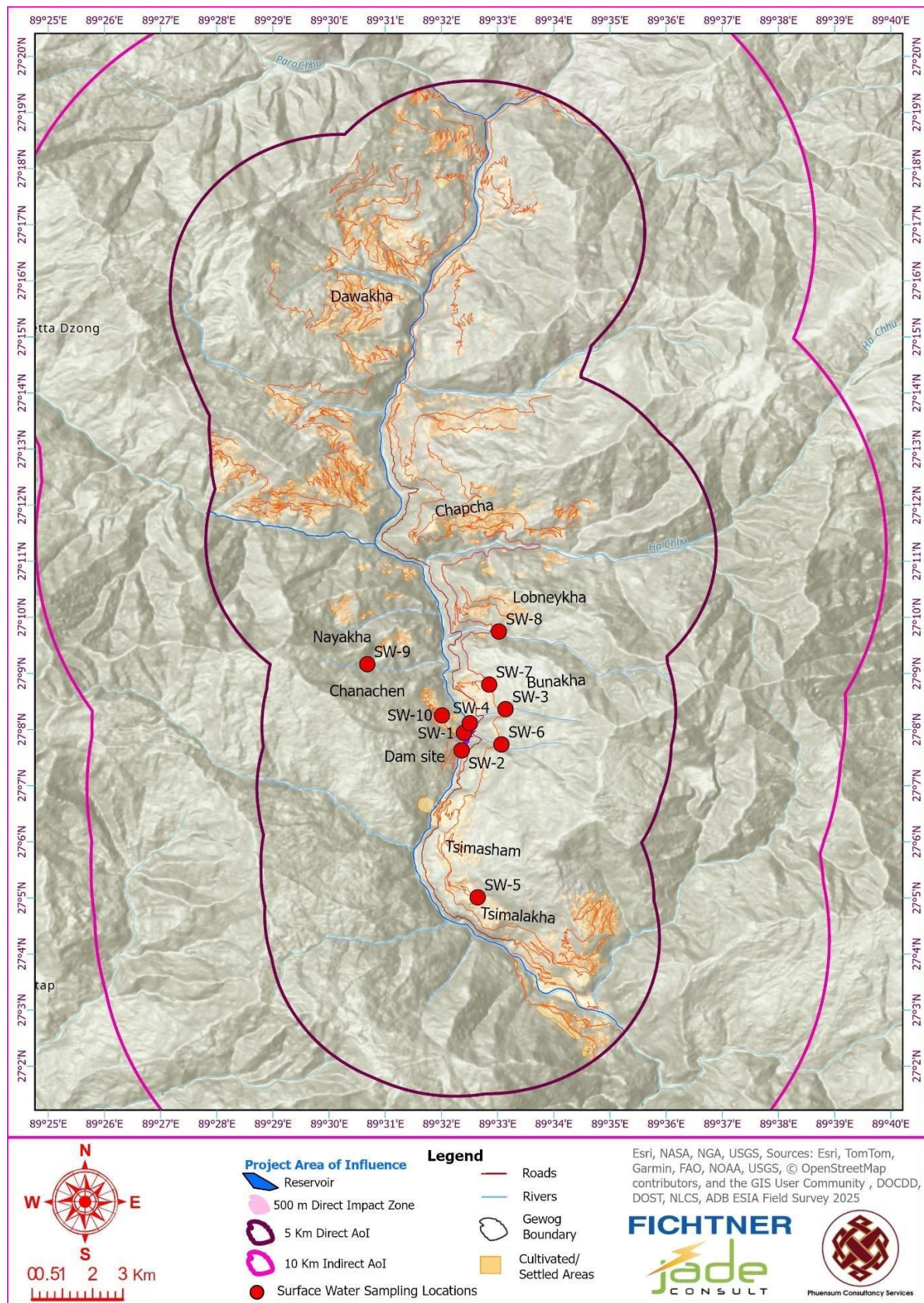


Figure 3: Surface water (SW) sampling locations within the Bunakha HPP' AoI - dry and wet seasons

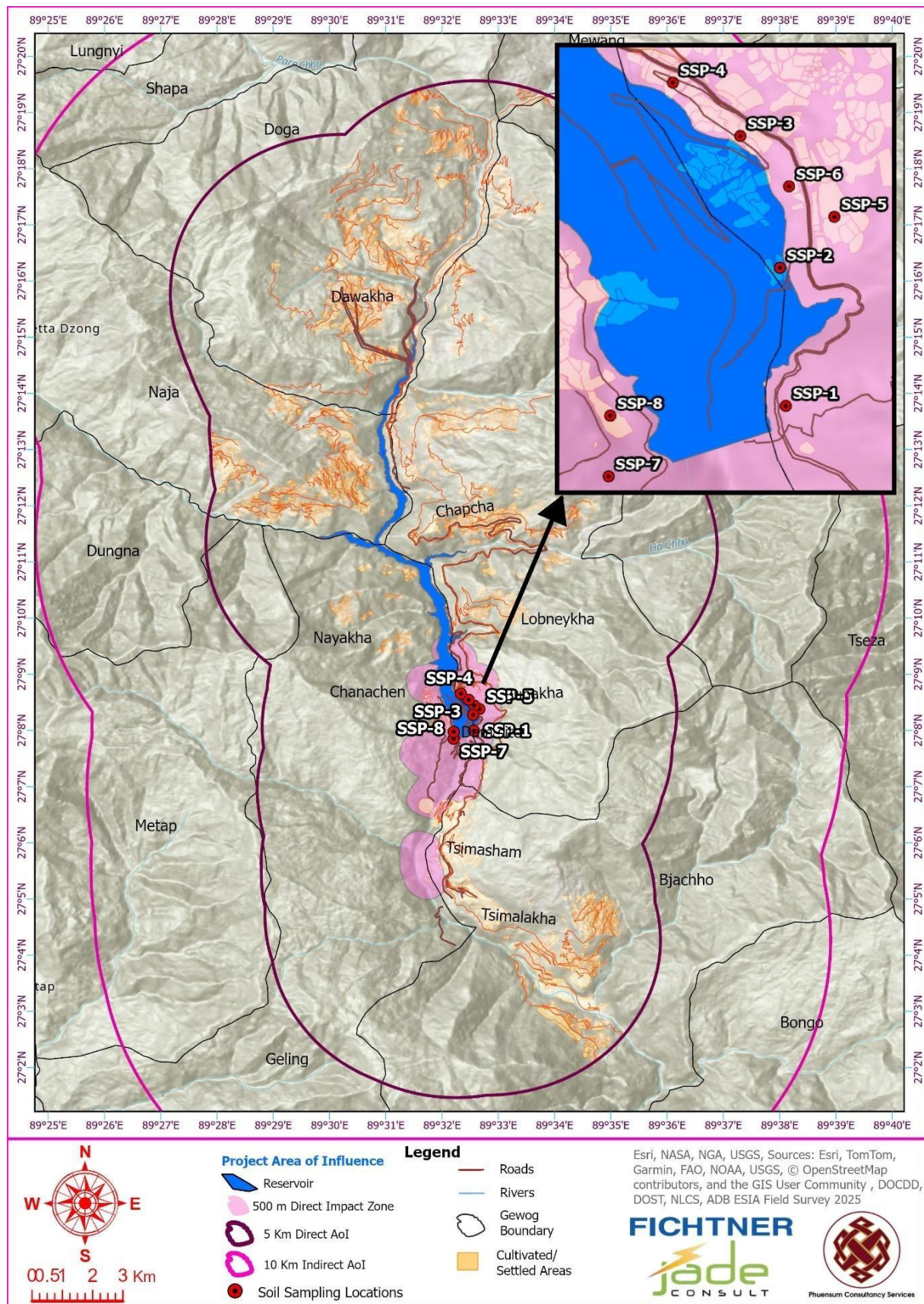
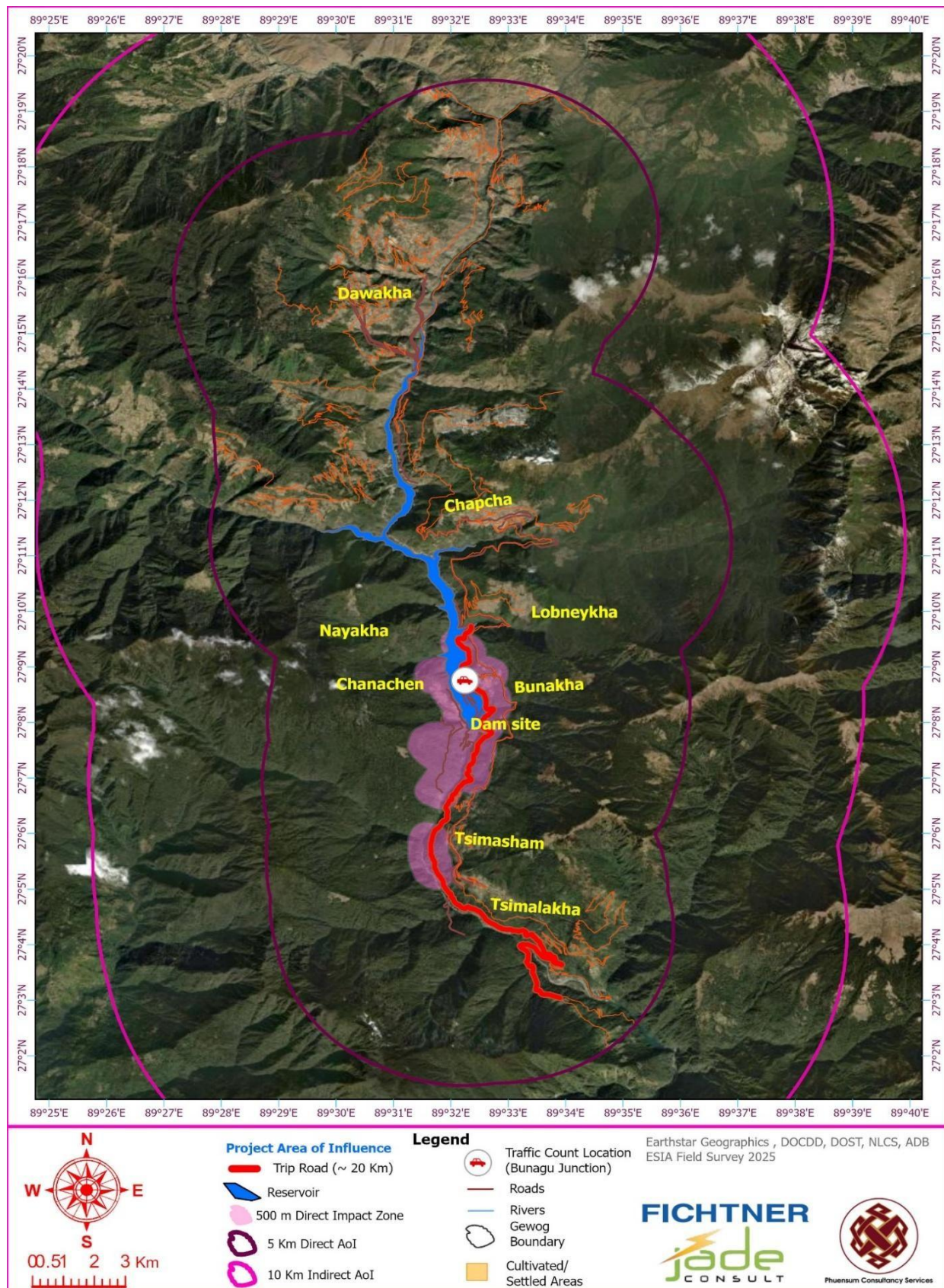


Figure 4: Soil sampling points (SSP) within the Bunakha HPP's AoI - dry (SSP-1 to 4) and wet (SSP-5 to 8) seasons



3.2 Monitoring, Sampling and Analysis Procedures

To ensure the collection of accurate, reliable, and scientifically defensible data, a standardized set of sampling and analysis procedures was followed for all environmental components during both the dry and wet season surveys. The methodologies adhere to national guidelines and international best practices.

3.2.1 Air Quality and Meteorological Monitoring

Ambient air quality and wind parameters were monitored continuously over a 24-hour period at each of the ten ANSP stations. Monitoring was conducted using calibrated AQM-09 Ambient Air Quality Monitoring Stations (manufactured by Henan Oceanus). This integrated system was used to collect data for the following parameters, in accordance with the requirements of Bhutan's Environmental Standards 2020. This survey was conducted by ENGEO Consultancy, which specializes in baseline air quality monitoring.

- Air Quality Parameters:
 - Particulate Matter (PM) (total suspended particles (TSP), PM₁₀, and PM_{2.5})
 - Gaseous Pollutants: Sulphur Dioxide (SO₂), Oxides of Nitrogen (NO_x), Ozone (O₃), and Carbon Monoxide (CO).
- Meteorological Parameters:
 - Wind speed (m/s)
 - Wind direction

This concurrent collection of pollutant and meteorological data is essential for understanding local dispersion patterns and interpreting the air quality results. The monitoring was conducted to establish a representative baseline of atmospheric conditions under typical daily cycles for both seasons.

3.2.2 Ambient Noise Monitoring

Concurrent with the air quality monitoring, ambient noise levels were measured at all ten ANSP stations using the integrated noise sensor of the AQM-09 monitoring station. Equivalent Continuous Noise Levels (Leq) were recorded over a 48-hour period on each season to capture full diurnal cycles. The data was then aggregated to establish representative baseline levels for:

- Daytime (Leq d): 6:00 am to 10:00 pm
- Night-time (Leq n): 10:00 pm to 6:00 am

3.2.3 Water Quality Sampling and Analysis

The water quality assessment involved both on-site measurements and laboratory analysis of collected samples.

- On-site measurements: At each of the ten surface water sampling sites, key parameters were measured directly in the field using calibrated, portable multi-parameter probes. These included pH, Dissolved Oxygen (DO), water temperature, and electrical conductivity.
- Laboratory Analysis: Water samples were collected from each site using clean bottles, stored in cool boxes, and sent to a certified laboratory in Kolkata, India for testing. The laboratory analysed a wide range of water quality indicators, including total suspended solids (TSS), turbidity, biological oxygen demand (BOD), chemical oxygen demand (COD), nitrates, phosphates, heavy metals, and both total and

faecal coliform bacteria. All testing followed the standard procedures outlined by the American Public Health Association (APHA) to ensure reliable and accurate results.

3.2.4 Soil Quality Sampling and Analysis

At each of the eight total locations sampled (four in April and four in July), a consistent methodology was applied. Composite samples were collected from two distinct depths:

- Surface Samples (0-20 cm): To assess the baseline for potential contamination from surface spills and dust accumulation.
- Subsurface Samples (20-50 cm): To evaluate the baseline condition for parameters that may leach through the soil profile.

Samples were collected using standardized tools, stored in clean, labelled bags, and dispatched for analysis at Qualissure Laboratory Services in Kolkata, India, a NABL accredited laboratory. The samples were analysed for key parameters relevant to potential project impacts, such as pH, heavy metals, nutrients, and Total Petroleum Hydrocarbons (TPH) at high-risk locations.

3.2.5 Traffic Count Survey

Vehicular traffic was monitored at Bunagu Junction on Asian Highway 48 (AH48) using manual count methods over a 16-hour period (6am-11pm) during both the dry and wet seasons. Data was collected by enumerators who recorded vehicles by type (e.g., cars/SUVs, light commercial vehicles, medium/heavy trucks, buses, two-wheelers) and by their direction of travel (Thimphu-bound and Phuentsholing-bound). This methodology allowed for the determination of baseline traffic volume, composition, and diurnal flow patterns.

4 Regulatory Standards and Guidelines

The baseline data collected for air, noise, water and soil quality are evaluated against a combination of legally binding national regulations and internationally recognized, health-based best-practice guidelines. This dual approach is essential to ensure compliance with Bhutan's legal framework while also providing a comprehensive assessment of the existing environmental conditions in the context of potential human health risks, a key requirement for international financing institutions.

4.1.1 National Regulatory Framework

The primary and legally binding regulatory benchmark for this Project is Bhutan's Environmental Standards 2020 (ES 2020), issued by the National Environment Commission (NEC). These standards define the permissible limits for pollutant discharges and ambient environmental quality within the Kingdom. All Project activities, from construction through operation, must adhere to these standards to obtain and maintain the required Environmental Clearance.

4.1.2 International Best-Practice Guidelines

To provide a global best-practice context and align with the requirements of the ADB, this report also references the latest health-based guidelines from the World Health Organization (WHO). These guidelines are often more stringent than national standards as they are based solely on the latest scientific evidence regarding health impacts, without consideration for economic or technical feasibility. The key international benchmarks used are:

- WHO Global Air Quality Guidelines (AQG) 2021: These guidelines provide recommendations on air quality levels necessary to protect public health from the adverse effects of air pollution.
- WHO Environmental Noise Guidelines for the European Region (2018): Although region-specific, these are widely used globally as a benchmark for assessing the health impacts of environmental noise.
- WHO Guidelines for Drinking-water Quality (GDWQ): These provide the authoritative basis for setting national regulations and standards for water safety to protect public health from chemical and microbial contaminants.
- Canadian Council of Ministers of the Environment (CCME) Soil Quality Guidelines for the Protection of Environmental and Human Health: These are widely recognized as Good International Industry Practice (GIIP) for assessing potential risks from soil contamination, particularly when comprehensive national standards are not available.

4.1.3 Applicable Standards for Air Quality

For the purposes of this assessment, the Project's Area of Influence is classified as a "Mixed Area" under ES 2020. The key applicable national limits and the corresponding international health-based guidelines are summarized in Table 1.

Table 1: Key regulatory standards and international guidelines for air quality applicable to the Bunakha HPP

Parameter	Averaging Period	Bhutan ES 2020 Limit (Mixed Area) *	WHO Guidelines**
Air Quality			
TSPM	24-hour mean	60 µg/m ³	-

Parameter	Averaging Period	Bhutan ES 2020 Limit (Mixed Area) *	WHO Guidelines**
Particulate Matter (PM _{2.5})	24-hour mean	60 µg/m ³	5 µg/m ³
Particulate Matter (PM ₁₀)	24-hour mean	200 µg/m ³	10 µg/m ³
Nitrogen Dioxide (NO ₂)	24-hour mean	120 µg/m ³	25 µg/m ³
Sulphur Dioxide (SO ₂)	24-hour mean	120 µg/m ³	40 µg/m ³
Ozone (O ₃)	8-hour mean (peak season)	100 µg/m ³	60 µg/m ³
Carbon Monoxide (CO)	8-hour mean	4 mg/m ³	10 mg/m ³

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

** Source: WHO Global Air Quality Guidelines (AQG) 2021

4.1.4 Applicable Standards for Noise

The key applicable national standards (community protection) and international guidelines (community and occupational protection) for environmental noise are:

- Environmental Standards (ES 2020): These national standards set legally binding limits for noise in community areas to prevent annoyance and sleep disturbance. For a "Mixed Area," the limits are 65 dBA (Daytime, Leq) and 55 dBA (Night-time, Leq). These apply to the Project's impact on sensitive receptors.
- WHO Environmental Noise Guidelines for the European Region (2018): These health-based guidelines provide recommendations to protect against the adverse health effects of road traffic noise. The recommendations are to maintain levels below 53 dBA (Lden) for average exposure and below 45 dBA (Lnight) for night-time exposure. These are used as an international benchmark.
- Occupational Health Standards (WHO, 2018): These standards protect workers from hearing damage. The WHO recommends limiting worker exposure to a maximum of 85 dBA as an 8-hour Time-Weighted Average (TWA). This applies to Project personnel in work zones.

The standards for community protection are summarized in Table 2.

Table 2: Key regulatory standards and international guidelines for noise quality applicable to the Bunakha HPP

Parameter	Averaging Period	Bhutan ES 2020 Limit (Mixed Area) ¹	WHO Guideline
Noise			
Ambient Noise Level	Daytime (06:00-22:00)	65 dBA (Leq)	< 53 dBA (Lden) ² (for road traffic)
Ambient Noise Level	Night-time (22:00-06:00)	55 dBA (Leq)	< 45 dBA (Lnight) ² (for road traffic)

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

** Source: WHO Environmental Noise Guidelines for the European Region (2018). Lden is the day-evening-night average sound level, and Lnight is the night-time average.

4.1.5 Applicable Standards for Water Quality

The assessment of water quality utilizes a use-based classification system as defined in Bhutan's ES 2020. The standards applied vary depending on the nature of the water source sampled:

- River water quality: Samples collected from the Wangchhu River and its major tributaries (SW-1, SW-2, SW-3, SW-4, and SW-9) are assessed against the Standards for River Water Quality of ES 2020. These

standards classify water bodies based on their designated best uses, such as fisheries, irrigation, and aquatic life propagation.

- Drinking water quality: Samples from community springs that serve as primary drinking water sources (SW-5, SW-6, SW-7, SW-10) are evaluated against the much stricter Standards for Drinking Water Quality of ES 2020. For international best-practice comparison, the WHO Guidelines for Drinking-water Quality are also referenced.
- Effluent discharge: While not part of the baseline, any future wastewater discharges from Project camps or facilities will be required to comply with the Standards for Industrial Effluent Discharge as per ES 2020. The compliance with these standards is not evaluated in this report.

Due to the extensive list of parameters for each standard, the specific limit values are presented directly within the water quality analysis section (Section 5.5) for direct comparison with the analytical results.

4.1.6 Applicable Standards for Soil Quality

Unlike the specific numerical limits provided for air, noise and water, Bhutan's Environmental Standards (ES 2020) contain general, qualitative requirements for land management but do not provide a comprehensive set of numerical standards for ambient soil quality (e.g., maximum permissible concentrations for heavy metals or hydrocarbons).

In such cases where specific national standards are not available, the Asian Development Bank's Safeguard Policy Statement requires the application of Good International Industry Practice (GIIP). This involves referencing internationally recognized, health-based standards to provide context for the baseline data.

In accordance with GIIP, the results for specific potential contaminants (e.g., heavy metals, hydrocarbons) are screened against the Canadian Council of Ministers of the Environment (CCME) Soil Quality Guidelines for the Protection of Environmental and Human Health for Residential/Parkland use. These guidelines are a widely accepted international benchmark for assessing potential health risks.

This screening approach serves two key purposes:

1. It helps to identify any pre-existing areas of potential concern that may require management, regardless of the Project.
2. It confirms the current suitability of the soil in the Project areas for its intended future uses, establishing a clear, defensible pre-Project condition.

Table 3: Canadian Council of Ministers of the Environment (CCME) Soil Quality Guidelines for the Protection of Environmental and Human Health for Residential/Parkland use

Sl. No.	Test Parameter	Unit	CCME Guideline (Residential/ Parkland)
1	Texture	-	—
2	Moisture Content	%	—
3	Alkalinity (as CaCO ₃)	mg/kg	—
4	Acidity (as CaCO ₃)	mg/kg	—
5	Porosity	%	—
6	pH at 25°C	-	—
7	Electrical Conductivity at 25 °C	mS/cm	—
8	Nitrogen (as N)	mg/kg	—
9	Phosphate (as P)	mg/kg	—
10	Potassium (as K)	mg/kg	—
11	NPK	Ratio	—
12	Calcium (as Ca)	mg/kg	—
13	Magnesium (as Mg)	mg/kg	—
14	Chloride(as Cl)	mg/kg	—
15	Sulphate (as SO ₄)	mg/kg	—
16	Carbonate	mg/kg	—
17	Boron (as B)	mg/kg	—
18	Sodium (as Na)	mg/kg	—
19	Cation Exchange Capacity	meq/100gm	—
20	Arsenic (as As)	mg/kg	12
21	Cadmium (as Cd)	mg/kg	1.4
22	Mercury (as Hg)	mg/kg	6.6
23	Nickel (as Ni)	mg/kg	50
24	Manganese (as Mn)	mg/kg	1900
25	Hexavalent Chromium (as Cr ⁺⁶)	mg/kg	0.8
26	Lead (as Pb)	mg/kg	70
27	Iron (as Fe)	mg/kg	—
28	Copper (as Cu)	mg/kg	63
29	Zinc (as Zn)	mg/kg	200
30	Sodium Adsorption Ratio(SAR)	-	500
31	Organic Carbon	%	64
32	Organic Matter	%	50
33	Water Holding capacity	%	5
34	Barium (as Ba)	mg/kg	1.6
35	Total Chromium(as Cr)	mg/kg	12
36	Cobalt (as Co)	mg/kg	1.4
37	Molybdenum (as Mo)	mg/kg	6.6
38	Cyanide (as CN)	mg/kg	50

5 Survey Results - Baseline Environmental Conditions

This chapter establishes the definitive pre-construction physical environmental baseline for the Bunakha HPP's Aol. This baseline serves as the scientific foundation for the subsequent Environmental and Social Impact Assessment (ESIA), providing the critical benchmark required to accurately predict project-induced impacts, design effective mitigation measures, and ensure future compliance monitoring. To create a robust characterization that accounts for the region's distinct seasonal variability, data was collected during three field campaigns designed to capture the environmental extremes of the dry season/Spring (April 2025), the wet/monsoon/winter season (July 2025), and the post-monsoon/Autumn season (November 2025).

The scope of the data presented in this chapter reflects the specific monitoring requirements for each environmental parameter, as outlined below:

- **Air, Noise, and Wind Conditions:** A full comparative analysis is provided for these parameters, with data from both the dry and wet season surveys presented to characterize the seasonal atmospheric extremes.
- **Soil Quality:** The baseline was established progressively across the two survey periods. An initial survey was conducted at four locations in April 2025. Following the finalization of project layouts for ancillary facilities, four additional sites corresponding to the new footprints of the labour camps, main workshop area and vehicle maintenance yards, and batching plants, were sampled in July 2025. This chapter presents the complete pre-construction baseline data from all eight locations.
- **Water Quality:** In accordance with the TOR, a four-season monitoring program is required. This report presents the findings from the first three completed campaigns.

5.1 Baseline Meteorological Conditions

Baseline wind speed and direction were continuously monitored at each of the ten ANSP stations during the dry (April 2025) and wet (July 2025) survey periods. Understanding the local wind regime across these distinct seasons is critical as it directly influences the dispersion of air pollutants, affects site planning for dust control, and informs the assessment of environmental risks and construction safety.

5.1.1 Results

The wind data collected during both the dry and wet seasons are summarized in Table 2. This table highlights key metrics including calm frequency, dominant wind direction, and maximum recorded wind speed for each location, allowing for a direct comparison of seasonal dynamics. The prevailing wind patterns are further visualized in the seasonal wind rose diagrams presented in Figure 5 (dry season) and Figure 6 (wet season).

Table 4: Comparative summary of wind conditions (dry vs. wet season) at the Bunakha HPP's Aol

Site ID	Location Description	Dry Season (April 2025)			Wet Season (July 2025)		
		Calm (%)	Max Speed (m/s)	Dominant Direction	Calm (%)	Max Speed (m/s)	Dominant Direction
ANSP-1	Campsite 4, Labtsakha	81.5%	2.9	ESE / W	64.0%	1.1	S
ANSP-2	Proposed Colony, Tsimalakha	20.0%	2.9	WNW	41.7%	1.8	ESE
ANSP-3	Dam site, Bunakha	68.0%	1.4	S	42.9%	2.5	ESE
ANSP-4	Bunakha Lhakhang	37.5%	2.1	SSW	58.1%	1.7	S
ANSP-5	Proposed Quarry site, Chanachen	60.0%	1.3	SSW	56.4%	2.0	SSW
		Dry Season (April 2025)			Wet Season (July 2025)		

Site ID	Location Description	Calm (%)	Max Speed (m/s)	Dominant Direction	Calm (%)	Max Speed (m/s)	Dominant Direction
ANSP-6	Sand & Aggregate Stockpile Site	68.0%	1.8	SES	55.6%	2.1	S
ANSP-7	Proposed Workshop, Below Highway	18.8%	4.8	ESE / SSW	56.0%	3.7	S
ANSP-8	Zangtey village (Heritage Area)	68.0%	1.7	SSE	55.2%	1.6	S
ANSP-9	Nayakha Village	52.0%	0.9	SW	24.0%	1.4	E / SW
ANSP-10	Chanachen Village Center	NS	NS	NS	55.1%	3.5	S

Notes:

- NS (not sampled): ANSP-10 was added after the dry season survey.
- Bold values indicate maximum and minimum across all sites:
 - Highest calm %: dry - ANSP-1 (81.5%) and wet - ANSP-1 (64.0%)
 - Lowest calm %: dry - ANSP-7 (18.8%) and wet - ANSP-9 (24.0%)
 - Highest wind speed: dry - ANSP-7 (4.8 m/s) and wet - ANSP-7 (3.7 m/s)
 - Lowest wind speed: dry - ANSP-9 (0.9 m/s) and wet – ANSP-1 (1.1 m/s)

5.1.2 Analysis of Seasonal Meteorological Dynamics

The comparative analysis reveals two distinct atmospheric regimes, driven by seasonal meteorological shifts.

Atmospheric stability and stagnation

The most critical seasonal difference is atmospheric stability. The dry season is characterized by a highly mechanically stable atmosphere with extreme stagnation, particularly at sheltered sites like ANSP-1 (81.5% calm) and ANSP-3 (68% calm). This severely limits natural pollutant dispersion. In contrast, the wet season is far more dynamic, with calm frequencies dropping significantly across all sites. For example, ANSP-9 (Nayakha Village) transforms from a stagnant area (52% calm) to the most actively ventilated site (24% calm), greatly enhancing its dispersion capacity.

Dominant Wind Patterns

The Project Aol is dominated by a topographically-driven up-valley (southerly to southwesterly) wind flow, which is present in the dry season but becomes stronger, more persistent, and more organized during the wet season. This establishes a predictable transport pathway from southern activity zones (quarry, stockpiles) towards northern sensitive receptors (Nayakha, Lobnekha Heritage Village). Localized channelling is also evident, especially at ANSP-2 (Tsimalakha), where winds align with the local valley orientation.

Wind Speeds and Extremes

The dry season exhibits greater extremes, with generally low wind speeds punctuated by a zone of high, turbulent wind at the exposed ANSP-7 (Workshop Area), which recorded the year's maximum speed of 4.8 m/s. During the wet season, wind speeds are more moderate but also more consistent across the Aol, with the localized high-speed zone at ANSP-7 becoming less pronounced.

Figure 6 and Figure 7 show the wind rose diagrams for all ANSP for both seasons.

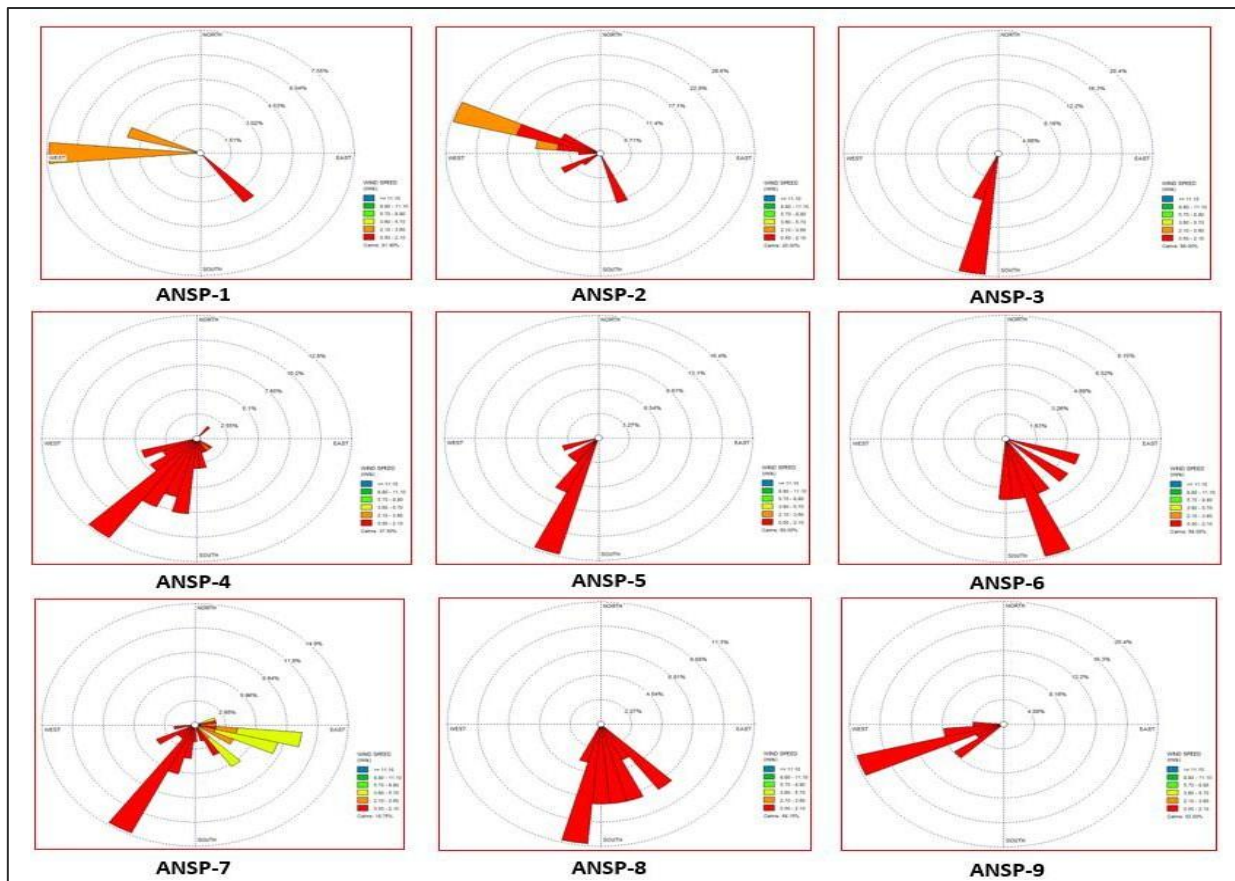


Figure 6: Wind rose diagrams of the ANSP at the Bunakha HPP's Aol (dry season/Spring – April 2025)

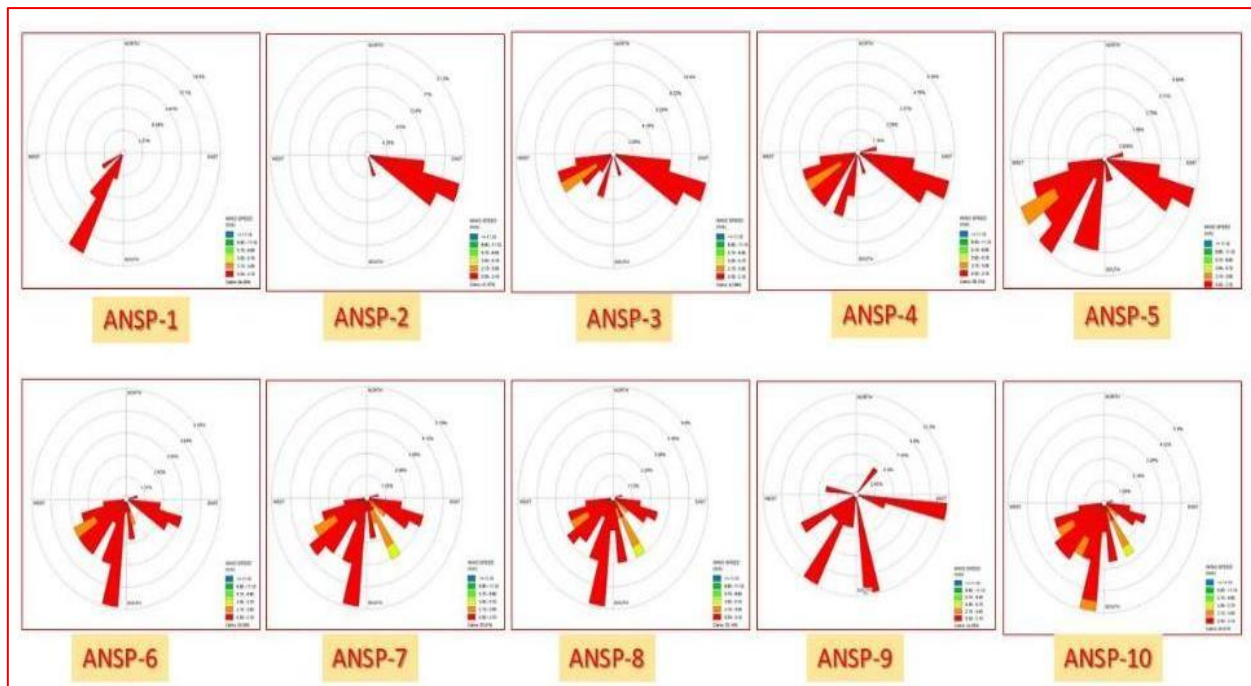


Figure 7: Wind rose diagrams of the ANSP at the Bunakha HPP's Aol (wet season/monsoon/Summer – July 2025)

5.1.3 Discussion of the Implications

The baseline wind data confirms a "dual-airshed" reality, which has direct and practical implications for Project planning, construction management, and environmental mitigation.

Air Quality and Dust Dispersion

The primary risk for air quality degradation due to poor dispersion is expected in the dry season. The persistent up-valley flow during the wet season means the primary risk shifts to the predictable transport of pollutants to downwind receptors. Any dust generated at southern project sites (e.g., ANSP-5 and ANSP-6) has a high potential to impact northern communities like Nayakha (ANSP-9) and Lobnekha (ANSP-8).

Seasonal Environmental Management

A one-size-fits-all approach to environmental management is not viable. Management strategies must be seasonally adapted:

- Dry season focus: Management must prioritize intense dust suppression at all sources (quarries, stockpiles, haul roads) and stringent control of emissions to counteract the high stagnation and prevent localized pollutant buildup.
- Wet season focus: While natural dust suppression from rain is a factor, management must focus on controlling combustion emissions (NO_x, SO₂) at the source, as these will be efficiently transported toward sensitive downwind communities.

5.2 Baseline Traffic Conditions and Emissions

A baseline traffic survey was conducted to quantify the volume, composition, and temporal patterns of vehicular movement on Asian Highway 48 (AH48) at the Bunagu Junction. This location is representative of the regional through-traffic that will pass the Project site, directly affecting key settlements along this corridor, including Bunakha and Tsimalakha, as well as providing primary access to Chanachen. This data is critical for understanding the primary existing source of air and noise pollution in these communities and for establishing a benchmark against which Project-related traffic impacts will be assessed.

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5.2.1 Traffic Volume and Composition

Traffic counts were conducted on a typical weekday during the dry season (April 23, 2025) and the wet season (July 28, 2025). The key findings regarding daily traffic volume and detailed vehicle composition are summarized in the tables below.

Table 5: Summary of daily traffic volume at the Bunagu Junction (06:00-22:00 hr)

Season	Direction	Total Daily Volume (Vehicles)	Bi-Directional Total
Dry season (April)	Phuentsholing → Thimphu	876	1,701
	Thimphu → Phuentsholing	825	
Wet season (July)	Phuentsholing → Thimphu	999	1,935
	Thimphu → Phuentsholing	936	

To better understand the specific types of vehicles contributing to the traffic flow and emissions, the data was broken down by vehicle class. The following tables show the percentage contribution of each vehicle type to the total traffic volume for each direction and season.

Table 6: Detailed vehicle composition at the Bunagu Junction – dry season (April 23, 2025)

Vehicle Class	Phuentsholing → Thimphu (%)	Thimphu → Phuentsholing (%)
Cars / Taxis / EVs (Class 1 & 2)	51.3%	48.1%
Minibus (<10 seats) (Class 3)	9.1%	9.1%
Pickup / Utility (Class 4)	13.0%	13.6%
Light Truck (2-axle) (Class 5)	4.7%	8.1%
Medium Truck (2-axle, dual wheel) (Class 6)	19.1%	18.2%
Heavy Truck (≥3 axles) (Class 7)	1.8%	1.6%
Articulated Truck / JCB (Class 8)	0.2%	0.2%
Motorcycle (Class 9)	0.8%	1.1%
Total	100.0%	100.0%

Table 7: Detailed vehicle composition at the Bunakha Junction – wet season (July 28, 2025)

Vehicle Class	Phuentsholing → Thimphu (%)	Thimphu → Phuentsholing (%)
Cars / Taxis / EVs (Class 1 & 2)	43.4%	44.8%
Minibus (<10 seats) (Class 3)	4.6%	3.2%
Pickup / Utility (Class 4)	22.3%	21.9%
Light Truck (2-axle) (Class 5)	25.1%	22.2%
Medium Truck (2-axle, dual wheel) (Class 6)	23.0%	28.2%
Heavy Truck (≥3 axles) (Class 7)	1.2%	0.7%
Articulated Truck / JCB (Class 8)	0.1%	0.1%
Motorcycle (Class 9)	0.2%	0.2%
Total	100.0%	100.0%

Analysis of Traffic Volume and Composition

The survey confirms AH48 is a major transport corridor with significant daily traffic volume and a substantial component of heavy commercial vehicles.

- Significant traffic volume with seasonal variation: The total daily traffic volume is substantial, averaging between 1,701 vehicles/day (dry season) and 1,935 vehicles/day (wet season). This represents a 13.8% increase in traffic in July compared to April, which may be attributable to seasonal economic activities or typical weekly variations.
- Dominance of passenger and utility vehicles: Across both seasons, standard passenger cars, taxis, and utility vehicles (Pickups like Boleros/Hilux) are the most numerous vehicles on the road, collectively making up over half of the total traffic.
- Medium trucks as the key freight carrier: The detailed breakdown confirms that Medium Trucks (Class 6) are the workhorses of this freight corridor. They consistently represent the single largest category of heavy commercial vehicles, accounting for 18-19% of traffic in the dry season and increasing significantly to 23-28% in the wet season. This specific vehicle class is a primary contributor to the high baseline NO₂ levels.
- Seasonal shift in truck types: A notable shift occurred between seasons. In the wet season, there was a significant increase in the proportion of Light and Medium Trucks (Classes 5 & 6), while the share of passenger cars and minibuses decreased. This suggests a seasonal increase in commercial transport and logistics activities.
- Minor contribution from other classes: The contribution from very heavy trucks (Classes 7 & 8), motorcycles, and EVs is minimal, collectively accounting for less than 4% of total traffic in both seasons.

5.2.2 Estimated Baseline Air Emissions from Traffic

To quantify the contribution of existing traffic to the local airshed quality, baseline daily emissions for key pollutants were estimated. This calculation provides a quantitative link between the observed traffic volumes and the measured baseline air quality.

Methodology and Assumptions

The emissions estimation was conducted using a Tier 1 methodology, which is appropriate for a baseline-level assessment where detailed local fleet information (e.g., vehicle age, specific engine technology) is not available.

- **Traffic Data:** The calculation is based on the higher-traffic wet season data (July 28, 2025) to provide a conservative (i.e., worst-case) estimate of daily emissions.
- **Trip Length:** A trip length of 20 kilometers is assumed (Figure 7). This length is representative of the approximate distance along the highway that encompasses the main Project components (from the main access road turnoff to the furthest worksite), providing an estimate of the total emissions load within the Project's direct Area of Influence.
- **Emission Factors:** Standard emission factors were sourced from the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2019, specifically from Table 3-1 of the "1.A.3.b.i-iv Road transport" chapter. This is a widely accepted international standard for such calculations, developed by the European Monitoring and Evaluation Programme and the European Environment Agency. The factors for "Euro 4" standards were selected as a representative average for the mixed-age vehicle fleet in the region.
- **Vehicle Class Aggregation:** The EMEP/EEA guidebook provides emission factors for broad vehicle categories, not for every specific class observed during the survey. To facilitate the calculation, the nine vehicle classes detailed in Table 6 were aggregated into three standardized Emission Factor Categories as shown in Table 7. This aggregation is a standard practice for a Tier 1 assessment and provides the necessary link between the site-specific traffic count and the international emission factors.

Table 8: Aggregation of Observed Vehicle Classes for Emission Calculation

Emission Factor Category	Corresponding Vehicle Classes from Table 6
Passenger Car (Gasoline)	Cars / Taxis / EVs (Class 1 & 2), Minibus (Class 3), Motorcycle (Class 9)
Light Commercial Truck < 3.5t (Diesel)	Pickup / Utility (Class 4)
Heavy-Duty Truck > 3.5t (Diesel)	Light Truck (Class 5), Medium Truck (Class 6), Heavy Truck (Class 7), Articulated Truck / JCB (Class 8)

Table 9: Emission Factors Used for Estimating Baseline Traffic Emissions

Emission Factor Category	CO (g/km)	NOx (g/km)	PM _{2.5} (g/km)	PM ₁₀ (g/km)	SO ₂ (g/km) ¹
Passenger Car (Gasoline)	1.056	0.082	0.005	0.007	0.003
Light Commercial Truck < 3.5t (Diesel)	0.076	0.460	0.008	0.010	0.004
Heavy-Duty Truck > 3.5t (Diesel)	0.540	3.500	0.060	0.065	0.005

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook 2019 (1.A.3.b.i-iv Road transport, Tier 1, Euro 4)

¹ SO₂ emissions are primarily dependent on the sulphur content of the fuel.

Calculation Results

The total daily emissions for each pollutant were calculated as follows:

$$\text{Emissions (kg/day)} = \sum [\text{Vehicle Count per Class} \times \text{Trip Length (20 km)} \times \text{Emission Factor (g/km)}] / 1000$$

g/kg

Table 9 shows the results of the calculation. These are estimations based on standard emission factors. Actual emissions may vary depending on vehicle age, maintenance practices, driving behaviour, and fuel quality.

Table 10: Estimated Daily Baseline Traffic Emissions at the Bunagu Junction – Wet Season

Pollutant	Total Daily Emissions (kg/day)	Primary Contributing Vehicle Category
Carbon Monoxide (CO)	62.6 kg	Passenger Cars & Light Vehicles
Oxides of Nitrogen (NOx)	109.2 kg	Heavy-Duty Trucks (>80%)
Fine Particulate Matter (PM _{2.5})	3.6 kg	Heavy-Duty Trucks
Particulate Matter (PM ₁₀)	3.8 kg	Heavy-Duty Trucks
Sulphur Dioxide (SO ₂)	0.2 kg	Heavy-Duty Trucks

Analysis of Estimated Emissions

The emissions estimation for a 20 km corridor reveals several key insights into the baseline air quality. Oxides of Nitrogen (NOx) are the most significant pollutant by mass, with an estimated daily emission of 109.2 kg. Critically, the data shows that over 80% of these NOx emissions originate from the heavy-duty vehicle fleet. This extremely high daily load is the most likely explanation for the widespread, year-round exceedances of WHO NO₂ guidelines measured during the air quality survey, confirming that highway traffic is the dominant air pollution source in the valley.

Carbon Monoxide (CO) is the second-most emitted pollutant at 62.6 kg/day. In contrast to NOx, these emissions are primarily generated by the larger volume of gasoline-powered passenger cars and light vehicles.

Particulate matter emissions are now estimated at 3.8 kg/day for PM₁₀ and 3.6 kg/day for PM_{2.5}. Similar to NOx, these harmful pollutants are predominantly generated by the heavy-duty truck fleet's diesel engines. Emissions of Sulphur Dioxide (SO₂) remain very low at 0.2 kg/day, reflecting the generally low sulphur content in modern fuels.

In summary, the baseline airshed is characterized by two distinct emission profiles: the heavy-duty vehicle fleet acts as a concentrated source of NOx and Particulate Matter, while the more numerous passenger vehicle fleet is the main source of CO.

5.2.3 Discussion of the Implications

The baseline traffic conditions and associated emissions profile have direct and critical implications for the Project's environmental management and construction planning.

The existing traffic, reaching over 1,900 vehicles per day, generates a very high baseline pollution load within the 20 km project corridor. The daily emissions of 109.2 kg of Oxides of Nitrogen (NOx) and 3.8 kg of Particulate Matter (PM₁₀) present a much more severe baseline than previously estimated. The introduction of the Project's construction fleet, which will also consist mainly of heavy vehicles, will therefore directly exacerbate this already critical air quality issue. This provides a clear imperative for imposing the most stringent emission controls (e.g., vehicle standards, maintenance schedules) on the Project's vehicle fleet to avoid significant cumulative impacts.

The high proportion of existing heavy trucks on the highway means there is a significant potential for conflict and congestion when Project construction traffic is added. This underscores the critical need for a

comprehensive Traffic Management Plan within the ESMP, focused on ensuring public safety, minimizing delays, and coordinating the movement of construction vehicles to prevent accidents.

This baseline serves as the foundation for forecasting future traffic. Applying the 7% annual growth rate identified in the Master Plan for National Highways Connectivity (DLA et al., 2025), the traffic volume at this location is expected to double in approximately 10 years, independent of the Project. The Project's traffic impacts will therefore be imposed on a corridor with already rapidly increasing traffic pressure, making mitigation measures even more crucial for long-term sustainability.

5.3 Baseline Air Quality

The baseline air quality assessment was conducted to characterize the existing conditions within the Project's Aol before the commencement of the construction activities. The primary objectives were to measure the concentration of key air pollutants, identify any pre-existing areas of concern, and establish a definitive benchmark against which future Project-induced impacts can be measured. The monitoring was conducted during both the dry season (April 2025) and the wet season (July 2025) to capture seasonal variations.

5.3.1 Results

Ambient air quality was monitored over a 24-hour period per season at strategic locations (ANSP-1 to ANSP-10). The results from the dry and wet season surveys are summarized in Table 8 and Table 9, respectively. The data is evaluated against both Bhutan's Environmental Standards (ES 2020) and the more stringent World Health Organization's Air Quality Guidelines (WHO AQG 2021).

Table 11: Average gaseous and particulate matter concentrations at the Bunakha's Aol (dry season/Spring - April 2025)

Parameter	ANSP-1 (Labtsakha)	ANSP-2 (Tsimalakha)	ANSP-3 (Damsite)	ANSP-4 (Bunakha Lhakhang)	ANSP-5 (Quarry, Chanachen)	ANSP-6 (Stockyard, Chanachen)	ANSP-7 (Campsite, Bunakha)	ANSP-8 (Zangtey)	ANSP-9 (Nayakha)	ES 2020 Limit*	WHO AQG 2021 Limit
TSP (µg/m3) 24 hr mean	9.3	19.5	6.8	18.9	91.4	6.8	6.3	6.6	28.6	200	NA
PM ₁₀ (µg/m3) 24 hr mean	9.2	19.1	5.9	16.5	19.0	6.2	5.9	6.4	28.2	100	15
PM _{2.5} (µg/m3) 24 hr mean	8.7	18.2	4.7	12.9	17.9	5.3	5.3	6.1	27.1	60	5
O ₃ (ug/m3) 8 hr mean	45.0	50.0	114.1	131.4	66.7	152.7	125.4	148.5	43.7	100	60
CO (mg/m3) 8 hr mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2000	4
SO ₂ (ug/m3) 24 hr mean	0.0	0.0	74.6	64.9	0.0	96.6	54.3	53.8	0.0	80	40
NO ₂ (ug/m3) 24 hr mean	39.0	40.3	24.8	28.4	38.6	26.4	24.7	24.4	40.3	80	10

Notes:

Red values indicate exceedances of the applicable ES 2020 or the WHO AQG 2021 guidelines.

ANSP-10 was not sampled in the dry season.

* Limit for "Mixed Areas", which are areas where residential, commercial or both activities take place

Table 12: Average gaseous and particulate matter concentrations at the Bunakha's Aol (wet season/Summer - July 2025)

Parameters	ANSP-1 (Labisakha)	ANSP-2 (Tsimalakha)	ANSP-3 (Damsite)	ANSP-4 (Bunakha Lhakhang)	ANSP-5 (Quarry, Chanachen)	ANSP-6 (Stockyard, Chanachen)	ANSP-7 (Campsite, Bunakha)	ANSP-8 (Zangtey)	ANSP-9 (Nayakha)	ANSP-10 (Chanachen)	ES 2020, Limit*	WHO AQG 2021
TSP (µg/m ³) 24 hr mean	1.0	2.2	7.9	5.8	5.6	7.7	4.5	1.8	6.7	6.3	200	NA
PM10 (µg/m ³) 24 hr mean	0.4	1.5	7.4	5.1	5.2	7.1	3.5	1.4	6.1	5.9	100	15
PM2.5 (µg/m ³) 24 hr mean	0.0	0.7	6.2	3.7	4.4	5.6	1.8	0.5	5.0	5.1	60	5
O ₃ (µg/m ³) 8 hr mean	87.5	90.8	10.0	6.7	88.5	8.8	87.5	11.1	95.4	9.4	100	60
CO (mg/m ³) 8 hr mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2000	4
SO ₂ (µg/m ³) 24 hr mean	34.4	32.4	0.0	0.0	42.7	0.0	68.7	0.0	47.1	0.0	80	40
NO ₂ (µg/m ³) 24 hr mean	43.2	43.2	58.4	57.0	41.0	58.2	41.3	54.9	40.0	57.5	80	10

Notes:

Red values indicate exceedances of the applicable ES 2020 or the WHO AQG 2021 guidelines.

* Limit for "Mixed Areas", which are areas where residential, commercial or both activities take place

5.3.2 Comparison with Standards and Discussion of Exceedances

The baseline data reveals a Project area with significant air quality challenges. While compliance with Bhutan's national standards is mixed, the data shows widespread and persistent exceedances of the stricter, health-based World Health Organization (WHO) Air Quality Guidelines across both seasons.

Compliance with National Standards (ES 2020)

During the wet season, all monitored parameters at all ten locations were found to be in full compliance with the national ES 2020 limits for mixed areas.

During the dry season, however, exceedances for two key pollutants were recorded:

- Ozone (O₃): Five of the nine monitored sites showed 8-hour mean concentrations exceeding the national standard of 100 µg/m³. The most significant exceedances were recorded at ANSP-3 (Damsite), ANSP-4 (Bunakha Lhakhang), ANSP-6 (Stockyard), ANSP-7 (Campsite), and ANSP-8 (Zangtey).
- Sulphur Dioxide (SO₂): One location, ANSP-6 (Stockyard), recorded a 24-hour mean SO₂ concentration of 96.6 µg/m³, which is above the national limit of 80 µg/m³.

All other parameters, including Nitrogen Dioxide (NO₂), Particulate Matter (PM_{2.5} and PM₁₀), and Carbon Monoxide (CO), were found to be well within the national ES 2020 limits at all locations during the dry season.

Comparison with WHO Guidelines (AQG 2021)

When benchmarked against the more stringent WHO guidelines designed to protect public health, the baseline data indicates a pre-stressed airshed with multiple pollutants of concern year-round.

- Nitrogen Dioxide (NO₂): This is the most critical and persistent pollutant. Concentrations at all ten sites during both the dry and wet seasons substantially exceeded the WHO's 24-hour guideline of 10 µg/m³, often by a factor of four to six. This confirms a significant, year-round air quality issue driven by regional sources, potentially primarily emissions from traffic.
- Fine Particulate Matter (PM_{2.5}): High PM_{2.5} values can become a major health concern, with levels varying significantly by season at the Project's Aol. Considering the WHO guideline of 5 µg/m³:
 - During the dry season, widespread exceedances were recorded at eight of the nine sites, with concentrations reaching up to 27.1 µg/m³ (over five times the guideline). Only ANSP-3 (Damsite) was compliant.
 - During the wet season, the "washout" effect of rain dramatically reduced levels, but four locations (ANSP-3, ANSP-6, ANSP-9, and ANSP-10) still recorded values at or slightly above the WHO guideline.
- Ozone (O₃): Exceedances of the WHO 8-hour guideline of 60 µg/m³ were a significant concern in both seasons, indicating conditions conducive to photochemical smog.
 - During the dry season, six of the nine sites (ANSP-3, ANSP-4, ANSP-5, ANSP-6, ANSP-7, and ANSP-8) recorded concentrations well above the guideline.
 - During the wet season, five sites (ANSP-1, ANSP-2, ANSP-5, ANSP-7, and ANSP-9) also exceeded the WHO guideline, highlighting that ozone formation remains a risk even during the monsoon period.
- Sulphur Dioxide (SO₂): Intermittent exceedances of the WHO 24-hour guideline (40 µg/m³) were observed, suggesting localized hot-spots:
 - During the dry season, five sites (ANSP-3, ANSP-4, ANSP-6, ANSP-7, and ANSP-8) recorded exceedances.
 - During the wet season, three sites (ANSP-5, ANSP-7, and ANSP-9) showed concentrations above the WHO guideline.
- Particulate Matter (PM₁₀): While compliant during the wet season, concentrations of PM₁₀ were a concern during the dry season. Four locations (ANSP-2, ANSP-4, ANSP-5, and ANSP-9) recorded levels exceeding the WHO 24-hour guideline of 15 µg/m³.
- Other pollutants (TSP and Carbon Monoxide): Concentrations of TSP have no corresponding WHO guideline. Carbon Monoxide (CO) levels were 0.0 mg/m³ at all sites during both surveys, remaining in full compliance with the WHO guideline.

5.3.3 Analysis of Spatial and Temporal Variations

The baseline data reveals a strong and predictable seasonal influence on ambient air quality, driven by the region's distinct meteorological shifts. This dynamic creates different air quality challenges in each period.

Dry season (April) conditions

Dominated by stagnation and photochemistry, this period is characterized by poor atmospheric dispersion and intense solar radiation, leading to the highest concentrations of most pollutants.

- Severe build-up of primary pollutants (PM_{2.5}, NO₂, CO): The wind rose data confirms a high frequency of calm, stable atmospheric conditions. This inhibits the dispersion of primary pollutants, causing concentrations of PM_{2.5}, NO₂, and especially CO to build up to their highest annual levels. The extreme exceedances of WHO guidelines for these pollutants are largely exclusive to this season.
- High photochemical smog formation (O₃): The combination of strong sunlight and stagnant air containing high concentrations of precursor pollutants (NO_x) acts as a powerful catalyst for photochemical reactions. This results in the formation of significant secondary pollution, leading to widespread exceedances of both national and WHO standards for ground-level Ozone (O₃).

Wet season (July) conditions

Dominated by atmospheric cleansing and transport, the monsoon period is characterized by improved dispersion, which significantly alters the pollution profile, though critical issues remain.

- Reduction of PM_{2.5} and CO: Frequent and heavy monsoon rains lead to the "washout" (wet deposition) of particulate matter and the efficient dispersion of gases like CO. This atmospheric cleansing explains the significant drop in both PM_{2.5} and CO concentrations, which fall to levels well within all guidelines.
- Persistence of primary pollutants (NO₂): Despite the rain, baseline levels of NO₂ remain high, continuing to exceed WHO guidelines at all ten locations. This confirms the presence of a persistent, significant year-round emission source (i.e., highway traffic) whose concentrations are not sufficiently mitigated by wet season conditions.
- Suppression of ozone: As expected, increased cloud cover and reduced solar radiation during the monsoon almost completely suppress the photochemical processes necessary for O₃ formation. Consequently, ozone levels fall to well within all national and international guidelines during this period.

Spatial variation (source-receptor dynamics)

The monitoring data, interpreted through the lens of seasonal wind patterns, reveals a clear spatial distribution of pollutants that directly links pollution hotspots to the primary regional emission source.

The spatial data collected points to the Thimphu-Phuentsholing Highway corridor as the possible dominant source of pollution in the region. The following is highlighted:

- High NO₂: The highest concentrations of NO₂ were consistently recorded at locations directly adjacent to the highway (e.g., ANSP-2, ANSP-4, ANSP-7). This spatial pattern points to vehicular traffic as the eventual primary regional source of NO₂. During the dry season, these high emissions, combined with poor dispersion, create a poor air quality corridor.
- High Ozone and SO₂: The highest concentrations of Ozone and Sulphur Dioxide during the dry season were also recorded at sites near the highway, particularly ANSP-6 (Stockyard) and ANSP-8 (Zangtey). This seems to indicate that the precursor pollutants (NO_x, VOCs, SO₂) emitted from traffic are fuelling the formation of secondary pollutants and creating localized hotspots under specific meteorological conditions.

Location of receptors

The data shows that pollutants are actively transported from the highway corridor to more remote communities.

The remote Nayakha Village (ANSP-9), with few internal emission sources, serves as a clear downwind receptor. It recorded consistently high NO₂ concentrations (~40 µg/m³) in both seasons, well above WHO guidelines. The wind rose analysis for the wet season shows a dominant up-valley (southerly) wind flow, creating a direct transport pathway from the highway corridor toward Nayakha. This defensibly characterizes Nayakha Village as a confirmed downwind sensitive receptor, vulnerable to emissions generated further down the valley.

5.3.4 Discussion of the Implications

The findings demonstrate that the Project is situated within an existing, pre-stressed airshed. The high year-round baseline for NO₂ and the severe dry-season baselines for, PM_{2.5}, and O₃ mean that there is low to no assimilative capacity for additional pollution before exceeding international health guidelines. The project will therefore be required to implement the most stringent emission controls possible on all machinery, generators, and vehicles to avoid exacerbating an already poor air quality situation.

The dry season is unequivocally the period of greatest concern for air quality. The combination of atmospheric stagnation and regional emissions leads to a compounding effect where multiple pollutants simultaneously reach hazardous levels. Widespread exceedances of WHO guidelines for PM_{2.5}, NO₂, CO, and O₃ during this period confirm a health risk for communities.

While other pollutants are seasonal, the consistent and severe exceedance of WHO guidelines for Nitrogen Dioxide (NO₂) at all sites during both seasons establishes it as the single most important pollutant for the project to manage year-round. Therefore, controlling NO_x emissions from all Project sources (machinery, blasting, vehicle fleets) shall be a priority.

A "one-size-fits-all" approach to air quality management is not viable. Management strategies must be adapted to the specific, severe risks of each season:

- Dry season focus (critical pollution episodes): Management must be at its most stringent during this period. The priorities shall be a combination of: 1) dust suppression; 2) NO_x emission control to reduce direct NO₂ exposure and limit O₃ formation; and 3) measures to minimize traffic congestion.
- Wet season focus (persistent NO₂): While the risks from PM_{2.5}, CO, and O₃ are naturally suppressed by rain, the focus must remain on the stringent control of NO_x combustion emissions. This is critical to address the persistent, year-round NO₂ problem and to manage the intermittent SO₂ hotspots observed during this season.

The identification of remote locations like Nayakha Village (ANSP-9) as confirmed downwind receptor sites demonstrates that pollutants from the highway corridor and future Project activities will be actively transported up the valley. The ESMP must therefore be robust enough to not only control emissions at the source but also to account for prevailing wind patterns to minimize impacts on downwind communities. This underscores the need for effective, source-level controls rather than relying on distance or dispersion for mitigation.

5.4 Baseline Noise Environment

The baseline ambient noise survey was conducted to characterize the existing acoustic environment across the Project area prior to any construction. The objectives were to measure baseline noise levels during both dry and wet seasons, compare them against applicable environmental and occupational standards, and establish a definitive benchmark for managing construction-related noise impacts on both the community and the workforce.

5.4.1 Results

Ambient noise levels were monitored over a 48-hour period at ten strategic locations during the dry season (April 2025) and wet season (July 2025). The results are presented as equivalent continuous noise levels (Leq) in Table 10 and Table 11.

Table 13: Baseline ambient noise levels (Leq dBA) at the Bunakha HPP's Aol - dry season/Spring (April 2025)

Site ID	Location Name	Daytime Leq (06:00-22:00)	Night-time Leq (22:00-06:00)
ANSP-1	Fallow land, Labtsakha	47.96	41.56
ANSP-2	Colony Area, Tsimalakha	54.11	53.09
ANSP-3	Proposed Damsite, Bunakha	64.50	64.04
ANSP-4	Bunakha Lhakhang compound	49.82	51.52
ANSP-5	Adjacent to proposed quarry, Chanachen	46.29	46.61
ANSP-6	RCC Batching Plant Area, Chanachen	48.77	45.11
ANSP-7	Proposed workshop area, Bunakha	47.10	45.05
ANSP-8	Zangtey (Part of Lobnekha Heritage Village)	49.09	48.30
ANSP-9	Nayakha village	40.28	36.53
ANSP-10	Chanachen village	NA	NA
	ES 2020 Limit (Mixed Area)	65 dBA	55 dBA
		< 53 dBA (Lden)² (for road traffic)	< 45 dBA (Lnight)² (for road traffic)

Note: Red values indicate exceedances of applicable ES 2020 or the WHO Environmental Noise Guidelines for the European Region (2018).

Table 14: Baseline ambient noise levels (Leq dBA) at the Bunakha HPP's Aol - wet season/Summer (July 2025)

Site ID	Location Name	Daytime Leq (06:00-22:00)	Night-time Leq (22:00-06:00)
ANSP-1	Fallow land, Labtsakha	53.11	48.78
ANSP-2	Colony Area, Tsimalakha	41.17	36.37
ANSP-3	Proposed Damsite, Bunakha	68.83	68.90
ANSP-4	Bunakha Lhakhang compound	39.96	39.00
ANSP-5	Adjacent to proposed quarry, Chanachen	47.31	46.44
ANSP-6	RCC Batching Plant Area, Chanachen	42.53	36.03
ANSP-7	Proposed workshop area, Bunakha	48.82	46.46
ANSP-8	Zangtey (Part of Lobnekha Heritage Village)	45.69	45.81
ANSP-9	Nayakha village	46.44	44.29
ANSP-10	Chanachen Village Centre	41.52	39.36
	ES 2020 Limit (Mixed Area)	65 dBA	55 dBA
	WHO 2018	< 53 dBA (Lden)² (for road traffic)	< 45 dBA (Lnight)² (for road traffic)

Note: Red values indicate exceedances of applicable ES 2020 or the stricter WHO Environmental Noise Guidelines for the European Region (2018).

5.4.2 Analysis of the Results

The baseline noise survey reveals a complex acoustic environment, characterized by quiet rural areas but also influenced by both natural and man-made (anthropogenic) noise sources.

Overall compliance and key exceedances

Baseline noise levels generally comply with Bhutan's ES 2020 national standards. The primary exception is the proposed damsite (ANSP-3), where, assumingly, the sound of the Wangchhu River at peak flow caused the night-time level to reach 68.90 dBA during the wet season, significantly exceeding the 55 dBA limit. This is deemed to be an exceedance caused by natural factors only.

However, the data also points to anthropogenic noise from highway traffic as a major issue. During the dry season, night-time levels at Tsimalakha (ANSP-2) and Bunakha Lhakhang (ANSP-4) exceeded the stricter WHO health-based guidelines (45 dBA).

Dominance of natural vs. anthropogenic noise

The acoustic environment is deemed defined by two dominant sources. The results point to the Wangchhu River as the primary natural source, creating high noise levels at the Dam site (ANSP-3), especially during the wet season. In contrast, away from the river, traffic on the Asian Highway 48 is deemed as the dominant anthropogenic source, influencing the noise environment for communities like Tsimalakha and Bunakha.

Identification of acoustically sensitive receptors

Three distinct types of sensitive receptors were identified:

1. Receptors in calm areas: Nayakha village (ANSP-9) and Chanachen Village (ANSP-10) are considered very sensitive to noise due to their low background noise levels, which are about 36-40 dBA. In these quiet places, any noise from construction or blasting will likely stand out and affect the community.
2. Areas with little room for extra noise: The Tsimalakha settlement (ANSP-2) is a sensitive receptor, especially at night. Its average noise level during the dry season is 53.09 dBA, which means there is less than 2 dBA of "margin" before the national limit of 55 dBA is reached.
3. Locations already above health guidelines: Bunakha Lhakhang (ANSP-4) and the Zangtey area of Lobneykha Heritage Village (ANSP-8) are concerning because their current noise levels are already higher than or very close to the World Health Organization's recommended limits. This means these areas are already experiencing high noise levels that could be harmful.

5.4.3 Discussion of the Implications

The initial noise data guides the future management of noise for both the community and workers involved in the Project.

Environmental noise management (community protection)

- The quiet background noise in places like Nayakha and Chanachen means that sounds from construction, such as blasting and heavy machinery, will be very noticeable. This big change in noise levels could lead to complaints from the community, even if the noise stays within legal limits.
- At the Damsite (ANSP-3): Noise levels often exceed the 55 dBA limit during the wet season, for which no extra noise can be tolerated.
- There is very little room for added noise at night (less than 2 dBA), so strict rules are needed to control night-time noise, especially from project-related traffic, to stay within the 55 dBA national standard.
- Communities along the highway, like Bunakha and Zangtey, are already facing high night-time noise levels that surpass the World Health Organization's safe guidelines. Thus, the project should follow national standards and take extra steps to avoid making the situation worse for residents.

Occupational noise management (worker protection)

- While environmental noise limits are between 55-65 dBA, the project must follow stricter worker health standards, keeping noise exposure to 85 dBA or lower over an 8-hour workday to protect hearing.
- Construction activities such as drilling, blasting, and operating heavy machinery inherently produce high noise levels, often exceeding 85 dBA near workers, a reality that is both expected and unavoidable. This is widely recognized across the construction, engineering, and occupational health sectors, with documented data showing that rock drills can reach 100–115 dBA, bulldozers and excavators typically operate at 90–105 dBA, and blasting events generate extremely high peak noise levels well beyond 115 dBA. These intensities underscore the critical need for effective noise mitigation and protective measures to ensure worker safety and regulatory compliance.
- Mandatory Hearing Conservation Program: Since there will definitely be dangerous noise levels, the Contractor's Environment, Health and Safety (EHS) Management Plan must include a Hearing Conservation Program. This is essential and should include:
 - Using quieter equipment: Prioritize quieter tools and schedule noisy activities wisely to reduce exposure.
 - Personal Protective Equipment (PPE): Workers must wear proper hearing protection, like earplugs or earmuffs, in all high-noise areas.
 - Training for workers: Provide thorough training about noise risks, symptoms of hearing loss, and how to use PPE correctly.
 - Monitoring noise levels: Regular checks to mark areas where hearing protection is necessary.
 - Health monitoring: Implement a medical program that includes initial and periodic hearing tests for all workers exposed to noise.

5.5 Baseline Water Quality

A comprehensive water quality monitoring program was implemented to establish the environmental baseline for the Bunakha Hydropower Project. The monitoring network was initially established with eight

(8) sampling sites during the dry season. This network was subsequently expanded to ten (10) sites during the wet season to include two (2) additional community water sources (SW-09 Nayakha chhu and SW-10 Chanachen Spring water). This expansion ensures full coverage of sensitive receptors, specifically addressing the finalized locations for support facilities such as the aggregate crushing and RCC batching plants in the Chanachen area. The complete network now comprises six (6) river sites along the Wangchhu River and its tributaries (Motolumchhu, Jililum chhu, & Zangteylum chhu), and four (4) key community water sources.

This report presents findings from three seasonal surveys: the dry/Spring season (April 2025), the wet/monsoon/Summer season (July 2025), and the post-monsoon/Autumn season (November 24-27, 2025). While the Terms of Reference (TOR) outline a four-season monitoring program, the final winter season survey has been deferred to the pre-construction phase (to be executed by the contractor). This decision was made to avoid delaying the ESIA reporting and to strictly adhere to the project's 120-day disclosure requirement. From a technical perspective, the absence of winter data in this report is considered low-risk; water quality characteristics during the winter are not expected to differ significantly from the dry season conditions already captured¹.

The primary objectives of this baseline analysis are to describe the chemical, physical, and bacteriological conditions of local water sources, check compliance with Bhutan's Environmental Standards (ES 2020) for Class B Rivers and drinking water, and set a clear benchmark for evaluating future impacts.

5.5.1 Results

The water in the Project area is chemically pure, highlighting the largely untouched and natural condition of the upper Wangchhu catchment and nearby community water sources. However, seasonal variations, especially in physical properties and bacterial levels, may pose challenges for Project operations and potential health risks for surrounding communities.

Tables 15 to 17 show the results of the water quality surveys.

Table 15: Water quality results at the Bunakha HPP's Aol - dry season/Spring (April 2025)

Parameter	Unit	SW-01 (Upstream Dam)	SW-02 (Downstream Dam)	SW-03 (Jililumchhu/ Upstream)	SW-04 (Jililumchhu/ Downstream)	SW-05 (Tsimasham Drinking Water)	SW-06 (Motolumchhu)	SW-07 (Chomteykha Spring)	SW-08 (Zanteylum chhu)	ES 2020 Standard (Class B)
Microbiological Parameters										
Total Coliform	MPN/100ml	8	8	6	8	6	8	12	8	< 5000
Faecal Coliform	MPN/100ml	6	6	4	4	2	6	8	4	< 2000
Faecal Streptococci	MPN/100ml	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	<1000
Physical Parameters										
pH at 25°C	-	7.75	7.87	7.97	7.87	7.36	7.04	7.84	8.04	6.0 - 9.0
Electrical Conductivity	µS/cm	82.8	103.6	96.4	110.3	117.2	124.1	105.3	88.1	< 1000
Total Suspended Solids (TSS)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 100
Total Dissolved Solids (TDS)	mg/L	48	58	54	64	68	72	60	52	< 1500
Turbidity	NTU	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	---
Colour	Hazen Units	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 50
Odour	-	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
Chemical Parameters										
Dissolved Oxygen (DO)	mg/L	7.6	7.9	7.8	8.2	7.4	7.8	8.2	8.2	> 4
Biochemical Oxygen Demand (BOD)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 5
Chemical Oxygen Demand (COD)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	---
Nutrients										
Nitrate (as NO ₃)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	---

Parameter	Unit	SW-01 (Upstream Dam)	SW-02 (Downstream Dam)	SW-03 (Jililumchhu/ Upstream)	SW-04 (Jililumchhu/ Downstream)	SW-05 (Tsimasham Drinking Water)	SW-06 (Motolumchhu)	SW-07 (Chomteykha Spring)	SW-08 (Zanteylum chhu)	ES 2020 Standard (Class B)
Phosphate (as PO ₄)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 0.1
Ammonia (as total ammonia - N)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 0.5
Total Kjeldahl Nitrogen (as N)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	---
Major Ions & Others										
Chloride (as Cl)	mg/L	9.9	3.5	5.9	7.9	7.9	7.9	7.9	9.9	< 200
Sulphate (as SO ₄)	mg/L	3.4	2.7	3.8	4.0	3.2	3.5	2.7	3.7	< 100
Fluoride (as F)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 2.0
Calcium Hardness (as CaCO ₃)	mg/L	24	28	20	12	16	20	8	24	---
Magnesium Hardness (as CaCO ₃)	mg/L	8	8	8	8	12	12	4	12	---
Sodium Absorption Ratio	-	0.54	0.82	0.51	0.64	0.51	0.44	0.89	0.43	< 26
Mineral Oil	mg/L	No film	No film	No film	No film	No film	No film	No film	No film	No film
Heavy Metals (all in mg/L)										
Dissolved Iron (as Fe)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 0.5
Copper (as Cu)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 0.5
Zinc (as Zn)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 0.5
Manganese (as Mn)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	---
Arsenic (as As)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 0.05
Cadmium (as Cd)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 0.003
Total Chromium (as Cr)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 0.05
Lead (as Pb)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 0.02

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Parameter	Unit	SW-01 (Upstream Dam)	SW-02 (Downstream Dam)	SW-03 (Jililumchhu/ Upstream)	SW-04 (Jililumchhu/ Downstream)	SW-05 (Tsimasham Drinking Water)	SW-06 (Motolumchhu)	SW-07 (Chomteykha Spring)	SW-08 (Zanteylum chhu)	ES 2020 Standard (Class B)
Mercury (as Hg)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 0.0005
Barium (as Ba)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	---
Boron (as B)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	---
Selenium (as Se)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 0.01
Organic Pollutants										
Phenolic Compounds	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 0.002
Surfactants	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 0.2
Total Pesticides	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 0.0005
Polychlorinated biphenyls (PCBs)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 0.0002
Polynuclear hydrocarbons (PAH)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 0.0002
Cyanide (as CN)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	< 0.05

Notes:

- Categorization of Sampling Sites:
 - Rivers and Tributaries (Class B River Standards apply): SW-01 (Wangchhu Upstream), SW-02 (Wangchhu Downstream), SW-03 (Jhililumchhu Upstream), SW-04 (Jhililumchhu Downstream), SW-06 (Motolumchhu), and SW-08 (Zanteylum chhu).
 - Community Drinking Water Sources (National Drinking Water Standards 2016 apply): SW-05 (Tsimasham), SW-07 (Chomteykha Spring).
- BDL (Below Detection Limit): This indicates that the concentration of the parameter was too low to be measured by the laboratory's analytical equipment. The specific detection limit for each parameter is provided in the laboratory test reports. For this table, all "BDL" results are in full compliance with the ES 2020 standards.
- "<" (Less Than): This symbol is used when the laboratory reports a result that is below a specific value (e.g., <2). This means the parameter was not detected at or above that value. For example, a Faecal Coliform result of <2 means no coliforms were detected, as the detection limit is 2 MPN/100ml.
- "—" (Dash): This indicates that no specific numerical standard is defined for that parameter under the Class B criteria in the ES 2020 standards.

Table 16: Water quality results at the Bunakha HPP's Aol - wet season/Summer (July 2025)

Parameter	Unit	SW-01 (Dam Upstream)	SW-02 (Dam Downstream)	SW-03 (Jhililumchhu / Upstream)	SW-04 (Jhililumchhu/ Downstream)	SW-05 (Tsimasham Drinking Water)	SW-06 (Motolumchhu)	SW-07 (Chomteykha Spring)	SW-08 (Zanteylum chhu)	SW-09 (Nayakha)	SW-10 (Chanachen Spring)	ES 2020 Standard (Class B)
Microbiological Parameters												
Total Coliform	MPN/100 ml	11	14	26	20	<2*	<2	<2	<2	<2	<2	< 5000
Faecal Coliform	MPN/100 ml	4	7	11	9	<2*	<2	<2	<2	<2	<2	< 2000
Faecal Streptococci	MPN/100 ml	<2	<2	<2	<2	NT	<2	<2	<2	<2	<2	<1000
Physical Parameters												
pH at 25°C	-	8.04	7.52	7.84	7.98	7.42	7.26	7.23	7.23	7.62	7.11	6.0 - 9.0
Electrical Conductivity	µS/cm	138	155	126	109	NT	133	74	118	83	96	< 1000
Total Suspended Solids (TSS)	mg/L	4	8	6	6	NT	<2.5	<2.5	<2.5	<2.5	<2.5	< 100
Total Dissolved Solids (TDS)	mg/L	82	94	78	68	NT	76	44	74	52	60	< 1500
Turbidity	NTU	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	---
Colour	Hazen Units	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	< 50
Odour	-	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
Chemical Parameters												
Dissolved Oxygen (DO)	mg/L	7.9	7.0	7.7	7.8	NT	7.4	7.6	7.9	7.3	7.9	> 4
Biochemical Oxygen Demand (BOD)	mg/L	<2	<2	<2	<2	NT	<2	<2	<2	<2	<2	< 5
Chemical Oxygen Demand (COD)	mg/L	<4	<4	<4	<4	NT	<4	<4	<4	<4	<4	---
Nutrients												
Nitrate (as NO ₃)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	---
Phosphate (as PO ₄)	mg/L	<0.15	<0.15	<0.15	<0.15	NT	<0.15	<0.15	<0.15	<0.15	<0.15	< 0.1
Ammonia (as total ammonia - N)	mg/L	<0.5	<0.5	<0.5	<0.5	NT	<0.5	<0.5	<0.5	<0.5	<0.5	< 0.5
Total Kjeldahl Nitrogen (as N)	mg/L	<0.1	<0.1	<0.1	<0.1	NT	<0.1	<0.1	<0.1	<0.1	<0.1	---
Major Ions & Others												

Parameter	Unit	SW-01 (Dam Upstream)	SW-02 (Dam Downstream)	SW-03 (Jhililumchhu Upstream)	SW-04 (Jhililumchhu/ Downstream)	SW-05 (Tsimasham Drinking Water)	SW-06 (Motolumchhu)	SW-07 (Chomteykha Spring)	SW-08 (Zanteylum chhu)	SW-09 (Nayakha)	SW-10 (Chanachen Spring)	ES 2020 Standard (Class B)
Microbiologic al Parameters												
Chloride (as Cl)	mg/L	13.6	19.4	9.7	11.7	NT	13.6	11.7	15.5	5.8	7.8	< 200
Sulphate (as SO ₄)	mg/L	5.3	5.6	4.8	4.6	4.0	4.4	4.1	4.8	4.2	6.3	< 100
Fluoride (as F)	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	< 2.0
Calcium Hardness (as CaCO ₃)	mg/L	23.3	34.9	23.3	23.3	15.5**	27.4	19.4	23.3	19.4	27.2	---
Magnesium Hardness (as CaCO ₃)	mg/L	11.6	19.4	15.5	11.6	NT	15.7	11.6	15.5	13.5	19.4	---
Sodium Absorption Ratio	-	1.24	0.84	0.79	0.79	NT	0.77	0.3	0.76	0.44	0.27	< 26
Mineral Oil	mg/L	No Film	No Film	No Film	No Film	NT	No Film	No Film	No Film	No Film	No Film	No film
Heavy Metals (all in mg/L)												
Dissolved Iron (as Fe)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	< 0.5
Copper (as Cu)	mg/L	<0.02	<0.02	<0.02	<0.02	NT	<0.02	<0.02	<0.02	<0.02	<0.02	< 0.5
Zinc (as Zn)	mg/L	<0.02	<0.02	<0.02	<0.02	NT	<0.02	<0.02	<0.02	<0.02	<0.02	< 0.5
Manganese (as Mn)	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	---
Arsenic (as As)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	< 0.05
Cadmium (as Cd)	mg/L	<0.002	<0.002	<0.002	<0.002	NT	<0.002	<0.002	<0.002	<0.002	<0.002	< 0.003
Total Chromium (as Cr)	mg/L	<0.05	<0.05	<0.05	<0.05	NT	<0.05	<0.05	<0.05	<0.05	<0.05	< 0.05
Lead (as Pb)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	< 0.02
Mercury (as Hg)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	< 0.0005
Barium (as Ba)	mg/L	<0.05	<0.05	<0.05	<0.05	NT	<0.05	<0.05	<0.05	<0.05	<0.05	---
Boron (as B)	mg/L	<0.5	<0.5	<0.5	<0.5	NT	<0.5	<0.5	<0.5	<0.5	<0.5	---
Selenium (as Se)	mg/L	<0.01	<0.01	<0.01	<0.01	NT	<0.01	<0.01	<0.01	<0.01	<0.01	< 0.01
Organic Pollutants												
Phenolic Compounds	mg/L	<0.001	<0.001	<0.001	<0.001	NT	<0.001	<0.001	<0.001	<0.001	<0.001	< 0.002
Surfactants	mg/L	<0.02	<0.02	<0.02	<0.02	NT	<0.02	<0.02	<0.02	<0.02	<0.02	< 0.2
Total Pesticides	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	NT	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	< 0.0005
Polychlorinated biphenyls (PCBs)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	NT	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	< 0.0002

Parameter	Unit	SW-01 (Dam Upstream)	SW-02 (Dam Downstream)	SW-03 (Jhililumchhu Upstream) /	SW-04 (Jhililumchhu/ Downstream)	SW-05 (Tsimasham Drinking Water)	SW-06 (Motolumchhu)	SW-07 (Chomteykha Spring)	SW-08 (Zanteylum chhu)	SW-09 (Nayakha)	SW-10 (Chanachen Spring)	ES 2020 Standard (Class B)
Microbiological Parameters												
Polynuclear hydrocarbons (PAH)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	NT	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	< 0.0002
Cyanide (as CN)	mg/L	<0.02	<0.02	<0.02	<0.02	NT	<0.02	<0.02	<0.02	<0.02	<0.02	< 0.05

Notes:

- Categorization of Sampling Sites:
 - Rivers and Tributaries (Class B River Standards apply): SW-01 (Wangchhu Upstream), SW-02 (Wangchhu Downstream), SW-03 (Jhililumchhu Upstream), SW-04 (Jhililumchhu Downstream), SW-06 (Motolumchhu), and SW-08 (Zanteylum chhu).
 - Community Drinking Water Sources (National Drinking Water Standards 2016 apply): SW-05 (Tsimasham), SW-07 (Chomteykha Spring), SW-09 (Nayakha Chhu), and SW-10 (Chanachen Spring).
- BDL (Below Detection Limit): This indicates that the concentration of the parameter was too low to be measured by the laboratory's analytical equipment. The specific detection limit for each parameter is provided in the laboratory test reports. For this table, all "BDL" results are in full compliance with the ES 2020 standards.
- "<" (Less Than): This symbol is used when the laboratory reports a result that is below a specific value (e.g., <2). This means the parameter was not detected at or above that value. For example, a Faecal Coliform result of <2 means no coliforms were detected, as the detection limit is 2 MPN/100ml.
- "—" (Dash): This indicates that no specific numerical standard is defined for that parameter under the Class B criteria in the ES 2020 standards.
- NT – Not Tested

Table 17: Water quality results at the Bunakha HPP's Aol - Post-Monsoon Season/Autumn (November 2025)

Parameter	Unit	SW-01 (Dam Upstream)	SW-02 (Dam Downstream)	SW-03 (Jhililum chhu / Upstream)	SW-04 (Jhililum chhu/ Downstream)	SW-05 (Tsimas ham Drinking Water)	SW-06 (Motol umchhu)	SW-07 (Chom teykha Spring)	SW-08 (Zantey lum chhu)	SW-09 (Naya kha)	SW-10 (Chan achen Spring)	ES 2020 Standard (Class B)
Microbiological Parameters												
Total Coliform	MPN/100ml	48	43	34	40	<2	<2	<2	<2	<2	<2	< 5000
Faecal Coliform	MPN/100ml	17	13	11	11	<2	<2	<2	<2	<2	<2	< 2000
Faecal Streptococci	MPN/100ml	2	6	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1000
Physical Parameters												
pH at 25°C	-	7.32	7.11	7.15	7.64	7.79	7.61	7.05	8.06	7.62	7.43	6.0 - 9.0
Electrical Conductivity	µS/cm	146	157	93	96	111	132	89	154	50	100	< 1000
Total Suspended Solids (TSS)	mg/L	6	8	4	4	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	< 100
Total Dissolved Solids (TDS)	mg/L	82	88	52	54	62	74	50	86	28	58	< 1500
Turbidity	NTU	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	---
Colour	Hazen Units	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	< 50
Odour	-	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
Chemical Parameters												
Dissolved Oxygen (DO)	mg/L	8.3	7.7	10.0	8.4	8.3	9.1	9.1	9.3	5.6	6.4	> 4
Biochemical Oxygen Demand (BOD)	mg/L	0.8	1.2	0.6	0.8	0.5	1.0	0.9	1.1	0.7	0.8	< 5
Chemical Oxygen Demand (COD)	mg/L	2.9	3.8	1.9	2.9	1.9	2.9	3.2	3.2	1.9	2.4	---
Nutrients												
Nitrate (as NO ₃)	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.28	<0.2	---

Parameter	Unit	SW-01 (Dam Upstream)	SW-02 (Dam Downstream)	SW-03 (Jhililum chhu / Upstream)	SW-04 (Jhililum chhu/ Downstream)	SW-05 (Tsimas ham Drinking Water)	SW-06 (Motol umchhu)	SW-07 (Chom teykha Spring)	SW-08 (Zantey lum chhu)	SW-09 (Naya kha)	SW-10 (Chan achen Spring)	ES 2020 Standard (Class B)
Phosphate (as PO ₄)	mg/L	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	< 0.1
Ammonia (as total ammonia - N)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	< 0.5
Total Kjeldahl Nitrogen (as N)	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	---
Major Ions & Others												
Chloride (as Cl)	mg/L	17.2	7.6	5.7	8.6	4.8	15.3	5.7	17.2	3.8	7.7	< 200
Sulphate (as SO ₄)	mg/L	10.7	5.9	5.2	7.2	5.1	18.1	6.2	19.5	4.9	8.5	< 100
Fluoride (as F)	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	< 2.0
Calcium Hardness (as CaCO ₃)	mg/L	29.1	32.8	14.6	18.2	25.5	25.5	10.9	25.5	10.9	14.6	---
Magnesium Hardness (as CaCO ₃)	mg/L	21.8	21.8	7.3	14.6	21.8	14.6	7.3	18.2	7.3	7.3	---
Sodium Absorption Ratio	-	0.53	0.66	0.86	0.44	0.41	0.61	0.77	0.73	0.27	0.96	< 26
Mineral Oil	mg/L	No Film	No Film	No Film	No Film	No Film	No Film	No Film	No Film	No Film	No Film	No film
Heavy Metals (all in mg/L)												
Dissolved Iron (as Fe)	mg/L	0.03	0.04	0.04	0.05	<0.02	0.03	<0.02	0.02	<0.02	0.04	< 0.5
Copper (as Cu)	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	< 0.5
Zinc (as Zn)	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	< 0.5
Manganese (as Mn)	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	---
Arsenic (as As)	mg/L	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	< 0.05
Cadmium (as Cd)	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	< 0.003

Parameter	Unit	SW-01 (Dam Upstream)	SW-02 (Dam Downstream)	SW-03 (Jhililum chhu / Upstream)	SW-04 (Jhililum chhu/ Downstream)	SW-05 (Tsimasham Drinking Water)	SW-06 (Motolumchhu)	SW-07 (Chomteykha Spring)	SW-08 (Zanteylum chhu)	SW-09 (Nayakha)	SW-10 (Chanachen Spring)	ES 2020 Standard (Class B)
Total Chromium (as Cr)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	< 0.05
Lead (as Pb)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	< 0.02
Mercury (as Hg)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	< 0.0005
Barium (as Ba)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	---
Boron (as B)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	---
Selenium (as Se)	mg/L	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	< 0.01
Organic Pollutants												
Phenolic Compounds	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	< 0.002
Surfactants	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	< 0.2
Total Pesticides	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	< 0.0005
Polychlorinated biphenyls (PCBs)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	< 0.0002
Polynuclear hydrocarbons (PAH)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	< 0.0002
Cyanide (as CN)	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	< 0.05

Notes:

- Categorization of Sampling Sites:
 - Rivers and Tributaries (Class B River Standards apply): SW-01 (Wangchhu Upstream), SW-02 (Wangchhu Downstream), SW-03 (Jhililumchhu Upstream), SW-04 (Jhililumchhu Downstream), SW-06 (Motolumchhu), and SW-08 (Zanteylum chhu).
 - Community Drinking Water Sources (National Drinking Water Standards 2016 apply): SW-05 (Tsimasham), SW-07 (Chomteykha Spring), SW-09 (Nayakha Chhu), and SW-10 (Chanachen Spring).
- BDL (Below Detection Limit): This indicates that the concentration of the parameter was too low to be measured by the laboratory's analytical equipment. The specific detection limit for each parameter is provided in the laboratory test reports. For this table, all "BDL" results are in full compliance with the ES 2020 standards.
- "<" (Less Than): This symbol is used when the laboratory reports a result that is below a specific value (e.g., <2). This means the parameter was not detected at or above that value. For example, a Faecal Coliform result of <2 means no coliforms were detected, as the detection limit is 2 MPN/100ml.
- "—" (Dash): This indicates that no specific numerical standard is defined for that parameter under the Class B criteria in the ES 2020 standards.

5.5.2 Detailed Seasonal Analysis

5.5.2.1 Physical Parameters (TSS, Turbidity, TDS, Conductivity)

Dry Season (April 2025): The hydrological system exhibited exceptional clarity across the board. Both the Rivers and Tributaries (SW-1, SW-2, SW-3, SW-4, SW-6, and SW-8) and the sampled Community Drinking Water Sources (SW-5 and SW-7) recorded Total Suspended Solids (TSS) and Turbidity below detectable levels. This reflects ideal low-flow conditions with minimal surface runoff. Total Dissolved Solids (TDS) and Electrical Conductivity were also low (e.g., TDS ~48–72 mg/L), indicating water with very little mineral content, typical of snowmelt and groundwater-fed mountain systems. *(Note: SW-9 and SW-10 were not yet part of the monitoring network during this phase).*

Wet Season (July 2025): The onset of the monsoon brought measurable changes, primarily affecting the Rivers and Tributaries. TSS levels rose to concentrations of 4–8 mg/L in the main river channels. While this remains well within Bhutan’s ES 2020 Class B standard (<100 mg/L), it clearly indicates the impact of surface runoff and erosion. Conductivity also increased in the river (reaching 155 µS/cm at SW-02 Dam Downstream), pointing to the flushing of minerals and salts from the catchment area.

For the Community Drinking Water Sources (SW-5, SW-7, SW-9, and SW-10), turbidity remained excellent at <1.0 NTU. (Note regarding SW-05: During this specific campaign, the laboratory analysis for SW-05 was strictly targeted to the limited parameter suite of the Bhutan Drinking Water Quality Standard 2016. Consequently, general physical parameters like TSS, TDS, and Conductivity were not tested [NT] by the lab, though visual and turbidity indicators remained clear).

Post-Monsoon Season (November 2025): By November, the physical characteristics of the water showed a clear divergence based on the source type and size:

- **Rivers and Tributaries (SW-1, SW-2, SW-3, SW-4, SW-6, SW-8):** The main Wangchhu rivers and its tributaries sites (SW-1 to SW-4) retained TSS levels similar to the wet season (4–8 mg/L), suggesting that fine sediments remain suspended in the larger water bodies even as flows recede. Conductivity also remained elevated compared to the dry season (146–157 µS/cm). However, the smaller tributaries within this category (SW-6 Motolumchhu and SW-8 Zanteylum chhu) cleared up significantly, with TSS returning to below detectable limits (<2.5 mg/L).
- **Community Drinking Water Sources (SW-5, SW-7, SW-9, SW-10):** All four community drinking water sources demonstrated pristine physical clarity, with TSS below detectable limits (<2.5 mg/L) and turbidity at <1.0 NTU. Full parameter testing resumed for SW-05 (Tsimasham Drinking Water) during this period, confirming excellent overall physical health (TDS at 62 mg/L and Conductivity at 111 µS/cm).

These findings suggest that while the main river system has a lingering sensitivity to suspended sediment loads, the local drinking water springs and smaller tributaries recover their physical clarity rapidly after the monsoon.

5.5.2.2 Bacteriological Parameters (Total and Faecal Coliforms)

Dry Season (April 2025): All sampled locations showed signs of bacteriological contamination. Within the Rivers and Tributaries (SW-1, SW-2, SW-3, SW-4, SW-6, and SW-8), Faecal Coliforms ranged from 4 to

6 MPN/100ml. Critically, the two Community Drinking Water Sources sampled during this phase (SW-5 and SW-7) also recorded Faecal Coliform levels of 2 and 8 MPN/100ml respectively, failing to meet Bhutan's ES 2020 drinking water standard (0 MPN/100ml or "Not Detected"). This suggests a baseline of low-level pollution from animal or human waste during low-flow periods. *(Note: SW-9 and SW-10 were added in the wet season and not sampled during this phase).*

Wet Season (July 2025): Contamination persisted and slightly increased within the Rivers and Tributaries group, particularly at the main river sites (SW-1 to SW-4), where Faecal Coliform counts rose to 4–11 MPN/100ml as surface runoff flushed pollutants into the main channels. In contrast, all four Community Drinking Water Sources (SW-5, SW-7, SW-9, and SW-10) showed non-detectable or very low levels (<2 MPN/100ml), likely due to the high dilution factor of heavy monsoon rains.

Post-Monsoon Season (November 2025): A distinct contrast emerged in the microbiological profile based on the type and size of the water body:

- **Main River Deterioration:** The main river sites within the Rivers and Tributaries category (SW-1 to SW-4) showed the highest contamination levels of the year. Total Coliforms reached 48 MPN/100ml and Faecal Coliforms peaked at 17 MPN/100ml (SW-01). This increase during the recession of high flows is attributed to a "concentration effect," as water volumes decrease while localized pollutant loads from the catchment remain.
- **Clear Tributaries and Community Sources:** The smaller streams within the Rivers and Tributaries group (SW-6 Motolumchhu, SW-8 Zanteylum chhu) and all four Community Drinking Water Sources (SW-5, SW-7, SW-9, SW-10) were found to be bacteriologically clean (<2 MPN/100ml for both Total and Faecal Coliforms).

Conclusion: Despite the clean results during the wet and post-monsoon periods for the community sources, the confirmed presence of faecal contamination during the dry season demonstrates that these drinking water supplies are highly vulnerable to seasonal fluctuations. Therefore, no community spring in the project area can be considered safe for year-round consumption without proper water treatment.

5.5.2.3 Chemical Parameters (pH, DO, Nutrients, Heavy Metals)

The chemical quality of water across the Project area, encompassing both the Rivers/Tributaries and the Community Drinking Water Sources is outstanding and remained consistently stable across all three monitored seasons.

- **pH:** Levels remained neutral to slightly alkaline (ranging from 7.04 to 8.06) across all 10 sites, which is well within both the Class B River and National Drinking Water standards, representing ideal conditions for aquatic life and human consumption.
- **Dissolved Oxygen (DO):** The surface waters remain exceptionally well-oxygenated. Notably, DO levels reached their peak during the cooler Post-Monsoon season, recording a high of 10.0 mg/L at SW-03 (Jhililumchhu tributary), indicating a robust and healthy aquatic ecosystem capable of supporting sensitive species.
- **Organics (BOD and COD):** During the Dry and Wet seasons, Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) were generally below detection limits across all relevant sites. In the Post-Monsoon season, trace levels of BOD (0.5–1.2 mg/L) and COD (1.9–3.8 mg/L) were detected across the network. These values are extremely low, well within all environmental

standards, and simply indicate a natural, slight accumulation of decomposing organic matter following the heavy monsoon biomass flush.

- **Nutrients (Nitrates, Phosphates):** Nutrient levels were consistently negligible, remaining well below the required thresholds for both river classifications and drinking water safety, indicating no significant agricultural fertilizer runoff in the immediate catchments.
- **Pollutants and Heavy Metals:** Across all three seasons, tests for heavy metals (Lead, Mercury, Cadmium, Arsenic, Chromium) and toxic organic pollutants (Phenols, Pesticides, PAHs, Cyanide) returned results that were consistently Below Detection Limits (BDL) or well below permissible standards at all 10 monitoring locations.

This data establishes a pristine chemical baseline for the entire hydrological network. Because the natural background levels of industrial pollutants and heavy metals are effectively zero, any future detection of these substances such as hydrocarbons from workshops or alkalinity from batching plants will serve as a clear, undeniable indicator of Project-related impact.

5.5.2.4 Analysis of Community Drinking Water Sources

To resolve any ambiguity between surface water bodies and actual human supply points, the ten water monitoring locations have been strictly categorized. Four specific locations within the Area of Influence have been definitively identified as existing or potential community drinking water supplies. Unlike the river and tributary sites (SW-01 through SW-04, SW-06, and SW-08), these four sources must be evaluated against the stricter safety thresholds of the Bhutanese Drinking Water Quality Standards (2016):

- SW-05: Tsimasham Drinking Water
- SW-07: Chomteykha Spring Water
- SW-09: Nayakha Chhu (a stream directly utilized by Nayakha village as a primary water source)
- SW-10: Chanachen Village Spring

For these four critical community sources, the seasonal monitoring reveals the following baseline conditions to inform Project planning and worker health strategies:

1. **Chemical Safety (Excellent Baseline):** Across all monitored seasons (Dry, Wet, Post-Monsoon), these four sources were found to be chemically pristine. No heavy metals, toxic organic compounds, or harmful agricultural nutrients were detected. From a purely chemical standpoint, these sources are safe for consumption and establish a zero-tolerance baseline against future project-induced spills (e.g., hydrocarbons or cement runoff).

2. **Microbiological Vulnerability (High Risk):** Despite their chemical purity, the biological safety of these sources fluctuates significantly with the seasons, making them unreliable.

- **Dry Season (High Risk):** Contamination from Faecal Coliforms was detected in the sampled drinking water sources (specifically SW-05 and SW-07, recording 2 and 8 MPN/100ml respectively). This violates the national standard of zero detectable coliforms, indicating a persistent baseline of low-level human or animal waste pollution during low-flow periods.
- **Wet & Post-Monsoon Seasons (Low Risk):** During the heavier flow periods, all four sources appeared bacteriologically clean (<2 MPN/100ml), likely due to the high dilution factor of monsoon rains and subsequent systemic flushing.

The presence of confirmed faecal contamination during the dry season renders these natural sources fundamentally unreliable for direct human consumption. The clear results observed in July and November do not negate the health risks identified in April. Therefore, the Project cannot rely on the raw, untreated water quality of these springs being consistently safe year-round. All project camps and offices must implement active water treatment and disinfection protocols.

5.5.3 Key Implications for the Project

The findings of the three-season water quality baseline carry specific, actionable implications for the Project's design and the Environmental and Social Management Plan (ESMP):

1. Erosion and Sediment Control Requirements: The persistence of Total Suspended Solids (TSS at 4–8 mg/L) in the main Wangchhu River during the low-flow post-monsoon season indicates that fine sediments in this catchment take considerable time to settle. Because the river system demonstrates a high sensitivity to runoff-induced turbidity, the ESMP must mandate strict, engineered sediment control measures (e.g., multi-stage settling ponds, silt fencing, and progressive revegetation of muck dumps) for all earth-moving and quarrying activities to prevent compounding this natural sediment load.

2. Mandatory Water Treatment and Provision: The confirmed presence of Faecal Coliforms during the dry season, coupled with high bacterial loads in the main river during post-monsoon flushing proves that no raw water source in the Project area can be deemed safely potable year-round. In strict compliance with the ADB Safeguard Policy Statement (SPS 2009) and Bhutanese occupational health regulations, the Project is mandated to provide clean, treated drinking water to all workers.

- Permanent Staff: Because permanent project staff will be housed at the existing Chukha Hydropower Colony, which already operates a functional, centralized Water Treatment Plant (WTP), no new heavy water infrastructure is required for them.
- Construction Workforce: To ensure strict health compliance without over-engineering, the Detailed Project Report (DPR) and ESMP must mandate the installation of scalable, modular package-type water treatment units (incorporating physical filtration and UV or chlorination disinfection) dedicated exclusively to all temporary labour camps and active construction site offices.

3. Zero-Tolerance Baseline for Chemical Pollution: The consistent absence of chemical pollutants, specifically heavy metals, toxic organics, and hydrocarbons across all seasons establishes a pristine, "zero-tolerance" chemical baseline. Because the natural background levels of these contaminants are effectively zero, regular water quality monitoring during construction is paramount. Any future detection of oil, grease, or heavy metals must be treated as a direct result of Project activities, automatically triggering immediate site investigation, root-cause analysis, and corrective action under the ESMP.

5.6 Baseline Soil Quality

A baseline soil quality assessment was carried out to understand the physical and chemical condition of soil across key locations in the Bunakha HPP area before construction begins.

The initial survey in April 2025 covered four (4) general sites (SSP-1 to SSP-4). The survey area was expanded in July 2025 to include four (4) additional targeted locations (SSP-05 to SSP-08) aligned with the planned footprints of major facilities such as the workshop, labour camps, and batching plant.

The assessment aimed to document soil texture and nutrient levels, check for any existing contamination from heavy metals or pollutants, evaluate the suitability of topsoil for future landscaping, and establish a clear benchmark for monitoring construction-related impacts. Since Bhutan’s Environmental Standards (ES 2020) do not specify soil quality limits, results were compared against the Canadian CCME Soil Quality Guidelines for Residential/Parkland use.

5.6.1 Results

Table 18 shows the results of the baseline soil surveys.

Physical properties

Soils are predominantly loamy, ranging from Sandy Loam to Sandy Clay Loam—ideal for agriculture and revegetation. pH levels are acidic to near-neutral (4.65–6.94), providing a useful baseline for detecting future chemical changes. Porosity (36–46%) and water holding capacity (32–43%) are moderate and typical of loamy soils.

Nutrient and organic content

Organic carbon levels vary, with most sites showing healthy values (>0.95%), indicating rich topsoil suitable for rehabilitation. Nitrogen, phosphate, and potassium levels are generally adequate, confirming soil fertility across the area.

Heavy metals and contaminants

All tested sites showed concentrations of heavy metals—including arsenic, cadmium, mercury, lead, chromium, and nickel—well below CCME guideline limits. No signs of industrial or human-caused contamination were found, confirming a pristine chemical baseline.

Table 18: Baseline soil quality results at the Bunakha HPP’s Aol (Initial campaign: dry season/April 2025; Revised footprint campaign: wet season/July 2025)

Sl. No.	Test Parameter	Unit	April 2025				July 2025				CCME Guideline ¹ (Residential/ Parkland)
			Result (SSP-1)	Result (SSP-2)	Result (SSP-3)	Result (SSP-4)	Result (SSP-05)	Result (SSP-06)	Result (SSP-07)	Result (SSP-08)	
1	Texture	-	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Clay	Sandy Clay Loam	Sandy Loam	Sandy Loam	Sandy Clay Loam	—
2	Moisture Content	%	2.6	2.6	2.4	1.8	3.7	2.8	2.3	2.9	—
3	Alkalinity (as CaCO ₃)	mg/kg	134	114	128	136	158	118	116	126	—
4	Acidity (as CaCO ₃)	mg/kg	12	14	14	22	10	22	38	28	—
5	Porosity	%	46	42	44	36	42	46	40	44	—
6	pH at 25°C	-	4.65	5.56	5.76	6.94	6.91	5.88	5.09	5.54	—
7	Electrical Conductivity at 25 °C	mS/cm	0.06	0.13	0.16	0.21	0.07	0.08	0.03	0.03	—
8	Nitrogen (as N)	mg/kg	86	118	122	162	163	121	106.6	134.6	—
9	Phosphate (as P)	mg/kg	10.8	14.8	26.1	22.4	12.3	11.7	17.2	16.7	—
10	Potassium (as K)	mg/kg	66	42	68	76	78	81	73	91	—
11	NPK	Ratio	5:1:3	5:1:3	4:1:1	5:1:2	6:1:3	5:1:4	3:1:2	4:1:3	—

Sl. No.	Test Parameter	Unit	April 2025				July 2025				CCME Guideline ¹ (Residential/ Parkland)
			Result (SSP-1)	Result (SSP-2)	Result (SSP-3)	Result (SSP-4)	Result (SSP-05)	Result (SSP-06)	Result (SSP-07)	Result (SSP-08)	
12	Calcium (as Ca)	mg/kg	726	994.7	846	739	1155	1045	1540	739	—
13	Magnesium (as Mg)	mg/kg	238	548.6	384	328	330	363	528	328	—
14	Chloride(as Cl)	mg/kg	77.8	69	59	77.9	82	58	74	77.9	—
15	Sulphate (as SO ₄)	mg/kg	16.4	16.2	28.9	21.8	12.3	12.8	22.3	21.8	—
16	Carbonate	mg/kg	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	—
17	Boron (as B)	mg/kg	1.9	2.2	2.1	2.6	2.3	1.8	1.3	2.6	—
18	Sodium (as Na)	mg/kg	48.6	88.1	84.8	89.3	52.4	38.3	54.7	61.6	—
19	Cation Exchange Capacity	meq/100gm	11.95	20.13	15.89	13.97	17.86	17.19	24.97	24.58	—
20	Arsenic (as As)	mg/kg	BDL	BDL	BDL	BDL	<0.25	<0.25	<0.25	<0.25	12
21	Cadmium (as Cd)	mg/kg	BDL	BDL	BDL	BDL	<0.2	<0.2	<0.2	<0.2	1.4
22	Mercury (as Hg)	mg/kg	BDL	BDL	BDL	BDL	<0.1	<0.1	<0.1	<0.1	6.6
23	Nickel (as Ni)	mg/kg	4.8	3.8	2.8	3.6	3.9	3.3	5.92	5.28	50
24	Manganese (as Mn)	mg/kg	10.2	8.4	11.4	8.4	12.4	9.26	14.3	14.3	1900
25	Hexavalent Chromium (as Cr ⁺⁶)	mg/kg	BDL	BDL	BDL	BDL	<0.5	<0.5	<0.5	<0.5	0.8
26	Lead (as Pb)	mg/kg	BDL	BDL	BDL	BDL	1.2	1.7	3.4	2.6	70
27	Iron (as Fe)	mg/kg	86.4	62.8	86.7	88.7	143.4	194	212.6	229	—
28	Copper (as Cu)	mg/kg	4.6	6.4	10.6	7.4	3.1	4.32	14.6	6.76	63
29	Zinc (as Zn)	mg/kg	9.2	12.7	18.7	12.3	23.2	26.9	38.7	38.3	200
30	Sodium Adsorption Ratio(SAR)	-	0.4	0.56	0.6	0.68	0.23	0.2	0.14	0.21	500
31	Organic Carbon	%	2.3	1.23	1.44	0.37	1.2	0.95	0.76	0.48	64
32	Organic Matter	%	3.97	2.12	2.48	0.64	2.07	1.64	1.31	0.83	50
33	Water Holding capacity	%	36	38	40	32	39	32	43	41	5
34	Barium (as Ba)	mg/kg	BDL	BDL	BDL	BDL	<1.0	<1.0	<1.0	<1.0	1.6
35	Total Chromium(as Cr)	mg/kg	BDL	BDL	BDL	BDL	<0.5	2.33	4.84	6.67	12
36	Cobalt (as Co)	mg/kg	BDL	BDL	BDL	BDL	<4.0	<4.0	<4.0	<4.0	1.4
37	Molybdenum (as Mo)	mg/kg	BDL	BDL	BDL	BDL	<0.5	<0.5	<0.5	<0.5	6.6
38	Cyanide (as CN)	mg/kg	BDL	BDL	BDL	BDL	<0.4	<0.4	<0.4	<0.4	50

BDL = Below Detection Limit. All results are well below international screening levels for residential/parkland use.

5.6.2 Discussion of the Implications

The absence of heavy metal contamination provides a “clean slate,” meaning any future detection of pollutants can be linked to Project activities. This supports the need for accountability and enforcement under the Environmental and Social Management Plan (ESMP).

The high-quality topsoil at most sites is a valuable resource. A Muck Management Plan must be included in the ESMP to ensure proper stripping, storage, and reuse for post-construction rehabilitation.

The baseline data enables a focused soil monitoring strategy. Regular testing should be conducted near high-risk areas such as batching plants, fuel depots, and equipment yards, targeting pH shifts, heavy metals, and hydrocarbons (e.g., TPH). This approach ensures early detection and timely response to any contamination, helping preserve the area's natural soil integrity.

6 Sensitive Environmental Receptors

A key objective of the baseline survey was to identify and characterize the sensitive environmental and social receptors within the Project's Aol. These receptors are the specific locations, communities, or sites that are most vulnerable to potential adverse impacts from the Project, such as increased noise, dust, water and soil pollution, or social disruption. The following sections detail these receptors, providing the context for the targeted mitigation measures that will be developed in the Environmental and Social Management Plan (ESMP).

The baseline data reveals a landscape where specific locations are highly sensitive to particular types of impacts. The key sensitivities that must be addressed by the Project's design and management plans are:

- Acoustic and air quality sensitivity in Chanachen: Due to the co-location of multiple high-impact facilities (quarry, crushers, batching plants) near the village, Chanachen is the Project's primary hotspot for noise and dust impacts.
- Noise intrusion sensitivity in Nayakha and Tsimalakha: Nayakha is highly sensitive due to its pristine acoustic environment, while Tsimalakha is sensitive due to its proximity to the regulatory night-time noise limit. Stringent noise management protocols are required.
- Water source protection: The pristine quality of community springs (e.g., Chomteykha, Chanachen) makes them critically sensitive to any form of contamination. Their protection shall be an environmental management priority.
- Cultural heritage integrity: The proximity of construction activities and traffic to sites like Bunakha Lhakhang necessitates specific mitigation measures for noise, vibration, and dust to preserve their cultural and spiritual integrity.

The following chapters describe in further detail the key sensitive receptors and proposed measures to avoid or mitigate risks and impacts.

6.1 Key Communities

Several permanent settlements are located within the Aol and are considered primary sensitive receptors due to their proximity to proposed construction activities and transport corridors. The location of these settlements is highlighted in Figure 8

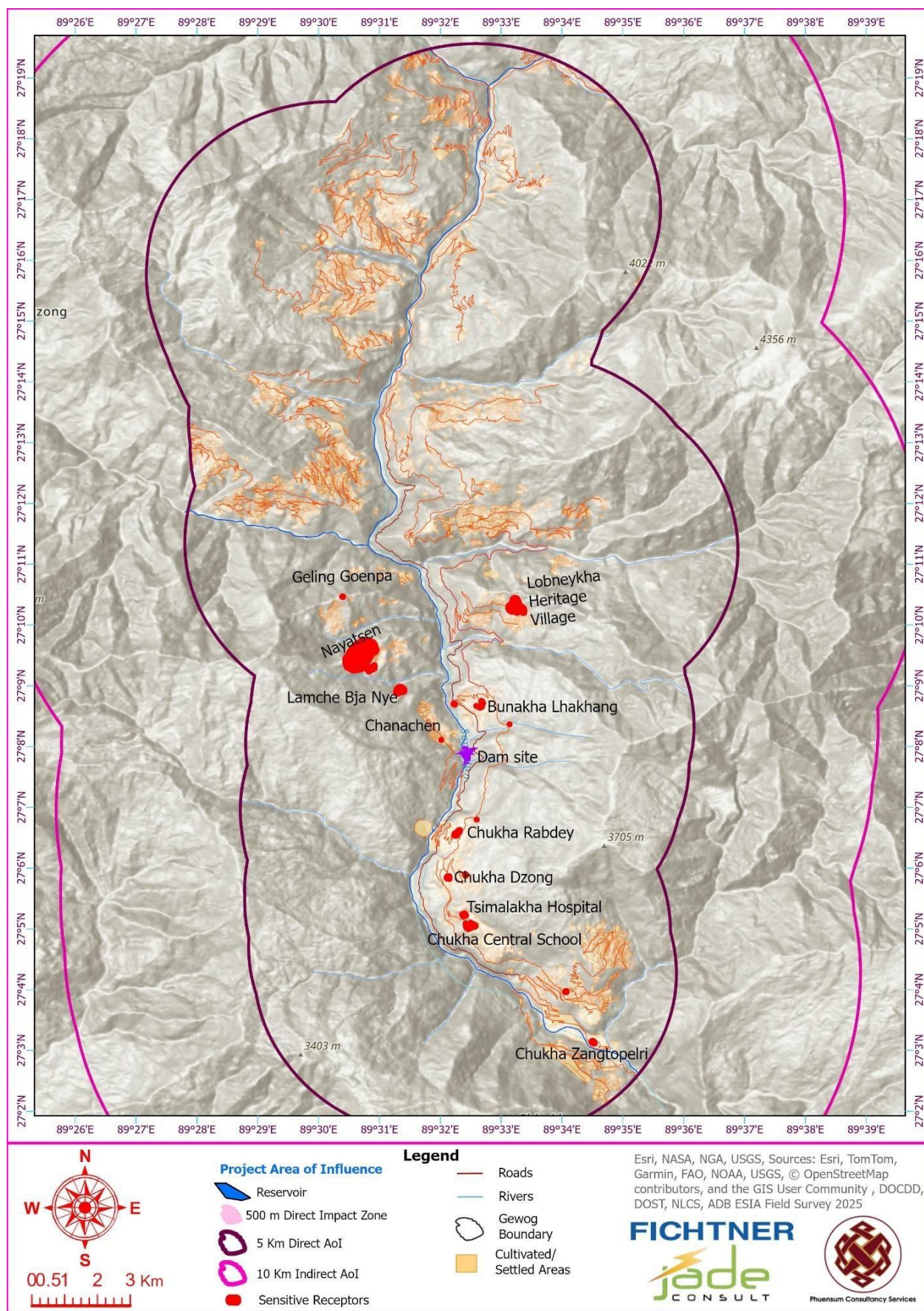


Figure 8: Key sensitive communities in the Bunakha HPP's AoI

6.1.1 Chanachen Village

Located on the right bank of the Wangchhu River, it is the most critically sensitive community within the Project's Aol due to its immediate proximity to high-impact facilities such as the main quarry, aggregate crushing units, and RCC/CVC batching plants. This positioning exposes residents to persistent noise, dust, vibration, and heavy traffic, creating a hotspot for cumulative environmental and social stress.

Baseline data from monitoring station ANSP-10 indicate an exceptionally quiet acoustic environment, meaning even moderate construction noise could cause significant disturbance and community dissatisfaction. Additionally, air quality monitoring reveals consistent exceedances of WHO guidelines for Nitrogen Dioxide (NO₂), pointing to a pre-stressed airshed with little tolerance for added emissions. The village's drinking water source (SW-10) is also vulnerable to contamination from nearby Project related activities. These factors collectively highlight Chanachen's sensitivity and reinforce the need for rigorous, source-level mitigation measures to be incorporated into the Environmental and Social Management Plan.

6.1.2 Nayakha Village

Situated further upstream, this village is identified as a sensitive receptor due to its extremely quiet acoustic environment and poor atmospheric dispersion characteristics. Baseline data from ANSP-9 revealed the lowest noise levels and the highest frequency of calm wind conditions (50%). This makes the community potentially vulnerable to noise intrusion (as they are accustomed to quiet conditions) and the local accumulation of air pollutants from construction traffic.

6.1.3 Bunakha Village

Bunakha Village, located on the eastern bank of the Wangchhu River, is a key residential and agricultural hub within the Project's Aol and home to the culturally significant temple Bunakha Lhakhang. The village lies directly along Asian Highway 48 (AH48), the main transport corridor for Project logistics, and near a proposed Project campsite (SSP-4), making it highly sensitive to traffic and construction-related impacts.

While shielded from direct construction at the dam and quarry sites, Bunakha faces risks from increased air pollution, noise, and vibration due to heavy vehicle movement. Baseline data shows existing exceedances of WHO guidelines for NO₂, O₃, and PM_{2.5}, a noise environment nearing disturbance thresholds, pristine soil vulnerable to contamination, and high-quality water sources at risk. These conditions make the village particularly sensitive to further environmental stress.

To mitigate impacts, the Project must implement targeted air, noise, and soil monitoring; develop community/public health and safety management measures to address traffic safety for AH48 through Bunakha; enforce strict controls on fuel and waste at ancillary facilities; protect water sources; and conduct structural and vibration assessments for Bunakha Lhakhang to preserve its integrity.

6.1.4 Tsimalakha Village

Tsimalakha is a key regional center that hosts critical facilities like the Tsimalakha Hospital and the Chukha Central School (). This makes the town a home to vulnerable populations such as children, the elderly, and patients who are especially sensitive to air and noise pollution. Additionally, and although the main Project traffic will bypass the town via Asian Highway 48, internal vehicle movements—particularly those linked to the proposed Bunakha HPP colony—are expected to impact the local road network.

Baseline data from monitoring station ANSP-2 shows elevated night-time noise levels (53.09 dBA) nearing Bhutan's national limit, along with NO₂ concentrations exceeding WHO guidelines, indicating a stressed environment with limited tolerance for additional disruption.

The Chukha Central School is centrally located within the Tsimalakha settlement between the hospital and the proposed Bunakha HPP Colony adjacent to environmental monitoring station ANSP-2 and water sampling point SW-5, making these data sources directly representative of its baseline conditions, which already show compromised air quality—particularly elevated NO₂ levels—and minimal acoustic headroom, with night-time noise nearing national limits. The school is a highly sensitive receptor due to its large population of children and its proximity to the main internal road used for project logistics. Although shielded from the main AH48 bypass, the school faces significant risks from local Project traffic.

The Tsimalakha Hospital, positioned on the northwestern edge of the settlement, is a vital healthcare facility and highly sensitive receptor, located approximately 1 to 1.2 kms from the proposed Bunakha HPP colony on the southeastern edge. Although the main project traffic will use the Damchu-Chukha bypass via Asian Highway 48—avoiding direct passage through the settlement—the hospital remains exposed to localized project-related traffic accessing the colony, Tsimalakha Bazar, and other internal facilities.

Specific risks for the town, the school and the hospital include threats to pedestrian safety, especially for schoolchildren; interference with learning and recovery environments due to noise; and potential delays in emergency access to the hospital.

To address these concerns, traffic safety measures must be prepared for Tsimalakha's internal roads, developed in consultation with local authorities. Proposed are night-time noise controls, designation of low-speed school zones, preparation of a dedicated school zone protocol prohibiting heavy vehicle movement during student arrival and departure times, enforcing low speed limits, installing safety signage and crossings, and mandating driver safety training. The uninterrupted emergency access to the hospital must be guaranteed.

Direct consultation with the hospital and the school administrations and local authorities is essential to coordinate logistics and safeguard emergency access, while environmental monitoring at station ANSP-2 and SW-5 should be used to track changes in air quality, water quality and noise levels.

6.2 Religious and Cultural Heritage Sites

The Project's Aol is embedded within a culturally significant landscape, encompassing over 30 religious and heritage sites. For assessment purposes, these sites are categorized by their proximity to construction zones and the level of potential impact. Those closest to major construction areas—such as the dam, quarry, batching plants, and transport corridors—are considered high-risk due to their exposure to noise, vibration, dust, and visual disruption. In contrast, many sites located in the remote upstream sections of the Aol are shielded by distance and terrain, making them less vulnerable to direct impacts. While these sites are acknowledged as part of the broader cultural context, they are not prioritized for immediate mitigation.

Figure 9 shows the location of the religious and cultural heritage sites within the Project's Aol.

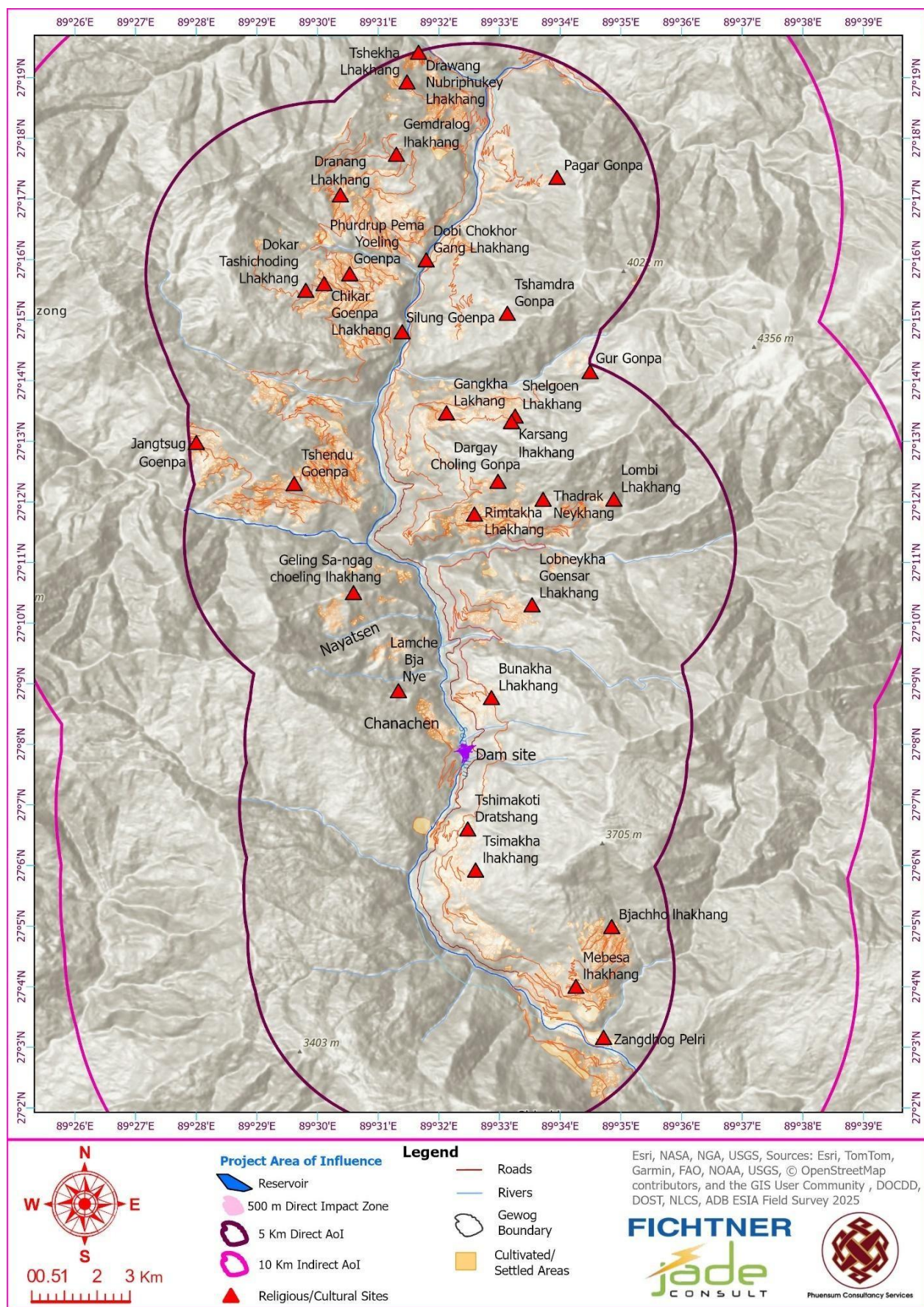


Figure 9: Key sensitive religious and cultural heritage sites in the Bunakha HPP's AoI

6.2.1 High-Risk Sites and Specific Sensitivities

The following locations are identified as particularly vulnerable and require focused protection and management:

- **Bunakha Lhakhang:** A prominent temple situated on the eastern riverbank, directly adjacent to the main access road. Its visibility from the proposed quarry and proximity to traffic routes make it highly susceptible to construction-related noise, vibration, and dust.
- **Lamche Bja (Elephant Cliff):** A spiritually revered cliff located upslope from the proposed quarry. During the public consultation held in Chanachen in July 2025, community members identified this as a critical issue. They expressed significant fear that blasting could disturb protective deities, raising a primary spiritual and cultural concern, while also voicing geotechnical concerns about the stability of the cliff face.
- **Lobnekha Heritage Village:** Positioned 3–4 km north-northeast of the main activity zone, this settlement lies directly downwind. Prevailing wind patterns increase its exposure to airborne pollutants, including dust and combustion emissions.
- **Nayatsen and Tsho Sacred Sites & Geling Goenpa:** Located northwest of the Project site, these sacred sites and the active monastery share a downwind position. Baseline data indicates poor air dispersion and a quiet soundscape, making them highly sensitive to dust and low-frequency noise from blasting operations.

6.2.2 Sites with Low to Negligible Risk

Several other cultural sites within the AoI are considered low-risk due to their distance from construction activities. These are located several kilometers upstream of the Bunakha HPP dam axis and consist of a cluster of temples and monasteries—such as Tshekhha Lhakhang, Drawang Nubriphukey Lhakhang, Pagar Gonpa, and Dobi Chokhor Gang Lhakhang.

7 Summary and recommendations

This report presents the findings of the comprehensive baseline environmental survey for the Bunakha Hydropower Project. The data herein provides the foundational basis for the subsequent Environmental and Social Impact Assessment (ESIA) and the development of a targeted Environmental and Social Management Plan (ESMP).

The monitoring approach was tailored to each environmental component:

- **Air, Noise, and Wind:** Baseline monitoring was completed over two distinct periods representing environmental extremes: the dry season (April 2025) and the wet season (July 2025).
- **Water Quality:** While the TOR stipulates a four-season monitoring program, this report presents findings from three campaigns: dry, wet, and post-monsoon (November 2025). The final winter season survey has been deferred to the pre-construction phase (to be executed by the contractor) to ensure the ESIA meets the strict 120-day disclosure deadline. From a technical standpoint, winter water quality conditions are considered analogous to the dry season, rendering the current three-season dataset robust for baseline assessment.
- **Soil Quality:** As the TOR does not specify a seasonal monitoring requirement, the full pre-construction baseline has been established based on samples collected across both survey periods.

The main results are summarized as follows:

Air Quality

The project area is a sensitive airshed already heavily impacted by regional traffic on the Thimphu-Phuentsholing highway. This results in a critical, year-round issue with Nitrogen Dioxide (NO₂), which consistently exceeds WHO health guidelines at all locations. The dry season exacerbates this, creating critical pollution episodes with widespread, severe exceedances of WHO guidelines for Fine Particulate Matter (PM_{2.5}) and Ozone (O₃) due to atmospheric stagnation and photochemical smog.

Noise Environment

The noise environment is a mix of quiet rural zones and areas influenced by natural and anthropogenic sources. The Wangchhu River naturally elevates ambient noise levels above the 55 dBA nighttime limit during the wet season. Highway traffic further impacts communities like Tsimalakha and Bunakha, pushing levels beyond safe WHO guidelines. Conversely, areas like Nayakha and Chanachen are acoustically pristine and highly sensitive, while Tsimalakha has a low tolerance for additional noise due to existing exceedances.

Water Quality

The Wangchhu River system and local tributaries are in excellent chemical health, consistently free from industrial pollutants, heavy metals, and toxic nutrients across all three monitored seasons. However, microbiological safety is a critical concern. While community springs appeared cleaner during the post-monsoon survey, the detection of Faecal Coliforms during the dry season confirms that these sources are vulnerable to seasonal contamination. Furthermore, the main river showed a spike in bacterial load during

the post-monsoon low-flow period. Consequently, no source in the area can be considered potable without treatment.

Soil Condition

The soil across the project footprint is in a pristine condition, with no pre-existing industrial or heavy metal contamination. This establishes a "clean slate" for future monitoring. The high organic content at most sites confirms that the existing topsoil is a valuable resource for future site rehabilitation.

Key Environmental Hotspots and Risks

The baseline data has enabled the identification of specific environmental hotspots and key risks that require focused attention during the Project's design and implementation:

- **Chanachen village (Impacts' Hotspot):** The planned co-location of the quarry, aggregate crushing units, and RCC/CVC batching plants makes Chanachen the most critical hotspot for impacts from dust, noise, and vibration on a community with a pre-stressed airshed and a pristine acoustic environment.
- **The Highway Corridor (Primary Pollution Source):** The Thimphu-Phuentsholing Highway (AH48) is the dominant source of regional air pollution, particularly for NO₂. Any project-related traffic will add a cumulative impact to this already stressed corridor, affecting communities like Bunakha and Tsimalakha.
- **Community Water Sources (Primary Health Risk):** The pristine chemical quality but seasonally contaminated bacteriological status of community springs makes them a critical resource to protect. The primary risk is chemical contamination from Project activities (fuel/chemical storage or camp wastewater), which would degrade their currently pristine chemical state.
- **Downwind Communities (Nayakha and Lobnekha):** These remote villages are confirmed downwind sensitive receptors, vulnerable to airborne pollutants transported from the main Project activity zones.

Recommendations for the ESIA/ESMP

1. Targeted Mitigation for Chanachen (Hotspot): The ESMP must include a dedicated sub-plan with stringent, targeted mitigation measures for the Chanachen community due to its proximity to the batching and crushing plants. Because large-scale external noise barriers may be topographically unfeasible, the project must rely on strict source-control engineering: fully covered conveyors, acoustic enclosures around crushers, and strict enforcement of daytime-only operating hours to protect the night-time acoustic environment. Furthermore, extensive water suppression systems must be deployed, utilizing water drawn strictly from the Wangchhu River (not from community springs or municipal lines) to avoid depleting local resources.

2. Air Quality Management: Management must be at its most rigorous during the dry season, focusing on controlling PM_{2.5}, NO_x, O₃ and CO. Year-round, the primary focus must be on minimizing NO_x emissions through strict equipment maintenance schedules and idling bans for all project machinery and vehicles, avoiding further exacerbation of the already stressed highway corridor baseline.

3. Water Source Protection (Watershed Management): A dedicated sub-plan must be created to protect the four identified community drinking water sources (SW-05, SW-07, SW-09, and SW-10). This plan must mandate:

- A strict 50-meter "No-Go Buffer Zone" around these spring heads where no project vehicles, machinery, or material stockpiling are permitted.
- Mandatory secondary containment (bundling capable of holding 110% volume) for any fuel, oil, or chemical storage located within 500 meters uphill of these sources.
- Clear protocols requiring immediate reporting and remediation of any accidental spills in the vicinity.

4. Mandatory Water Treatment Provision: Given the confirmed presence of faecal coliforms during the dry season, reliance on raw spring or river water is unsafe. In strict compliance with ADB SPS 2009 occupational health mandates, the Project must deliver clean drinking water to all workers. While permanent staff will utilize the existing Water Treatment Plant (WTP) at the Chukha Hydropower Colony, the ESMP and Detailed Project Report (DPR) must mandate the installation of scalable, modular package-type water treatment units (incorporating physical filtration and UV/chlorination disinfection) for all temporary labour camps and active site offices.

5. Sediment Control: The ESMP must require all contractors to implement best-practice erosion and sediment control measures (e.g., multi-stage settling ponds and silt fencing). The post-monsoon data shows that fine sediments persist in the main river even as flows recede; therefore, controls must be engineered to remain effective in both low-flow and high-flow conditions to protect the aquatic ecosystem.

6. Noise, Vibration, and Structural Protection: Given the proximity of high-impact activities (specifically quarrying, blasting, and heavy transport) to sensitive communities and culturally significant sites like Bunakha Lhakhang and Lamche Bja, proactive structural protection is a priority. It is mandatory for the Project to conduct a comprehensive pre-construction structural condition survey (dilapidation survey) of every residential, commercial, and religious structure within Chanachen and Bunakha villages. This must be completed prior to the commencement of any construction works to establish a definitive structural baseline, which is essential for fairly assessing and managing any future grievances regarding vibration-induced damage. Furthermore, the ESMP must mandate active operational controls during construction, including controlled blasting techniques (e.g., micro-delays), continuous vibration monitoring, and community pre-warning systems, to mitigate risks and preserve both structural and spiritual integrity.

The quantitative data established in this report must be formally adopted as the performance benchmark for all construction-phase and operational environmental monitoring. This will ensure that any degradation of the environment is quickly identified, quantified, and rectified, providing a clear basis for regulatory compliance and contractual enforcement.

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Annex 1: Field Works Photographs

Photographs showing Air and Noise Quality Monitoring using AQM-9 Machine at 10 Locations



Photographs showing Surface Water Sampling & In-situ Tests Conducted at 10 Locations



Photographs showing Soil Sampling at 8 Locations



SSP-1



SSP-2



SSP-3



SSP-4



SSP-5



SSP-6



SSP-7



SSP-8

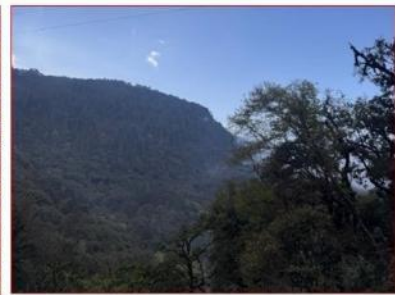
Annex 2: Photographic Record of Key Environmental Receptors



Bunakha Lhakhang



Nayakha Sacred Rock



Nayakha Tsen



Tsimalakha Hospital



Chukha Central School



Lobnekha Heritage Village

Annex 3: Air, Noise and Wind Monitoring Results – April 2025 (Dry Season)



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TEST REPORT

Sample Location: ANSP-1 (Labtsakha – Proposed Campsite)

Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

Report Code: ENGEO/2025/02
Issued To (Client Name): Fichtner GmbH & Co. KG & JADE Consult in association with NextGen/PCS - Consultancy service for Review and Update of DPR and ESIA of Bunakha
Issued Date: 01/05/2025
Sampling Conducted by: ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)
Sampling No. & Location: ANSP-1 (Labtsakha – Proposed Campsite)
Sampling Duration: 18/04/2025 (11:00:00) To 19/04/2025 (11:00:00)
Sampling Instrument used: AQM-09 (Oceanus) Real Time Sampler
Ambient Temperature: 12.49 (°C)
Relative Humidity: 83.16 (%)
Weather Condition: Cloudy
Altitude: 2250 m

AIR QUALITY RESULTS

S.No	Parameters	Test Methods ¹	Results	Unit	ES2020, NEC ²	WHO AQG 2021 ³
1	Total Suspended Particulate Matter	Light scattering technique	9.27	µg/m ³	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	9.17	µg/m ³	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	8.66	µg/m ³	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO ₂	Electrochemical sensor or UV photometry	39.00	µg/m ³	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O ₃	UV photometry	30.83	µg /m ³	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO ₂	UV fluorescence or electrochemical sensor	0.00	µg/m ³	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.00	µg/m ³	2000(8 hr mean)	4 (8 hr mean)

NOISE LEVEL MEASUREMENTS

S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 ⁴
1	Sound Pressure Level (SPL)	SLM continuous recording	47.96	dB	65 (Day)	85 (8-hour exposure for occupational setting).
			41.56		55 (Night)	

¹ 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.

² ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

³ 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)

⁴ WHO 2018 - WHO Environmental Noise Guidelines (2018).

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HOURLY WIND CONDITIONS

Year	Month	Day	Hour	Wind direction (°)	Wind speed (m/s)
2025	4	18	11	90	0.1
2025	4	18	12	131	0.3
2025	4	18	13	136	0.5
2025	4	18	14	96	0.4
2025	4	18	15	94	0.1
2025	4	18	16	57	0
2025	4	18	17	66	0
2025	4	18	18	38	0
2025	4	18	19	38	0
2025	4	18	20	45	0
2025	4	18	21	43	0
2025	4	18	22	38	0
2025	4	18	23	40	0
2025	4	19	0	49	0
2025	4	19	1	49	0
2025	4	19	2	28	0
2025	4	19	3	25	0
2025	4	19	4	29	0
2025	4	19	5	33	0
2025	4	19	6	58	0
2025	4	19	7	62	0
2025	4	19	8	66	0
2025	4	19	9	40	0
2025	4	19	10	61	0
2025	4	19	11	273	2.9
2025	4	19	12	273	2.9
2025	4	19	13	291	2.8

Test conducted and Reports
Prepared by:


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Field Inspection and Test
Reports Verified by:


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TEST REPORT

Sample Location: ANSP-2 (Tsimalakha – Proposed Colony)

Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

Report Code:	ENGEO/2025/03	Issued Date:	01/05/2025
Issued To (Client Name):	Fichtner GmbH & Co. KG & JADE Consult in association with NextGen/PCS - Consultancy service for Review and Update of DPR and ESIA of Bunakha		
Sampling Conducted by	:	ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)	
Sampling No. & Location	:	ANSP-2 (Tsimalakha – Proposed Colony)	
Sampling Duration	:	19/04/2025 (12:45:00) To 20/04/2025 (12:45:00)	
Sampling Instrument used	:	AQM-09 (Oceanus) Real Time Sampler	
Ambient Temperature	:	16.40 (°C)	
Relative Humidity	:	76.36 (%)	
Weather Condition	:	Sunny	
Altitude	:	2197 m	

AIR QUALITY RESULTS

S.No	Parameters	Test Methods ¹	Results	Unit	ES2020, NEC ²	WHO AQG 2021 ³
1	Total Suspended Particulate Matter	Light scattering technique	19.53	µg/m ³	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	19.12	µg/m ³	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	18.20	µg/m ³	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO ₂	Electrochemical sensor or UV photometry	40.27	µg/m ³	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O ₃	UV photometry	49.46	µg /m ³	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO ₂	UV fluorescence or electrochemical sensor	0.00	µg/m ³	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.00	µg/m ³	2000(8 hr mean)	4 (8 hr mean)

NOISE LEVEL MEASUREMENTS

S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 ⁴
1	Sound Pressure Level (SPL)	SLM continuous recording	54.11	dB	65 (Day)	85 (8-hour exposure for occupational setting).
			53.09		55 (Night)	

¹ 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.

² ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

³ 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)

⁴ WHO 2018 - WHO Environmental Noise Guidelines (2018).

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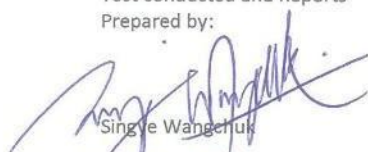
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HOURLY WIND CONDITIONS

Year	Month	Day	Hour	Wind direction (°)	Wind speed (m/s)
2025	4	19	12	273	2.9
2025	4	19	13	291	2.8
2025	4	19	14	285	2.6
2025	4	19	15	281	2
2025	4	19	16	294	1.8
2025	4	19	17	300	1.6
2025	4	19	18	288	0.8
2025	4	19	19	265	0.5
2025	4	19	20	244	0.6
2025	4	19	21	242	0.5
2025	4	19	22	275	0.5
2025	4	19	23	172	0.2
2025	4	20	0	181	0
2025	4	20	1	298	0.8
2025	4	20	2	199	0.4
2025	4	20	3	205	0.2
2025	4	20	4	159	1
2025	4	20	5	161	0.7
2025	4	20	6	160	0.7
2025	4	20	7	199	0.2
2025	4	20	8	227	0.7
2025	4	20	9	292	1.6
2025	4	20	10	277	2.7
2025	4	20	11	291	2.5
2025	4	20	12	293	2

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TEST REPORT

Sample Location: ANSP-3 (Proposed Dam Site)

Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

Report Code: ENGEO/2025/04 Issued Date: 01/05/2025
Issued To (Client Name): Fichtner GmbH & Co. KG & JADE Consult in association with NextGen/PCS - Consultancy service for Review and Update of DPR and ESIA of Bunakha
Sampling Conducted by : ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)
Sampling No. & Location : ANSP-3 (Proposed Dam Site)
Sampling Duration : 15/04/2025 (11:00:00) To 16/04/2025 (11:00:00)
Sampling Instrument used : AQM-09 (Oceanus) Real Time Sampler
Ambient Temperature : 14.76 (°C)
Relative Humidity : 73.32 (%)
Weather Condition : Cloudy
Altitude : 1834 m

AIR QUALITY RESULTS

S.No	Parameters	Test Methods ¹	Results	Unit	ES2020, NEC ²	WHO AQG 2021 ³
1	Total Suspended Particulate Matter	Light scattering technique	6.85	µg/m ³	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	5.93	µg/m ³	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	4.72	µg/m ³	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO ₂	Electrochemical sensor or UV photometry	24.76	µg/m ³	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O ₃	UV photometry	114.07	µg/m ³	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO ₂	UV fluorescence or electrochemical sensor	74.58	µg/m ³	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.02	µg/m ³	2000(8 hr mean)	4 (8 hr mean)

NOISE LEVEL MEASUREMENTS

S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 ⁴
1	Sound Pressure Level (SPL)	SLM continuous recording	64.50	dB	65 (Day)	85 (8-hour exposure for occupational setting).
			64.04		55 (Night)	

¹ 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.

² ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

³ 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)

⁴ WHO 2018 - WHO Environmental Noise Guidelines (2018).

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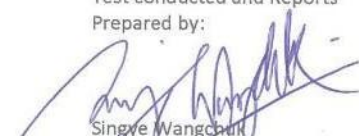
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HOURLY WIND CONDITIONS

Year	Month	Day	Hour	Wind direction (°)	Wind speed (m/s)
2025	4	15	11	199	0.3
2025	4	15	12	195	0.9
2025	4	15	13	190	1.1
2025	4	15	14	188	0.7
2025	4	15	15	191	0.6
2025	4	15	16	173	0.3
2025	4	15	17	44	0
2025	4	15	18	105	0
2025	4	15	19	185	0
2025	4	15	20	198	0
2025	4	15	21	120	0
2025	4	15	22	147	0
2025	4	15	23	68	0
2025	4	16	0	60	0
2025	4	16	1	71	0.1
2025	4	16	2	51	0.1
2025	4	16	3	58	0.1
2025	4	16	4	63	0.2
2025	4	16	5	57	0.2
2025	4	16	6	87	0
2025	4	16	7	133	0
2025	4	16	8	211	0.1
2025	4	16	9	188	0.5
2025	4	16	10	202	0.9
2025	4	16	11	192	1.4

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TEST REPORT

Sample Location: ANSP-4 (Bunakha Lhakhang – Sensitive Location)

Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

Report Code: ENGEO/2025/05
Issued To (Client Name): Fichtner GmbH & Co. KG & JADE Consult in association with NextGen/PCS - Consultancy service for Review and Update of DPR and ESIA of Bunakha
Issued Date: 01/05/2025
Sampling Conducted by: ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)
Sampling No. & Location: ANSP-4 (Bunakha Lhakhang)
Sampling Duration: 21/04/2025 (14:45:00) To 22/04/2025 (14:45:00)
Sampling Instrument used: AQM-09 (Oceanus) Real Time Sampler
Ambient Temperature: 18.33 (°C)
Relative Humidity: 73.82 (%)
Weather Condition: Cloudy
Altitude: 2158 m

AIR QUALITY RESULTS

S.No	Parameters	Test Methods ¹	Results	Unit	ES2020, NEC ²	WHO AQG 2021 ³
1	Total Suspended Particulate Matter	Light scattering technique	18.90	µg/m ³	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	16.54	µg/m ³	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	12.89	µg/m ³	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO ₂	Electrochemical sensor or UV photometry	28.37	µg/m ³	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O ₃	UV photometry	133.95	µg /m ³	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO ₂	UV fluorescence or electrochemical sensor	64.91	µg/m ³	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.02	µg/m ³	2000(8 hr mean)	4 (8 hr mean)

NOISE LEVEL MEASUREMENTS

S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 ⁴
1	Sound Pressure Level (SPL)	SLM continuous recording	49.82	dB	65 (Day)	85 (8-hour exposure for occupational setting.)
			51.52		55 (Night)	

¹ 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.

² ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

³ 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)

⁴ WHO 2018 - WHO Environmental Noise Guidelines (2018)

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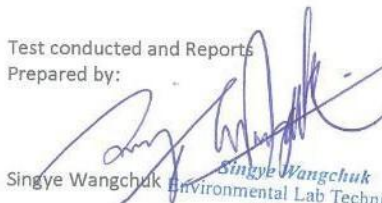
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HOURLY WIND CONDITIONS

Year	Month	Day	Hour	Wind direction (°)	Wind speed (m/s)
2025	4	21	1	189	0.9
2025	4	21	2	133	0.8
2025	4	21	3	189	0
2025	4	21	4	133	0
2025	4	21	5	158	0
2025	4	21	6	124	0.1
2025	4	21	7	146	0.2
2025	4	21	8	278	0.3
2025	4	21	9	148	0.9
2025	4	21	10	164	1.3
2025	4	21	11	189	0.9
2025	4	21	12	186	0.8
2025	4	21	13	186	0.8
2025	4	21	14	248	0.9
2025	4	21	15	237	0.6
2025	4	21	16	221	0.8
2025	4	21	17	243	0.6
2025	4	21	18	249	0.5
2025	4	21	19	240	0.2
2025	4	21	20	235	0.1
2025	4	21	21	220	0.3
2025	4	21	22	234	0.1
2025	4	22	23	248	0
2025	4	22	0	227	0.1
2025	4	22	1	247	0.1

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TEST REPORT

Sample Location: ANSP-5 (Chanachen – Proposed Quarry Site)

Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

Report Code: ENGEO/2025/06 Issued Date: 01/05/2025
Issued To (Client Name): Fichtner GmbH & Co. KG & JADE Consult in association with NextGen/PCS - Consultancy service for Review and Update of DPR and ESIA of Bunakha
Sampling Conducted by : ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)
Sampling No. & Location : ANSP-5 (Chanachen – Proposed Quarry Site)
Sampling Duration : 16/04/2025 (14:45:00) To 17/04/2025 (14:45:00)
Sampling Instrument used : AQM-09 (Oceanus) Real Time Sampler
Ambient Temperature : 15.76 (°C)
Relative Humidity : 74.40 (%)
Weather Condition : Cloudy
Altitude : 2195 m

AIR QUALITY RESULTS

S.No	Parameters	Test Methods ¹	Results	Unit	ES2020, NEC ²	WHO AQG 2021 ³
1	Total Suspended Particulate Matter	Light scattering technique	19.40	µg/m ³	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	18.95	µg/m ³	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	17.94	µg/m ³	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO ₂	Electrochemical sensor or UV photometry	38.59	µg/m ³	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O ₃	UV photometry	62.10	µg/m ³	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO ₂	UV fluorescence or electrochemical sensor	0.00	µg/m ³	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.00	µg/m ³	2000(8 hr mean)	4 (8 hr mean)

NOISE LEVEL MEASUREMENTS

S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 ⁴
1	Sound Pressure Level (SPL)	SLM continuous recording	46.29	dB	65 (Day)	85 (8-hour exposure for occupational setting).
			46.61		55 (Night)	

¹ 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.

² ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

³ 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)

⁴ WHO 2018 - WHO Environmental Noise Guidelines (2018).

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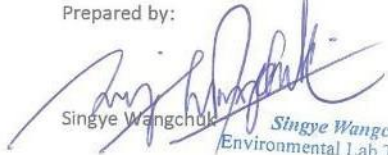
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HOURLY WIND CONDITIONS

Year	Month	Day	Hour	Wind direction (°)	Wind speed (m/s)
2025	4	16	14	211	1.3
2025	4	16	15	198	1.3
2025	4	16	16	205	1.3
2025	4	16	17	230	0.7
2025	4	16	18	247	0.6
2025	4	16	19	148	0.2
2025	4	16	20	129	0.1
2025	4	16	21	105	0
2025	4	16	22	90	0
2025	4	16	23	162	0
2025	4	17	0	152	0.1
2025	4	17	1	140	0.1
2025	4	17	2	180	0
2025	4	17	3	177	0.1
2025	4	17	4	215	0.5
2025	4	17	5	178	0.2
2025	4	17	6	184	0
2025	4	17	7	158	0
2025	4	17	8	175	0.1
2025	4	17	9	156	0.1
2025	4	17	10	170	0.4
2025	4	17	11	204	1.2
2025	4	17	12	201	1.2
2025	4	17	13	204	1.1
2025	4	17	14	213	1.1

Test conducted and Reports
Prepared by:


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TEST REPORT

Sample Location: ANSP-6 (Chanachen – Proposed Muck Disposal Site)

Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

Report Code: ENGEO/2025/07 Issued Date: 01/05/2025
Issued To (Client Name): Fichtner GmbH & Co. KG & JADE Consult in association with NextGen/PCS - Consultancy service for Review and Update of DPR and ESIA of Bunakha
Sampling Conducted by : ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)
Sampling No. & Location : ANSP-6 (Chanachen – Proposed Muck Disposal Site)
Sampling Duration : 16/04/2025 (16:00:00) To 17/04/2025 (16:00:00)
Sampling Instrument used : AQM-09 (Oceanus) Real Time Sampler
Ambient Temperature : 15.09 (°C)
Relative Humidity : 79.37 (%)
Weather Condition : Cloudy
Altitude : 2095 m

AIR QUALITY RESULTS

S.No	Parameters	Test Methods ¹	Results	Unit	ES2020, NEC ²	WHO AQG 2021 ³
1	Total Suspended Particulate Matter	Light scattering technique	6.84	µg/m ³	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	6.17	µg/m ³	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	5.35	µg/m ³	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO ₂	Electrochemical sensor or UV photometry	26.44	µg/m ³	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O ₃	UV photometry	141.58	µg /m ³	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO ₂	UV fluorescence or electrochemical sensor	96.60	µg/m ³	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.00	µg/m ³	2000(8 hr mean)	4 (8 hr mean)

NOISE LEVEL MEASUREMENTS

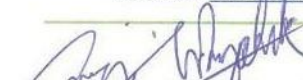
S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 ⁴
1	Sound Pressure Level (SPL)	SLM continuous recording	48.77	dB	65 (Day)	85 (8-hour exposure for occupational setting.
			45.11		55 (Night)	

¹ 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.

² ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

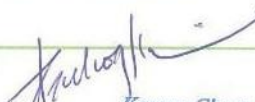
³ WHO AQG 2021 – WHO Average Air Quality Guideline 2021 (WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide)

⁴ WHO 2018 - WHO Environmental Noise Guidelines (2018).


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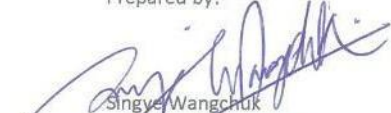
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HOURLY WIND CONDITIONS

Year	Month	Day	Hour	Wind direction (°)	Wind speed (m/s)
2025	4	16	16	173	1
2025	4	16	17	158	1.1
2025	4	16	18	147	0.6
2025	4	16	19	167	0.4
2025	4	16	20	160	0.2
2025	4	16	21	162	0.2
2025	4	16	22	196	0.1
2025	4	16	22	133	0
2025	4	17	0	141	0.2
2025	4	17	1	145	0.2
2025	4	17	2	151	0.1
2025	4	17	3	168	0.1
2025	4	17	4	182	0.5
2025	4	17	5	209	0.2
2025	4	17	6	222	0
2025	4	17	7	158	0.1
2025	4	17	8	150	0
2025	4	17	9	129	0.2
2025	4	17	10	156	0.4
2025	4	17	11	114	1
2025	4	17	12	173	1
2025	4	17	13	158	1.1
2025	4	17	14	128	1.8
2025	4	17	15	160	0.2
2025	4	17	16	162	0.2

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Prepared by:


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Field Inspection and Test
Reports Verified by:


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TEST REPORT

Sample Location: ANSP-7 (Below AH48 – Proposed Workshop Area)

Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

Report Code: ENGEO/2025/08
Issued To (Client Name): Fichtner GmbH & Co. KG & JADE Consult in association with NextGen/PCS - Consultancy service for Review and Update of DPR and ESIA of Bunakha
Issued Date: 01/05/2025
Sampling Conducted by: ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)
Sampling No. & Location: ANSP-7 (Proposed Work Area, Bunakha)
Sampling Duration: 17/04/2025 (18:30:00) To 18/04/2025 (18:30:00)
Sampling Instrument used: AQM-09 (Oceanus) Real Time Sampler
Ambient Temperature: 17.43 (°C)
Relative Humidity: 68.80 (%)
Weather Condition: Cloudy
Altitude: 1994 m

AIR QUALITY RESULTS

S.No	Parameters	Test Methods ¹	Results	Unit	ES2020, NEC ²	WHO AQG 2021 ³
1	Total Suspended Particulate Matter	Light scattering technique	6.33	µg/m ³	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	5.86	µg/m ³	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	5.33	µg/m ³	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO ₂	Electrochemical sensor or UV photometry	24.69	µg/m ³	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O ₃	UV photometry	125.48	µg /m ³	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO ₂	UV fluorescence or electrochemical sensor	54.30	µg/m ³	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.00	µg/m ³	2000(8 hr mean)	4 (8 hr mean)

NOISE LEVEL MEASUREMENTS

S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 ⁴
1	Sound Pressure Level (SPL)	SLM continuous recording	47.10	dB	65 (Day)	85 (8-hour exposure for occupational setting.
			45.05		55 (Night)	

¹ 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.

² ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

³ 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)

⁴ WHO 2018 - WHO Environmental Noise Guidelines (2018).

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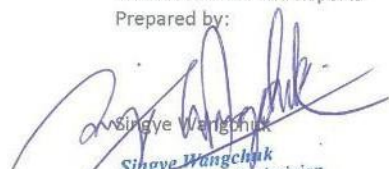
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HOURLY WIND CONDITIONS

Year	Month	Day	Hour	Wind direction (°)	Wind speed (m/s)
2025	4	17	18	183	3.6
2025	4	17	19	86	2.3
2025	4	17	20	164	1.8
2025	4	17	21	229	0.5
2025	4	17	22	240	0.6
2025	4	17	23	213	0.2
2025	4	18	0	255	0.1
2025	4	18	1	240	0.5
2025	4	18	2	268	0.2
2025	4	18	3	208	0.4
2025	4	18	4	171	0.2
2025	4	18	5	115	0.2
2025	4	18	6	170	0.3
2025	4	18	7	165	0.4
2025	4	18	8	83	0.6
2025	4	18	9	110	3.1
2025	4	18	10	111	3.8
2025	4	18	11	142	3.8
2025	4	18	12	111	4
2025	4	18	13	74	4.8
2025	4	18	14	100	3.7
2025	4	18	15	140	3.6
2025	4	18	16	178	0.7
2025	4	18	17	210	0.6
2025	4	18	18	257	0.7

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TEST REPORT

Sample Location: ANSP-8 (Zangtey, Lobneykha – Proposed Quarry Site)

Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

Report Code: ENGEO/2025/09
Issued To (Client Name): Fichtner GmbH & Co. KG & JADE Consult in association with NextGen/PCS - Consultancy service for Review and Update of DPR and ESIA of Bunakha
Issued Date: 01/05/2025
Sampling Conducted by: ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)
Sampling No. & Location: ANSP-8 (Zangtey, Lobneykha – Proposed Quarry Site)
Sampling Duration: 20/04/2025 (10:20:00) To 21/04/2025 (10:20:00)
Sampling Instrument used: AQM-09 (Oceanus) Real Time Sampler
Ambient Temperature: 17.02 (°C)
Relative Humidity: 71.66 (%)
Weather Condition: Sunny
Altitude: 2237 m

AIR QUALITY RESULTS

S.No	Parameters	Test Methods ¹	Results	Unit	ES2020, NEC ²	WHO AQG 2021 ³
1	Total Suspended Particulate Matter	Light scattering technique	6.58	µg/m ³	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	6.39	µg/m ³	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	6.08	µg/m ³	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO ₂	Electrochemical sensor or UV photometry	24.44	µg/m ³	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O ₃	UV photometry	126.17	µg/m ³	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO ₂	UV fluorescence or electrochemical sensor	53.81	µg/m ³	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.01	µg/m ³	2000(8 hr mean)	4 (8 hr mean)

NOISE LEVEL MEASUREMENTS

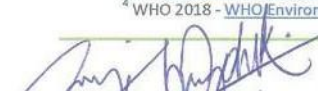
S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 ⁴
1	Sound Pressure Level (SPL)	SLM continuous recording	49.09	dB	65 (Day)	85 (8-hour exposure for occupational setting.
			48.30		55 (Night)	

¹ 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.

² ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

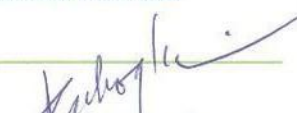
³ WHO AQG 2021 - WHO Average Air Quality Guideline 2021 (WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide)

⁴ WHO 2018 - WHO Environmental Noise Guidelines (2018).


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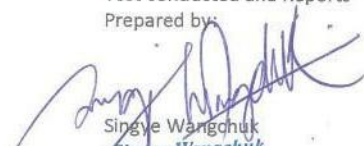
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HOURLY WIND CONDITIONS

Year	Month	Day	Hour	Wind direction (°)	Wind speed (m/s)
2025	4	20	10	205	1.4
2025	4	20	11	140	1.7
2025	4	20	12	143	1.6
2025	4	20	13	174	1.6
2025	4	20	14	184	1
2025	4	20	15	183	1.2
2025	4	20	16	197	1.6
2025	4	20	17	186	1.2
2025	4	20	18	170	0.8
2025	4	20	19	161	0.5
2025	4	20	20	166	0.3
2025	4	20	21	191	0
2025	4	20	22	164	0
2025	4	20	23	166	0
2025	4	21	0	198	0
2025	4	21	1	171	0
2025	4	21	2	190	0
2025	4	21	3	189	0
2025	4	21	4	133	0
2025	4	21	5	158	0
2025	4	21	6	124	0.1
2025	4	21	7	146	0.2
2025	4	21	8	278	0.3
2025	4	21	9	148	0.9
2025	4	21	10	164	1.3

Test conducted and Reports
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TEST REPORT

Sample Location: ANSP-9 (Nayakha Village)

Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

Report Code: ENGEO/2025/10
Issued To (Client Name): Fichtner GmbH & Co. KG & JADE Consult in association with NextGen/PCS - Consultancy service for Review and Update of DPR and ESIA of Bunakha
Issued Date: 01/05/2025
Sampling Conducted by : ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)
Sampling No. & Location : ANSP-9 (Nayakha Village)
Sampling Duration : 20/04/2025 (16:05:00) To 21/04/2025 (16:05:00)
Sampling Instrument used : AQM-09 (Oceanus) Real Time Sampler
Ambient Temperature : 14.51 (°C)
Relative Humidity : 82.18 (%)
Weather Condition : Cloudy
Altitude : 2507 m

AIR QUALITY RESULTS

S.No	Parameters	Test Methods ¹	Results	Unit	ES2020, NEC ²	WHO AQG 2021 ³
1	Total Suspended Particulate Matter	Light scattering technique	28.65	µg/m ³	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	28.24	µg/m ³	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	27.08	µg/m ³	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO ₂	Electrochemical sensor or UV photometry	40.32	µg/m ³	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O ₃	UV photometry	38.67	µg /m ³	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO ₂	UV fluorescence or electrochemical sensor	0.00	µg/m ³	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.00	µg/m ³	2000(8 hr mean)	4 (8 hr mean)

NOISE LEVEL MEASUREMENTS

S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 ⁴
1	Sound Pressure Level (SPL)	SLM continuous recording	40.28	dB	65 (Day)	85 (8-hour exposure for occupational setting).
			36.53		55 (Night)	

¹ 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.

² ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

³ 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)

⁴ WHO 2018 - WHO Environmental Noise Guidelines (2018).

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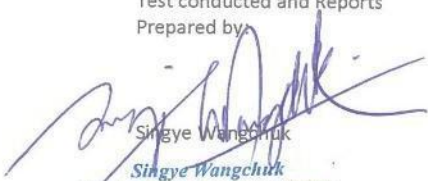
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HOURLY WIND CONDITIONS

Year	Month	Day	Hour	Wind direction (°)	Wind speed (m/s)
2025	4	20	16	247	0.8
2025	4	20	17	249	0.6
2025	4	20	18	247	0.8
2025	4	20	19	259	0.3
2025	4	20	20	248	0.1
2025	4	20	21	204	0
2025	4	20	22	190	0
2025	4	20	23	229	0
2025	4	21	0	227	0
2025	4	21	1	222	0
2025	4	21	2	275	0
2025	4	21	3	250	0
2025	4	21	4	319	0
2025	4	21	5	184	0
2025	4	21	6	200	0
2025	4	21	7	201	0.4
2025	4	21	8	231	0.6
2025	4	21	9	238	0.9
2025	4	21	10	227	0.6
2025	4	21	11	248	0.8
2025	4	21	12	259	0.6
2025	4	21	13	253	0.6
2025	4	21	14	253	0.7
2025	4	21	15	258	0.8
2025	4	21	16	270	0.5

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Prepared by:


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Reports Verified by:


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Annex 4: Air, Noise and Wind Monitoring Results – July 2025 (Wet Season)



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TEST REPORT

Sample Location: ANSP-1 (Labtsakha)

Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

Report Code: ENGEO/2025/11
Issued To (Client Name): Fichtner GmbH & Co. KG & JADE Consult in association with NextGen/PCS - Consultancy service for Review and Update of DPR and ESIA of Bunakha
Issued Date: 04/08/2025
Sampling Conducted by: ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)
Sampling No. & Location: ANSP-1 (Labtsakha)
Sampling Duration: 25/07/2025 (18:00:00) To 26/07/2025 (18:00:00)
Sampling Instrument used: AQM-09 (Oceanus) Real Time Sampler
Ambient Temperature: 19.56 (°C)
Relative Humidity: 85.92 (%)
Weather Condition: Raining
Altitude: 2250 m

AIR QUALITY RESULTS

S.No	Parameters	Test Methods ¹	Results	Unit	ES2020, NEC ²	WHO AQG 2021 ³
1	Total Suspended Particulate Matter	Light scattering technique	1.02	µg/m ³	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	0.40	µg/m ³	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	0.00	µg/m ³	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO ₂	Electrochemical sensor or UV photometry	43.19	µg/m ³	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O ₃	UV photometry	87.46	µg /m ³	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO ₂	UV fluorescence or electrochemical sensor	34.36	µg/m ³	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.00	µg/m ³	2000(8 hr mean)	4 (8 hr mean)

NOISE LEVEL MEASUREMENTS

S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 ⁴
1	Sound Pressure Level (SPL)	SLM continuous recording	53.11	dB	65 (Day)	85 (8-hour exposure for occupational setting.
			48.78		55 (Night)	

¹ 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.

² ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

³ 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)

⁴ WHO 2018 - WHO Environmental Noise Guidelines (2018)

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Karma Chogyel
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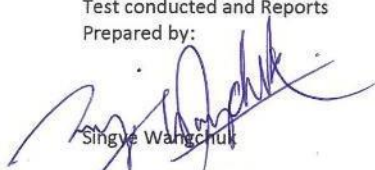
ENGEO Consultancy
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Thimphu, Bhutan
Contact #: 7774809
Whatsapp # 7774809
Email: sengyelk@gmail.com

HOURLY WIND CONDITIONS

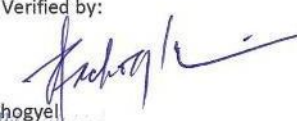
Year	Month	Day	Hour	Wind direction (°)	Wind speed (m/s)
2025	7	25	18	213	0.2
2025	7	25	19	216	0.1
2025	7	25	20	169	0.1
2025	7	25	21	80	0
2025	7	25	22	116	0
2025	7	25	23	172	0
2025	7	26	0	233	0
2025	7	26	1	241	0
2025	7	26	2	264	0
2025	7	26	3	264	0
2025	7	26	4	282	0
2025	7	26	5	142	0
2025	7	26	6	269	0
2025	7	26	7	185	0.1
2025	7	26	8	217	0.4
2025	7	26	9	210	0.6
2025	7	26	10	237	0.6
2025	7	26	11	209	0.4
2025	7	26	12	219	1
2025	7	26	13	214	1
2025	7	26	14	215	1.1
2025	7	26	15	209	1.1
2025	7	26	16	202	0.9
2025	7	26	17	206	0.7
2025	7	26	18	199	0

Test conducted and Reports
Prepared by:


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Field Inspection and Test
Reports Verified by:


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TEST REPORT

Sample Location: ANSP-2 (Tsimalakha – Proposed Colony)

Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

Report Code: ENGEO/2025/12 Issued Date: 04/08/2025
Issued To (Client Name): Fichtner GmbH & Co. KG & JADE Consult in association with NextGen/PCS - Consultancy service for Review and Update of DPR and ESIA of Bunakha
Sampling Conducted by : ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)
Sampling No. & Location : ANSP-2 (Tsimalakha – Proposed Colony)
Sampling Duration : 26/07/2025 (19:10:00) To 27/07/2025 (19:10:00)
Sampling Instrument used : AQM-09 (Oceanus) Real Time Sampler
Ambient Temperature : 20.04 (°C)
Relative Humidity : 83.09 (%)
Weather Condition : Foggy
Altitude : 2197 m

AIR QUALITY RESULTS

S.No	Parameters	Test Methods ¹	Results	Unit	ES2020, NEC ²	WHO AQG 2021 ³
1	Total Suspended Particulate Matter	Light scattering technique	2.21	µg/m ³	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	1.49	µg/m ³	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	0.70	µg/m ³	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO ₂	Electrochemical sensor or UV photometry	43.23	µg/m ³	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O ₃	UV photometry	90.84	µg /m ³	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO ₂	UV fluorescence or electrochemical sensor	32.41	µg/m ³	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.00	µg/m ³	2000(8 hr mean)	4 (8 hr mean)

NOISE LEVEL MEASUREMENTS

S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 ⁴
1	Sound Pressure Level (SPL)	SLM continuous recording	41.17	dB	65 (Day)	85 (8-hour exposure for occupational setting.
			36.37		55 (Night)	

¹ 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.

² ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

³ 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)

⁴ WHO 2018 - WHO Environmental Noise Guidelines (2018)

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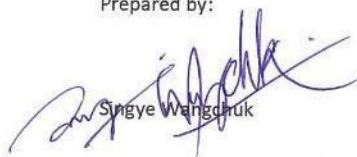
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HOURLY WIND CONDITIONS

Year	Month	Day	Hour	Wind direction (°)	Wind speed (m/s)
2025	7	26	20	156	0.2
2025	7	26	21	113	0.3
2025	7	26	22	100	0.5
2025	7	26	23	176	0.3
2025	7	27	0	216	0
2025	7	27	1	268	0
2025	7	27	2	110	0.1
2025	7	27	3	192	0
2025	7	27	4	243	0.3
2025	7	27	5	268	0.2
2025	7	27	6	225	0.1
2025	7	27	7	159	0.5
2025	7	27	8	100	0.6
2025	7	27	9	107	0.9
2025	7	27	10	115	1.4
2025	7	27	11	106	1.8
2025	7	27	12	119	1.5
2025	7	27	13	100	1
2025	7	27	14	115	1.3
2025	7	27	15	111	1.1
2025	7	27	16	120	0.7
2025	7	27	17	113	0.9
2025	7	27	18	105	0.6
2025	7	27	19	153	0.3

Test conducted and Reports
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TEST REPORT

Sample Location: ANSP-3 (Proposed Dam Site)

Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

Report Code: ENGEO/2025/13 Issued Date: 04/08/2025
Issued To (Client Name): Fichtner GmbH & Co. KG & JADE Consult in association with NextGen/PCS - Consultancy service for Review and Update of DPR and ESIA of Bunakha
Sampling Conducted by : ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)
Sampling No. & Location : ANSP-3 (Proposed Dam Site)
Sampling Duration : 27/07/2025 (12:10:00) To 28/07/2025 (12:10:00)
Sampling Instrument used : AQM-09 (Oceanus) Real Time Sampler
Ambient Temperature : 20.35 (°C)
Relative Humidity : 87.31 (%)
Weather Condition : Sunny
Altitude : 1834 m

AIR QUALITY RESULTS

S.No	Parameters	Test Methods ¹	Results	Unit	ES2020, NEC ²	WHO AQG 2021 ³
1	Total Suspended Particulate Matter	Light scattering technique	7.93	µg/m ³	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	7.37	µg/m ³	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	6.22	µg/m ³	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO ₂	Electrochemical sensor or UV photometry	58.44	µg/m ³	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O ₃	UV photometry	9.98	µg/m ³	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO ₂	UV fluorescence or electrochemical sensor	0.00	µg/m ³	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.00	µg/m ³	2000(8 hr mean)	4 (8 hr mean)

NOISE LEVEL MEASUREMENTS

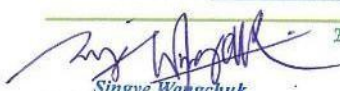
S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 ⁴
1	Sound Pressure Level (SPL)	SLM continuous recording	68.83	dB	65 (Day)	85 (8-hour exposure for occupational setting).
			68.90		55 (Night)	

¹ 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.

² ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

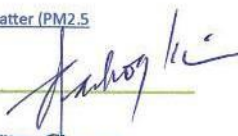
³ WHO AQG 2021 – WHO Average Air Quality Guideline 2021 (WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide)

⁴ WHO 2018 - WHO Environmental Noise Guidelines (2018).


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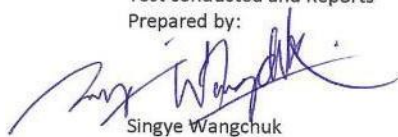
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HOURLY WIND CONDITIONS

Year	Month	Day	Hour	Wind direction (°)	Wind speed (m/s)
2025	7	27	13	245	2.5
2025	7	27	14	235	2.5
2025	7	27	15	242	2.4
2025	7	27	16	255	1.8
2025	7	27	17	219	1.2
2025	7	27	18	204	0.7
2025	7	27	19	197	0.8
2025	7	27	20	240	0.9
2025	7	27	21	232	0.6
2025	7	27	22	234	0.6
2025	7	27	23	217	0.2
2025	7	28	0	227	0
2025	7	28	1	226	0
2025	7	28	2	170	0
2025	7	28	3	70	0
2025	7	28	4	71	0
2025	7	28	5	74	0
2025	7	28	6	75	0
2025	7	28	7	76	0
2025	7	28	8	77	0
2025	7	28	9	100	0.1
2025	7	28	10	245	1.4
2025	7	28	11	251	1.6
2025	7	28	12	252	1.5
2025	7	28	13	263	1.2

Test conducted and Reports
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TEST REPORT

Sample Location: ANSP-4 (Bunakha Lhakhang – Sensitive Location)

Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

Report Code: ENGEO/2025/14 Issued Date: 04/08/2025
Issued To (Client Name): Fichtner GmbH & Co. KG & JADE Consult in association with NextGen/PCS - Consultancy service for Review and Update of DPR and ESIA of Bunakha
Sampling Conducted by : ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)
Sampling No. & Location : ANSP-4 (Bunakha Lhakhang)
Sampling Duration : 21/07/2025 (18:30:00) To 22/07/2025 (23:30:00)
Sampling Instrument used : AQM-09 (Oceanus) Real Time Sampler
Ambient Temperature : 19.78 (°C)
Relative Humidity : 85.62 (%)
Weather Condition : Raining
Altitude : 2158 m

AIR QUALITY RESULTS

S.No	Parameters	Test Methods ¹	Results	Unit	ES2020, NEC ²	WHO AQG 2021 ³
1	Total Suspended Particulate Matter	Light scattering technique	5.83	µg/m ³	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	5.11	µg/m ³	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	3.74	µg/m ³	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO ₂	Electrochemical sensor or UV photometry	57.00	µg/m ³	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O ₃	UV photometry	6.66	µg/m ³	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO ₂	UV fluorescence or electrochemical sensor	0.00	µg/m ³	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.00	µg/m ³	2000(8 hr mean)	4 (8 hr mean)

NOISE LEVEL MEASUREMENTS

S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 ⁴
1	Sound Pressure Level (SPL)	SLM continuous recording	39.96	dB	65 (Day)	85 (8-hour exposure for occupational setting)
			39		55 (Night)	

¹ 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.

² ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

³ 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)

⁴ WHO 2018 - WHO Environmental Noise Guidelines (2018).

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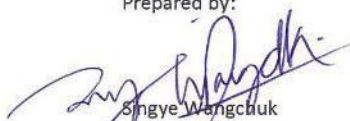
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HOURLY WIND CONDITIONS

Year	Month	Day	Hour	Wind direction (°)	Wind speed (m/s)
2025	7	21	19	144	0.3
2025	7	21	20	157	0.1
2025	7	21	21	132	0.2
2025	7	21	22	159	0.1
2025	7	21	23	133	0.1
2025	7	22	0	177	0.3
2025	7	22	1	216	0.5
2025	7	22	2	211	0.2
2025	7	22	3	99	0.1
2025	7	22	4	131	0.1
2025	7	22	5	113	0
2025	7	22	6	73	0
2025	7	22	7	225	0.4
2025	7	22	8	201	0.4
2025	7	22	9	232	0.7
2025	7	22	15	200	1.7
2025	7	22	16	191	1.1
2025	7	22	17	187	1.1
2025	7	22	18	189	0.4
2025	7	22	19	223	0.1
2025	7	22	20	305	0
2025	7	22	21	82	0.1
2025	7	22	22	85	0.2
2025	7	23	23	82	0.2
2025	7	23	0	93	0

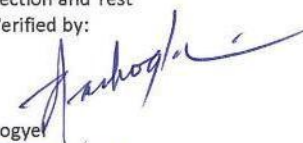
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TEST REPORT

Sample Location: ANSP-5 (Chanachen – Proposed Quarry Site)

Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

Report Code:	ENGEO/2025/15	Issued Date:	04/08/2025
Issued To (Client Name):	Fichtner GmbH & Co. KG & JADE Consult in association with NextGen/PCS - Consultancy service for Review and Update of DPR and ESIA of Bunakha		
Sampling Conducted by	:	ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)	
Sampling No. & Location	:	ANSP-5 (Chanachen – Proposed Quarry Site)	
Sampling Duration	:	23/07/2025 (10:15:00) To 24/07/2025 (10:15:00)	
Sampling Instrument used	:	AQM-09 (Oceanus) Real Time Sampler	
Ambient Temperature	:	22.28 (°C)	
Relative Humidity	:	74.65 (%)	
Weather Condition	:	Sunny	
Altitude	:	2195 m	

AIR QUALITY RESULTS

S.No	Parameters	Test Methods ¹	Results	Unit	ES2020, NEC ²	WHO AQG 2021 ³
1	Total Suspended Particulate Matter	Light scattering technique	5.65	µg/m ³	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	5.15	µg/m ³	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	4.43	µg/m ³	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO ₂	Electrochemical sensor or UV photometry	40.98	µg/m ³	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O ₃	UV photometry	88.46	µg/m ³	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO ₂	UV fluorescence or electrochemical sensor	42.67	µg/m ³	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.00	µg/m ³	2000(8 hr mean)	4 (8 hr mean)

NOISE LEVEL MEASUREMENTS

S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 ⁴
1	Sound Pressure Level (SPL)	SLM continuous recording	47.31	dB	65 (Day)	85 (8-hour exposure for occupational setting).
			46.44		55 (Night)	

¹ 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.

² ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

³ 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)

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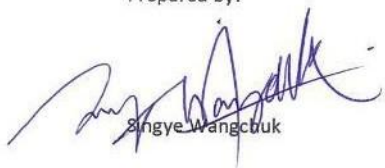
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HOURLY WIND CONDITIONS

Year	Month	Day	Hour	Wind direction (°)	Wind speed (m/s)
2025	7	23	11	225	1.8
2025	7	23	12	241	2
2025	7	23	13	167	1.8
2025	7	23	14	219	1.8
2025	7	23	15	198	1.7
2025	7	23	16	185	1
2025	7	23	17	186	1
2025	7	23	18	231	0.5
2025	7	23	19	225	0.1
2025	7	23	20	207	0
2025	7	23	21	213	0
2025	7	23	22	247	0
2025	7	23	23	99	0
2025	7	24	0	88	0
2025	7	24	1	104	0
2025	7	24	2	151	0
2025	7	24	3	131	0.1
2025	7	24	4	169	0.1
2025	7	24	5	78	0.2
2025	7	24	6	206	0.9
2025	7	24	7	249	1
2025	7	24	8	238	0.8
2025	7	24	9	239	0.3
2025	7	24	10	215	0.8

Test conducted and Reports
Prepared by:


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Reports Verified by:


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TEST REPORT

Sample Location: ANSP-6 (Chanachen – Proposed Sand & Aggregate Stock Pile-1)

Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

Report Code:	ENGEO/2025/16	Issued Date:	04/08/2025
Issued To (Client Name):	Fichtner GmbH & Co. KG & JADE Consult in association with NextGen/PCS - Consultancy service for Review and Update of DPR and ESIA of Bunakha		
Sampling Conducted by	:	ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)	
Sampling No. & Location	:	ANSP-6 (Chanachen – Proposed Sand & Aggregate Stock Pile-1)	
Sampling Duration	:	23/07/2025 (12:50:00) To 24/07/2025 (12:50:00)	
Sampling Instrument used	:	AQM-09 (Oceanus) Real Time Sampler	
Ambient Temperature	:	21.65 (°C)	
Relative Humidity	:	78.60 (%)	
Weather Condition	:	Sunny	
Altitude	:	2095 m	

AIR QUALITY RESULTS

S.No	Parameters	Test Methods ¹	Results	Unit	ES2020, NEC ²	WHO AQG 2021 ³
1	Total Suspended Particulate Matter	Light scattering technique	7.75	µg/m ³	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	7.09	µg/m ³	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	5.63	µg/m ³	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO ₂	Electrochemical sensor or UV photometry	58.18	µg/m ³	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O ₃	UV photometry	8.83	µg /m ³	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO ₂	UV fluorescence or electrochemical sensor	0.00	µg/m ³	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.00	µg/m ³	2000(8 hr mean)	4 (8 hr mean)

NOISE LEVEL MEASUREMENTS

S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 ⁴
1	Sound Pressure Level (SPL)	SLM continuous recording	42.53	dB	65 (Day)	85 (8-hour exposure for occupational setting.
			36.03		55 (Night)	

¹ 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.

² ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

³ 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)

⁴ WHO 2018 - WHO Environmental Noise Guidelines (2018)

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HOURLY WIND CONDITIONS

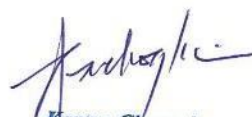
Year	Month	Day	Hour	Wind direction (°)	Wind speed (m/s)
2025	7	23	13	190	1.9
2025	7	23	14	161	2.1
2025	7	23	15	174	1.8
2025	7	23	16	187	1.3
2025	7	23	17	188	1.1
2025	7	23	18	226	0.4
2025	7	23	19	152	0.3
2025	7	23	20	192	0.2
2025	7	23	21	231	0
2025	7	23	22	22	0
2025	7	23	23	32	0
2025	7	24	0	96	0.1
2025	7	24	1	58	0.1
2025	7	24	2	56	0
2025	7	24	3	49	0.1
2025	7	24	4	100	0.3
2025	7	24	5	132	0.1
2025	7	24	6	185	0.7
2025	7	24	7	225	0.9
2025	7	24	8	127	0.2
2025	7	24	9	191	0.5
2025	7	24	10	179	1.5
2025	7	24	11	200	1.6
2025	7	24	12	206	1.9
2025	7	24	13	167	2

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TEST REPORT

Sample Location: ANSP-7 (Below AH48 – Proposed Labour Camp-2)

Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

Report Code:	ENGEO/2025/17	Issued Date:	04/08/2025
Issued To (Client Name):	Fichtner GmbH & Co. KG & JADE Consult in association with NextGen/PCS - Consultancy service for Review and Update of DPR and ESIA of Bunakha		
Sampling Conducted by	:	ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)	
Sampling No. & Location	:	ANSP-7 (Proposed Labour Camp-2, Bunakha)	
Sampling Duration	:	22/07/2025 (08:05:00) To 23/07/2025 (08:05:00)	
Sampling Instrument used	:	AQM-09 (Oceanus) Real Time Sampler	
Ambient Temperature	:	20.98 (°C)	
Relative Humidity	:	81.78 (%)	
Weather Condition	:	Raining	
Altitude	:	1994 m	

AIR QUALITY RESULTS

S.No	Parameters	Test Methods ¹	Results	Unit	ES2020, NEC ²	WHO AQG 2021 ³
1	Total Suspended Particulate Matter	Light scattering technique	4.51	µg/m ³	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	3.48	µg/m ³	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	1.85	µg/m ³	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO ₂	Electrochemical sensor or UV photometry	41.35	µg/m ³	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O ₃	UV photometry	87.52	µg/m ³	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO ₂	UV fluorescence or electrochemical sensor	68.68	µg/m ³	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.05	µg/m ³	2000(8 hr mean)	4 (8 hr mean)

NOISE LEVEL MEASUREMENTS

S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 ⁴
1	Sound Pressure Level (SPL)	SLM continuous recording	48.82	dB	65 (Day)	85 (8-hour exposure for occupational setting).
			46.46		55 (Night)	

¹ 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.

² ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

³ 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)

⁴ WHO 2018 - WHO Environmental Noise Guidelines (2018).

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HOURLY WIND CONDITIONS

Year	Month	Day	Hour	Wind direction (°)	Wind speed (m/s)
2025	7	22	9	160	0.9
2025	7	22	10	227	0.6
2025	7	22	11	153	1.5
2025	7	22	12	145	2.9
2025	7	22	13	150	3.4
2025	7	22	14	132	3.4
2025	7	22	15	147	3.7
2025	7	22	16	145	3.1
2025	7	22	17	135	3.3
2025	7	22	18	132	2.1
2025	7	22	19	141	0.4
2025	7	22	20	241	0
2025	7	22	21	331	0
2025	7	22	22	154	0.1
2025	7	23	23	50	0.1
2025	7	23	0	83	0.1
2025	7	23	1	37	0
2025	7	23	2	54	0
2025	7	23	3	118	0.1
2025	7	23	4	89	0.1
2025	7	23	5	85	0.1
2025	7	23	6	96	0.2
2025	7	23	7	126	0.4
2025	7	23	8	119	0.1

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TEST REPORT

Sample Location: ANSP-8 (Zangtey, Lobneykha Heritage Village)

Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

Report Code: ENGEO/2025/18
Issued To (Client Name): Fichtner GmbH & Co. KG & JADE Consult in association with NextGen/PCS - Consultancy service for Review and Update of DPR and ESIA of Bunakha
Issued Date: 04/08/2025
Sampling Conducted by: ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)
Sampling No. & Location: ANSP-8 (Zangtey, Lobneykha Heritage Village)
Sampling Duration: 26/07/2025 (09:45:00) To 27/07/2025 (09:45:00)
Sampling Instrument used: AQM-09 (Oceanus) Real Time Sampler
Ambient Temperature: 21.05 (°C)
Relative Humidity: 77.71 (%)
Weather Condition: Sunny
Altitude: 2237 m

AIR QUALITY RESULTS

S.No	Parameters	Test Methods ¹	Results	Unit	ES2020, NEC ²	WHO AQG 2021 ³
1	Total Suspended Particulate Matter	Light scattering technique	1.83	µg/m ³	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	1.42	µg/m ³	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	0.48	µg/m ³	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO ₂	Electrochemical sensor or UV photometry	54.91	µg/m ³	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O ₃	UV photometry	11.10	µg /m ³	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO ₂	UV fluorescence or electrochemical sensor	0.00	µg/m ³	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.00	µg/m ³	2000(8 hr mean)	4 (8 hr mean)

NOISE LEVEL MEASUREMENTS

S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 ⁴
1	Sound Pressure Level (SPL)	SLM continuous recording	45.69	dB	65 (Day)	85 (8-hour exposure for occupational setting.
			45.81		55 (Night)	

¹ 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.

² ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

³ 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](#))

⁴ WHO 2018 - WHO Environmental Noise Guidelines (2018).

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HOURLY WIND CONDITIONS

Year	Month	Day	Hour	Wind direction (°)	Wind speed (m/s)
2025	7	26	10	193	1.5
2025	7	26	11	166	1.1
2025	7	26	12	148	1
2025	7	26	13	187	1.2
2025	7	26	14	174	1.3
2025	7	26	15	184	1.4
2025	7	26	16	179	1.3
2025	7	26	17	202	1
2025	7	26	18	194	1
2025	7	26	19	168	0.5
2025	7	26	20	164	0.3
2025	7	26	21	167	0.2
2025	7	26	22	199	0.4
2025	7	26	23	155	0.1
2025	7	27	0	114	0.1
2025	7	27	1	230	0
2025	7	27	2	317	0
2025	7	27	3	332	0
2025	7	27	4	182	0.1
2025	7	27	5	152	0.2
2025	7	27	6	141	0
2025	7	27	7	259	0.2
2025	7	27	8	257	0.6
2025	7	27	9	245	0.6

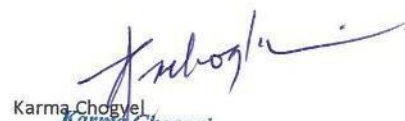
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Prepared by:



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TEST REPORT

Sample Location: ANSP-9 (Nayakha Village)

Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

Report Code: ENGEO/2025/19 **Issued Date:** 04/08/2025
Issued To (Client Name): Fichtner GmbH & Co. KG & JADE Consult in association with NextGen/PCS - Consultancy service for Review and Update of DPR and ESIA of Bunakha
Sampling Conducted by : ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)
Sampling No. & Location : ANSP-9 (Nayakha Village)
Sampling Duration : 24/07/2025 (12:45:00) To 25/07/2025 (12:45:00)
Sampling Instrument used : AQM-09 (Oceanus) Real Time Sampler
Ambient Temperature : 20.63 (°C)
Relative Humidity : 75.67 (%)
Weather Condition : Sunny
Altitude : 2507 m

AIR QUALITY RESULTS

S.No	Parameters	Test Methods ¹	Results	Unit	ES2020, NEC ²	WHO AQG 2021 ³
1	Total Suspended Particulate Matter	Light scattering technique	6.70	µg/m ³	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	6.12	µg/m ³	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	5.03	µg/m ³	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO ₂	Electrochemical sensor or UV photometry	39.98	µg/m ³	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O ₃	UV photometry	95.41	µg/m ³	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO ₂	UV fluorescence or electrochemical sensor	47.14	µg/m ³	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.00	µg/m ³	2000(8 hr mean)	4 (8 hr mean)

NOISE LEVEL MEASUREMENTS

S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 ⁴
1	Sound Pressure Level (SPL)	SLM continuous recording	46.44	dB	65 (Day)	85 (8-hour exposure for occupational setting).
			44.29		55 (Night)	

¹ 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.

² ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

³ 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)

⁴ WHO 2018 - WHO Environmental Noise Guidelines (2018).

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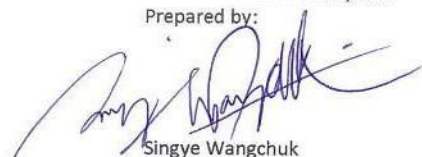
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HOURLY WIND CONDITIONS

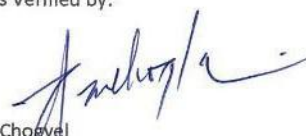
Year	Month	Day	Hour	Wind direction (°)	Wind speed (m/s)
2025	7	24	13	94	1.1
2025	7	24	14	106	1.1
2025	7	24	15	99	0.7
2025	7	24	16	102	0.5
2025	7	24	17	133	0.2
2025	7	24	18	149	0.2
2025	7	24	19	142	0.1
2025	7	24	20	140	0.1
2025	7	24	21	140	0.1
2025	7	24	22	186	0.3
2025	7	24	23	214	0.6
2025	7	25	0	237	0.5
2025	7	25	1	277	1.1
2025	7	25	2	236	1.1
2025	7	25	3	222	0.5
2025	7	25	4	192	0.9
2025	7	25	5	165	1.3
2025	7	25	6	226	1.4
2025	7	25	7	213	0.6
2025	7	25	8	195	0.5
2025	7	25	9	214	0.6
2025	7	25	10	166	0.6
2025	7	25	11	165	0.6
2025	7	25	12	103	0.8
2025	7	25	13	39	1

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TEST REPORT

Sample Location: ANSP-10 (Chanachen Village)

Outdoor Ambient Air Quality, Noise Levels and Wind Conditions

Report Code: ENGEO/2025/20
Issued To (Client Name): Fichtner GmbH & Co. KG & JADE Consult in association with NextGen/PCS - Consultancy service for Review and Update of DPR and ESIA of Bunakha
Issued Date: 04/08/2025
Sampling Conducted by : ENGEO Consultancy (Laboratory Services for Conducting Ambient Air, Noise, Soil and Water Quality Monitoring)
Sampling No. & Location : ANSP-10 (Chanachen Village)
Sampling Duration : 24/07/2025 (15:15:00) To 25/07/2025 (15:15:00)
Sampling Instrument used : AQM-09 (Oceanus) Real Time Sampler
Ambient Temperature : 22.28 (°C)
Relative Humidity : 77.08 (%)
Weather Condition : Cloudy
Altitude : 2034 m

AIR QUALITY RESULTS

S.No	Parameters	Test Methods ¹	Results	Unit	ES2020, NEC ²	WHO AQG 2021 ³
1	Total Suspended Particulate Matter	Light scattering technique	6.32	µg/m ³	200(24 hr mean)	-
2	Conc. of PM10	Light scattering technique	5.94	µg/m ³	100(24 hr mean)	45 (24 hr mean)
3	Conc. of PM2.5	Light scattering technique	5.06	µg/m ³	60 (24 hr mean)	15 (24 hr mean)
4	Conc. of NO ₂	Electrochemical sensor or UV photometry	57.53	µg/m ³	80 (24 hr mean)	25 (24 hr mean)
5	Conc. of O ₃	UV photometry	9.40	µg /m ³	100 (8 hr mean)	100 (8 hr mean)
6	Conc. of SO ₂	UV fluorescence or electrochemical sensor	0.00	µg/m ³	80 (24 hr mean)	40 (24 hr mean)
7	Conc. of CO	Non-dispersive infrared (NDIR) or electrochemical sensor	0.00	µg/m ³	2000(8 hr mean)	4 (8 hr mean)

NOISE LEVEL MEASUREMENTS

S.No	Parameters	Test Methods	Results	Unit	ES2020, NEC	WHO 2018 ⁴
1	Sound Pressure Level (SPL)	SLM continuous recording	41.52	dB	65 (Day)	85 (8-hour exposure for occupational setting).
			39.36		55 (Night)	

¹ 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.

² ES2020 Standards for Mixed Area (-means area where residential, commercial or both activities take place).

³ 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)

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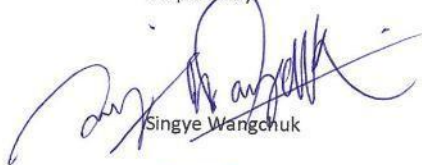
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HOURLY WIND CONDITIONS

Year	Month	Day	Hour	Wind direction (°)	Wind speed (m/s)
2025	7	24	16	207	2.4
2025	7	24	17	217	1.6
2025	7	24	18	226	1.3
2025	7	24	19	249	0.7
2025	7	24	20	223	0.5
2025	7	24	21	237	0.5
2025	7	24	22	171	0.2
2025	7	24	23	176	0.1
2025	7	25	0	218	0.2
2025	7	25	1	205	0.3
2025	7	25	2	170	0.3
2025	7	25	3	195	0.2
2025	7	25	4	232	0.3
2025	7	25	5	224	0.3
2025	7	25	6	191	0.4
2025	7	25	7	171	0.2
2025	7	25	8	274	0.1
2025	7	25	9	120	0.3
2025	7	25	10	317	0.3
2025	7	25	11	208	1.2
2025	7	25	12	208	3.5
2025	7	25	13	192	2.5
2025	7	25	14	209	2.3
2025	7	25	15	214	1.6

Test conducted and Reports
Prepared by:


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Annex 5: Water Quality Test Results (Dry, Wet & Post-Monsoon)

Dry Season

DOC NO: QLS/SAMP/08-D/00

TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No.	: QLS/P-27/25-26/C/01
	Date	: 17.05.2025
	Sample No.	: QLS/P-27/25-26/01
	Sample Description	: Surface Water
	Source of Surface Water	: River Water
	Location Code	: SW-01
	Co-ordinates	: N 27° 7' 56.3556", E 89° 32' 24.0036"
	Sampling Method	: APHA 24 th Edition 2023; 1060B
	Date of Performance	: 28.04.2025-16.05.2025
	Sample Drawn On	: 15.04.2025
	Ref No. Date	: Work Order Dated, 26.03.2025

Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	6
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	8
3.	Faecal Streptococci MPN/100ml	20	1000	1000	IS 1622-1981,(RA 2019)	BDL

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 2 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.75
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	BDL
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	BDL
4.	Electrical Conductivity in μ S/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	82.8
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	BDL
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	BDL
8.	Fluoride (as F) in mg/l	APHA 24th Edition-2023, 4500 F-D	1	2.0	---	BDL
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec 1, 2022	25	100	---	3.4
10.	Chloride (as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	9.9
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	BDL
12.	Phosphate (as PO ₄) in mg/l	APHA 24th Edition-2023, 4500-P-D	0.5	<0.1	---	BDL
13.	Dissolved Oxygen in mg/l	APHA 24th Edition-2023, 4500-O-C	6	4	---	7.6
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44)-1993, RA:2019	2	5	50	BDL
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg – B	0.5	2.0	---	BDL
16.	Ammonia (as total ammonia – N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	BDL
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	BDL
18.	Copper (as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	BDL
19.	Zinc (as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	BDL
20.	Arsenic (as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	BDL
21.	Cadmium (as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	BDL
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	BDL
23.	Lead (as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	BDL
24.	Selenium (as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	BDL
25.	Mercury (as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	BDL

Report No.	: QLS/P-27/25-26/C/01
Date	: 17.05.2025

26.	Phenolic Compounds(as C ₆ H ₅ OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	BDL
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	BDL
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	BDL
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	BDL
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	BDL
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.54
32.	Boron(as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	BDL
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	BDL
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	48
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	24
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	8
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	BDL
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	BDL
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	BDL

Detection Limit:

1.Colour- 5 Hazen Unit, 2. Turbidity -1 NTU, 3. Surfactant- 0.02 mg/l, 4. Copper – 0.02 mg/l, 5. Manganese- 0.02 mg/l, 6.Mineral Oil- 0.5 mg/l, 7. Phenolic Compounds- 0.001 mg/l, 8.Cadmium- 0.002 mg/l, 9. Lead- 0.01 mg/l, 10. Mercury- 0.001 mg/l, 13. Polychlorinated biphenyls – 0.0001 mg/l, 14. Total Chromium- 0.05 mg/l, 15. Total Arsenic – 0.01 mg/l, 16.Barium-0.05 mg/l, 17. Selenium- 0.01mg/l, 18.Cyanide- 0.02 mg/l, 19.PAH- 0.0001 mg/l, 20. COD- 4 mg/l, 21. BOD- 2 mg/l, 22. DO- 1 mg/l, 23. Ammonia- 0.5 mg/l, 24.Boron- 0.5mg/l, 25.Nitrate- 0.5mg/l, 26.Fluoride- 0.1mg/l, 27.Phosphate- 0.15mg/l, 28.Iron- 0.05mg/l, 29.Zinc- 0.02mg/l, 30.Polynuclear hydrocarbons- 0.0001mg/l 31. Total Kjeldahl Nitrogen- 0.1mg/l, 32. Iron- 0.05 mg/l, 33.TSS – 2.5 mg/l

BDL- Below Detection Limit

Report Prepared By :

for Qualissure Laboratory Services
Reviewed & Authorized by

(Soumy Chakraborty, Microbiologist)
(Authorized Signatory)

for Qualissure Laboratory Services
Reviewed & Authorized by

(Bishnupriya Banerjee, Chemist)
(Authorized Signatory)

— End of Report —

TEST REPORT

Name & Address Of the Customer :	Report No. : QLS/P-27/25-26/C/02
Phuensum Consultancy Services	Date : 17.05.2025
4 th Floor Jattu Building, Jattu Commercial Complex,	Sample No. : QLS/P-27/25-26/02
Thimpu, Bhutan	Sample Description : Surface Water
Site: Bunakha Project	Source of Surface Water : River Water
	Location Code : SW-02
	Co-ordinates : N 27° 7' 37.8078", E 89° 32' 21.4908"
	Sampling Method : APHA 24 th Edition 2023; 1060B
	Date of Performance : 28.04.2025-16.05.2025
	Sample Drawn On : 17.04.2025
	Ref No. Date : Work Order Dated. 26.03.2025

Analysis Result**(A) Microbiological Analysis**

Sl. No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	6
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	8
3.	Faecal Streptococci MPN/100ml	20	1000	1000	IS 1622-1981,(RA 2019)	BDL

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 2 MPN/100 ml

(B) Chemical Analysis

Sl. No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.87
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	BDL
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	BDL
4.	Electrical Conductivity in $\mu\text{S}/\text{cm}$ at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	103.6
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	BDL
7.	Nitrate (as NO_3) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	BDL
8.	Fluoride(as F) in mg/l	APHA 24th Edition-2023, 4500 F D	1	2.0	---	BDL
9.	Sulphate (as SO_4) in mg/l	IS 3025 (Part 24): Sec 1, 2022	25	100	---	2.7
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	3.5
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	BDL
12.	Phosphate (as PO_4) in mg/l	APHA 24th Edition-2023, 4500-P-D	0.5	<0.1	---	BDL
13.	Dissolved Oxygen in mg/l	APHA 24th Edition-2023, 4500-O-C	6	4	---	7.9
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44)-1993, RA:2019	2	5	50	BDL
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg – B	0.5	2.0	---	BDL
16.	Ammonia (as total ammonia – N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	BDL
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	BDL
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	BDL
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	BDL
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	BDL
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	BDL
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	BDL
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	BDL
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	BDL
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	BDL

Report No.	: QLS/P-27/25-26/C/02
Date	: 17.05.2025

26.	Phenolic Compounds(as C ₆ H ₅ OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	BDL
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	BDL
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	BDL
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	BDL
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	BDL
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.82
32.	Boron(as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	BDL
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	BDL
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	58
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	28
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	8
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	BDL
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	BDL
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	BDL

Detection Limit:

1.Colour- 5 Hazen Unit, 2. Turbidity -1 NTU, 3. Surfactant- 0.02 mg/l, 4. Copper – 0.02 mg/l, 5. Manganese- 0.02 mg/l, 6.Mineral Oil- 0.5 mg/l, 7. Phenolic Compounds- 0.001 mg/l, 8.Cadmium- 0.002 mg/l, 9. Lead- 0.01 mg/l, 10. Mercury- 0.001 mg/l, 13. Polychlorinated biphenyls – 0.0001 mg/l, 14. Total Chromium- 0.05 mg/l, 15. Total Arsenic – 0.01 mg/l, 16.Barium-0.05 mg/l, 17. Selenium- 0.01mg/l, 18.Cyanide- 0.02 mg/l, 19.PAH- 0.0001 mg/l, 20. COD- 4 mg/l, 21. BOD- 2 mg/l, 22. DO- 1 mg/l, 23. Ammonia- 0.5 mg/l, 24.Boron- 0.5mg/l, 25.Nitrate- 0.5mg/l, 26.Fluoride- 0.1mg/l, 27.Phosphate- 0.15mg/l, 28.Iron- 0.05mg/l, 29.Zinc- 0.02mg/l, 30.Polynuclear hydrocarbons- 0.0001mg/l 31. Total Kjeldahl Nitrogen- 0.1mg/l, 32. Iron- 0.05 mg/l, 33.TSS – 2.5 mg/l

BDL- Below Detection Limit

Report Prepared By :

for Qualissure Laboratory Services
Reviewed & Authorized by

(Soumy Chakraborty, Microbiologist)
(Authorized Signatory)

for Qualissure Laboratory Services
Reviewed & Authorized by

(Bishnupriya Banerjee, Chemist)
(Authorized Signatory)

— End of Report —

TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No.	: QLS/P-27/25-26/C/03
	Date	: 17.05.2025
	Sample No.	: QLS/P-27/25-26/03
	Sample Description	: Surface Water
	Source of Surface Water	: River Water
	Location Code	: SW-3
	Co-ordinates	: N 27° 8' 21.789", E 89° 33' 8.3694"
	Sampling Method	: APHA 24 th Edition 2023; 1060B
	Date of Performance	: 28.04.2025-16.05.2025
	Sample Drawn On	: 18.04.2025
	Ref No. Date	: Work Order Dated. 26.03.2025

Analysis Result**(A) Microbiological Analysis**

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	
3.	Faecal Streptococci MPN/100ml	20	1000	1000	IS 1622-1981,(RA 2019)	

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 2 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.97
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	BDL
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	BDL
4.	Electrical Conductivity in μ S/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	96.4
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	BDL
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	BDL
8.	Fluoride(as F) in mg/l	APHA 24th Edition-2023, 4500 F D	1	2.0	---	BDL
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec 1, 2022	25	100	---	3.8
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	5.9
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	BDL
12.	Phosphate (as PO ₄) in mg/l	APHA 24th Edition-2023, 4500-P-D	0.5	<0.1	---	BDL
13.	Dissolved Oxygen in mg/l	APHA 24th Edition-2023, 4500-O-C	6	4	---	7.8
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44)-1993, RA:2019	2	5	50	BDL
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg – B	0.5	2.0	---	BDL
16.	Ammonia (as total ammonia – N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	BDL
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	BDL
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	BDL
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	BDL
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	BDL
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	BDL
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	BDL
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	BDL
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	BDL
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	BDL

Report No.	: QLS/P-27/25-26/C/03
Date	: 17.05.2025

26.	Phenolic Compounds(as C ₆ H ₅ OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	BDL
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	BDL
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	BDL
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	BDL
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	BDL
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.51
32.	Boron(as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	BDL
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	BDL
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	54
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	20
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	8
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	BDL
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	BDL
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	BDL

Detection Limit:

1.Colour- 5 Hazen Unit, 2. Turbidity -1 NTU, 3. Surfactant- 0.02 mg/l, 4. Copper – 0.02 mg/l, 5. Manganese- 0.02 mg/l, 6.Mineral Oil- 0.5 mg/l, 7. Phenolic Compounds- 0.001 mg/l, 8.Cadmium- 0.002 mg/l, 9. Lead- 0.01 mg/l, 10. Mercury- 0.001 mg/l, 13. Polychlorinated biphenyls – 0.0001 mg/l, 14. Total Chromium- 0.05 mg/l, 15. Total Arsenic – 0.01 mg/l, 16.Barium-0.05 mg/l, 17. Selenium- 0.01mg/l, 18.Cyanide- 0.02 mg/l, 19.PAH- 0.0001 mg/l, 20. COD- 4 mg/l, 21. BOD- 2 mg/l, 22. DO- 1 mg/l, 23. Ammonia- 0.5 mg/l, 24.Boron- 0.5mg/l, 25.Nitrate- 0.5mg/l, 26.Fluoride- 0.1mg/l, 27.Phosphate- 0.15mg/l, 28.Iron- 0.05mg/l, 29.Zinc- 0.02mg/l, 30.Polynuclear hydrocarbons- 0.0001mg/l 31. Total Kjeldahl Nitrogen- 0.1mg/l, 32. Iron- 0.05 mg/l, 33.TSS – 2.5 mg/l

BDL- Below Detection Limit

Report Prepared By :

for Qualissure Laboratory Services
Reviewed & Authorized by

(Soumy Chakraborty, Microbiologist)
(Authorized Signatory)

for Qualissure Laboratory Services
Reviewed & Authorized by

(Bishnupriya Banerjee, Chemist)
(Authorized Signatory)

— End of Report —

TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No.	: QLS/P-27/25-26/C/04
	Date	: 17.05.2025
	Sample No.	: QLS/P-27/25-26/04
	Sample Description	: Surface Water
	Source of Surface Water	: River Water
	Location Code	: SW-4
	Co-ordinates	: N 27° 8' 13.2864", E 89° 32' 43.6164"
	Sampling Method	: APHA 24 th Edition 2023; 1060B
	Date of Performance	: 28.04.2025-16.05.2025
	Sample Drawn On	: 23.04.2025
	Ref No. Date	: Work Order Dated. 26.03.2025

Analysis Result**(A) Microbiological Analysis**

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	4
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	8
3.	Faecal Streptococci MPN/100ml	20	1000	1000	IS 1622-1981,(RA 2019)	BDL

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 2 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.87
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	BDL
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	BDL
4.	Electrical Conductivity in μ S/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	110.3
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	BDL
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	BDL
8.	Fluoride(as F) in mg/l	APHA 24th Edition-2023, 4500 F D	1	2.0	---	BDL
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec 1, 2022	25	100	---	4.0
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	7.9
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	BDL
12.	Phosphate (as PO ₄) in mg/l	APHA 24th Edition-2023, 4500-P-D	0.5	<0.1	---	BDL
13.	Dissolved Oxygen in mg/l	APHA 24th Edition-2023, 4500-O-C	6	4	---	8.2
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44)-1993, RA:2019	2	5	50	BDL
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg – B	0.5	2.0	---	BDL
16.	Ammonia (as total ammonia – N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	BDL
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	BDL
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	BDL
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	BDL
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	BDL
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	BDL
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	BDL
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	BDL
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	BDL
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	BDL

Report No.	: QLS/P-27/25-26/C/04
Date	: 17.05.2025

26.	Phenolic Compounds(as C ₆ H ₅ OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	BDL
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	BDL
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	BDL
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	BDL
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	BDL
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.64
32.	Boron(as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	BDL
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	BDL
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	64
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	12
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	8
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	BDL
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	BDL
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	BDL

Detection Limit:

1.Colour- 5 Hazen Unit, 2. Turbidity -1 NTU, 3. Surfactant- 0.02 mg/l, 4. Copper – 0.02 mg/l, 5. Manganese- 0.02 mg/l, 6.Mineral Oil- 0.5 mg/l, 7. Phenolic Compounds- 0.001 mg/l, 8.Cadmium- 0.002 mg/l, 9. Lead- 0.01 mg/l, 10. Mercury- 0.001 mg/l, 13. Polychlorinated biphenyls – 0.0001 mg/l, 14. Total Chromium- 0.05 mg/l, 15. Total Arsenic – 0.01 mg/l, 16.Barium-0.05 mg/l, 17. Selenium- 0.01mg/l, 18.Cyanide- 0.02 mg/l, 19.PAH- 0.0001 mg/l, 20. COD- 4 mg/l, 21. BOD- 2 mg/l, 22. DO- 1 mg/l, 23. Ammonia- 0.5 mg/l, 24.Boron- 0.5mg/l, 25.Nitrate- 0.5mg/l, 26.Fluoride- 0.1mg/l, 27.Phosphate- 0.15mg/l, 28.Iron- 0.05mg/l, 29.Zinc- 0.02mg/l, 30.Polynuclear hydrocarbons- 0.0001mg/l 31. Total Kjeldahl Nitrogen- 0.1mg/l, 32. Iron- 0.05 mg/l, 33.TSS – 2.5 mg/l

BDL- Below Detection Limit

Report Prepared By :

for Qualissure Laboratory Services
Reviewed & Authorized by

(Soumy Chakraborty, Microbiologist)
(Authorized Signatory)

for Qualissure Laboratory Services
Reviewed & Authorized by

(Bishnupriya Banerjee, Chemist)
(Authorized Signatory)

— End of Report —

TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No.	: QLS/P-27/25-26/C/05
	Date	: 17.05.2025
	Sample No.	: QLS/P-27/25-26/05
	Sample Description	: Surface Water
	Source of Surface Water	: Drinking Water, Tsimlakha
	Location Code	: SW-5
	Co-ordinates	: N 27° 5' 0.4884", E 89° 32' 38.6376"
	Sampling Method	: APHA 24 th Edition 2023; 1060B
	Date of Performance	: 28.04.2025-12.05.2025
	Sample Drawn On	: 20.04.2025
	Ref No. Date	: Work Order Dated. 26.03.2025

Analysis Result**(A) Microbiological Analysis**

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	2
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	6
3.	Faecal Streptococci MPN/100ml	20	1000	1000	IS 1622-1981,(RA 2019)	BDL

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 2 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.36
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	BDL
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	BDL
4.	Electrical Conductivity in μ S/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	117.2
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	BDL
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	BDL
8.	Fluoride(as F) in mg/l	APHA 24th Edition-2023, 4500 F D	1	2.0	---	BDL
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec 1, 2022	25	100	---	3.2
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	7.9
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	BDL
12.	Phosphate (as PO ₄) in mg/l	APHA 24th Edition-2023, 4500-P-D	0.5	<0.1	---	BDL
13.	Dissolved Oxygen in mg/l	APHA 24th Edition-2023, 4500-O-C	6	4	---	7.4
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44)-1993, RA:2019	2	5	50	BDL
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg – B	0.5	2.0	---	BDL
16.	Ammonia (as total ammonia – N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	BDL
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	BDL
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	BDL
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	BDL
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	BDL
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	BDL
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	BDL
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	BDL
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	BDL
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	BDL

Report No.	: QLS/P-27/25-26/C/05
Date	: 17.05.2025

26.	Phenolic Compounds(as C ₆ H ₅ OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	BDL
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	BDL
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	BDL
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	BDL
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	BDL
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.51
32.	Boron(as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	BDL
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	BDL
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	68
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	16
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	12
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	BDL
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	BDL
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	BDL

Detection Limit:

1.Colour- 5 Hazen Unit, 2. Turbidity -1 NTU, 3. Surfactant- 0.02 mg/l, 4. Copper – 0.02 mg/l, 5. Manganese- 0.02 mg/l, 6.Mineral Oil- 0.5 mg/l, 7. Phenolic Compounds- 0.001 mg/l, 8.Cadmium- 0.002 mg/l, 9. Lead- 0.01 mg/l, 10. Mercury- 0.001 mg/l, 13. Polychlorinated biphenyls – 0.0001 mg/l, 14. Total Chromium- 0.05 mg/l, 15. Total Arsenic – 0.01 mg/l, 16.Barium-0.05 mg/l, 17. Selenium- 0.01mg/l, 18.Cyanide- 0.02 mg/l, 19.PAH- 0.0001 mg/l, 20. COD- 4 mg/l, 21. BOD- 2 mg/l, 22. DO- 1 mg/l, 23. Ammonia- 0.5 mg/l, 24.Boron- 0.5mg/l, 25.Nitrate- 0.5mg/l, 26.Fluoride- 0.1mg/l, 27.Phosphate- 0.15mg/l, 28.Iron- 0.05mg/l, 29.Zinc- 0.02mg/l, 30.Polynuclear hydrocarbons- 0.0001mg/l 31. Total Kjeldahl Nitrogen- 0.1mg/l, 32. Iron- 0.05 mg/l, 33.TSS – 2.5 mg/l

BDL- Below Detection Limit

Report Prepared By :

for Qualissure Laboratory Services
Reviewed & Authorized by

(Soumy Chakraborty, Microbiologist)
(Authorized Signatory)

for Qualissure Laboratory Services
Reviewed & Authorized by

(Bishnupriya Banerjee, Chemist)
(Authorized Signatory)

— End of Report —

TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No.	: QLS/P-27/25-26/C/06
	Date	: 14.05.2025
	Sample No.	: QLS/P-27/25-26/06
	Sample Description	: Surface Water
	Source of Surface Water	: River Water
	Location Code	: SW-6
	Co-ordinates	: N 27° 7' 44.0472", E 89° 33' 4.2114"
	Sampling Method	: APHA 24 th Edition 2023; 1060B
	Date of Performance	: 28.04.2025-12.05.2025
	Sample Drawn On	: 18.04.2025
	Ref No. Date	: Work Order Dated. 26.03.2025

Analysis Result**(A) Microbiological Analysis**

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	6
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	8
3.	Faecal Streptococci MPN/100ml	20	1000	1000	IS 1622-1981,(RA 2019)	BDL

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 2 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.04
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	BDL
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	BDL
4.	Electrical Conductivity in μ S/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	124.1
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	BDL
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	BDL
8.	Fluoride(as F) in mg/l	APHA 24th Edition-2023, 4500 F D	1	2.0	---	BDL
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec 1, 2022	25	100	---	3.5
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	7.9
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	BDL
12.	Phosphate (as PO ₄) in mg/l	APHA 24th Edition-2023, 4500-P-D	0.5	<0.1	---	BDL
13.	Dissolved Oxygen in mg/l	APHA 24th Edition-2023, 4500-O-C	6	4	---	7.8
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44)-1993, RA:2019	2	5	50	BDL
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg – B	0.5	2.0	---	BDL
16.	Ammonia (as total ammonia – N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	BDL
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	BDL
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	BDL
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	BDL
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	BDL
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	BDL
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	BDL
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	BDL
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	BDL
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	BDL

Report No.	: QLS/P-27/25-26/C/06
Date	: 17.05.2025

26.	Phenolic Compounds(as C ₆ H ₅ OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	BDL
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	BDL
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	BDL
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	BDL
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	BDL
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.44
32.	Boron(as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	BDL
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	BDL
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	72
36.	Calcium Hardness in mg/l	APHA 24 th Edition-2023, 3500 Ca B	200	---	---	20
37.	Magnesium Hardness in mg/l	APHA 24 th Edition-2023, 3500 Mg B	200	---	---	12
38.	Barium (as Ba) in mg/l	APHA 24 th Edition-2023, 3111 D	0.7	---	---	BDL
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	BDL
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24 th Edition-2023, 5220 B	5	---	---	BDL

Detection Limit:

1.Colour- 5 Hazen Unit, 2. Turbidity -1 NTU, 3. Surfactant- 0.02 mg/l, 4. Copper – 0.02 mg/l, 5. Manganese- 0.02 mg/l, 6.Mineral Oil- 0.5 mg/l, 7. Phenolic Compounds- 0.001 mg/l, 8.Cadmium- 0.002 mg/l, 9. Lead- 0.01 mg/l, 10. Mercury- 0.001 mg/l, 13. Polychlorinated biphenyls – 0.0001 mg/l, 14. Total Chromium- 0.05 mg/l, 15. Total Arsenic – 0.01 mg/l, 16.Barium-0.05 mg/l, 17. Selenium- 0.01mg/l, 18.Cyanide- 0.02 mg/l, 19.PAH- 0.0001 mg/l, 20. COD- 4 mg/l, 21. BOD- 2 mg/l, 22. DO- 1 mg/l, 23. Ammonia- 0.5 mg/l, 24.Boron- 0.5mg/l, 25.Nitrate- 0.5mg/l, 26.Fluoride- 0.1mg/l, 27.Phosphate- 0.15mg/l, 28.Iron- 0.05mg/l, 29.Zinc- 0.02mg/l, 30.Polynuclear hydrocarbons- 0.0001mg/l 31. Total Kjeldahl Nitrogen- 0.1mg/l, 32. Iron- 0.05 mg/l, 33.TSS – 2.5 mg/l

BDL- Below Detection Limit

Report Prepared By :

for Qualissure Laboratory Services
Reviewed & Authorized by

(Soumy Chakraborty, Microbiologist)
(Authorized Signatory)

for Qualissure Laboratory Services
Reviewed & Authorized by

(Bishnupriya Banerjee, Chemist)
(Authorized Signatory)

— End of Report —

TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No.	: QLS/P-27/25-26/C/07
	Date	: 17.05.2025
	Sample No.	: QLS/P-27/25-26/07
	Sample Description	: Surface Water
	Source of Surface Water	: River Water
	Location Code	: SW-7
	Co-ordinates	: N 27° 8' 48.3108", E 89° 32' 50.9634"
	Sampling Method	: APHA 24 th Edition 2023; 1060B
	Date of Performance	: 28.04.2025-16.05.2025
	Sample Drawn On	: 18.04.2025
	Ref No. Date	: Work Order Dated. 26.03.2025

Analysis Result**(A) Microbiological Analysis**

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	8
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	12
3.	Faecal Streptococci MPN/100ml	20	1000	1000	IS 1622-1981,(RA 2019)	BDL

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 2 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.84
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	BDL
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	BDL
4.	Electrical Conductivity in μ S/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	105.3
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	BDL
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	BDL
8.	Fluoride(as F) in mg/l	APHA 24th Edition-2023, 4500 F D	1	2.0	---	BDL
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec 1, 2022	25	100	---	2.7
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	7.9
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	BDL
12.	Phosphate (as PO ₄) in mg/l	APHA 24th Edition-2023, 4500-P-D	0.5	<0.1	---	BDL
13.	Dissolved Oxygen in mg/l	APHA 24th Edition-2023, 4500-O-C	6	4	---	8.2
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44)-1993, RA:2019	2	5	50	BDL
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg – B	0.5	2.0	---	BDL
16.	Ammonia (as total ammonia – N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	BDL
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	BDL
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	BDL
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	BDL
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	BDL
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	BDL
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	BDL
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	BDL
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	BDL
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	BDL

Report No.	: QLS/P-27/25-26/C/07
Date	: 17.05.2025

26.	Phenolic Compounds(as C ₆ H ₅ OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	BDL
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	BDL
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	BDL
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	BDL
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	BDL
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.89
32.	Boron(as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	BDL
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	BDL
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	60
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	8
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	4
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	BDL
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	BDL
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	BDL

Detection Limit:

1.Colour- 5 Hazen Unit, 2. Turbidity -1 NTU, 3. Surfactant- 0.02 mg/l, 4. Copper – 0.02 mg/l, 5. Manganese- 0.02 mg/l, 6.Mineral Oil- 0.5 mg/l, 7. Phenolic Compounds- 0.001 mg/l, 8.Cadmium- 0.002 mg/l, 9. Lead- 0.01 mg/l, 10. Mercury- 0.001 mg/l, 13. Polychlorinated biphenyls – 0.0001 mg/l, 14. Total Chromium- 0.05 mg/l, 15. Total Arsenic – 0.01 mg/l, 16.Barium-0.05 mg/l, 17. Selenium- 0.01mg/l, 18.Cyanide- 0.02 mg/l, 19.PAH- 0.0001 mg/l, 20. COD- 4 mg/l, 21. BOD- 2 mg/l, 22. DO- 1 mg/l, 23. Ammonia- 0.5 mg/l, 24.Boron- 0.5mg/l, 25.Nitrate- 0.5mg/l, 26.Fluoride- 0.1mg/l, 27.Phosphate- 0.15mg/l, 28.Iron- 0.05mg/l, 29.Zinc- 0.02mg/l, 30.Polynuclear hydrocarbons- 0.0001mg/l 31. Total Kjeldahl Nitrogen- 0.1mg/l, 32. Iron- 0.05 mg/l, 33.TSS – 2.5 mg/l

BDL- Below Detection Limit

Report Prepared By :

for Qualissure Laboratory Services
Reviewed & Authorized by

(Soumy Chakraborty, Microbiologist)
(Authorized Signatory)

for Qualissure Laboratory Services
Reviewed & Authorized by

(Bishnupriya Banerjee, Chemist)
(Authorized Signatory)

— End of Report —

TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No.	: QLS/P-27/25-26/C/08
	Date	: 17.05.2025
	Sample No.	: QLS/P-27/25-26/08
	Sample Description	: Surface Water
	Source of Surface Water	: River Water
	Location Code & Name	: SW-S
	Co-ordinates	: N 27° 9' 44.9388", E 89° 33' 1.4508"
	Sampling Method	: APHA 24 th Edition 2023; 1060B
	Date of Performance	: 28.04.2025-16.05.2025
	Sample Drawn On	: 20.04.2025
	Ref No. Date	: Work Order Dated. 26.03.2025

Analysis Result**(A) Microbiological Analysis**

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	4
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	8
3.	Faecal Streptococci MPN/100ml	20	1000	1000	IS 1622-1981,(RA 2019)	BDL

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 2 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	8.04
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	BDL
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	BDL
4.	Electrical Conductivity in μ S/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	88.1
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	BDL
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	BDL
8.	Fluoride(as F) in mg/l	APHA 24th Edition-2023, 4500 F D	1	2.0	---	BDL
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec 1, 2022	25	100	---	3.7
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	9.9
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	BDL
12.	Phosphate (as PO ₄) in mg/l	APHA 24th Edition-2023, 4500-P-D	0.5	<0.1	---	BDL
13.	Dissolved Oxygen in mg/l	APHA 24th Edition-2023, 4500-O-C	6	4	---	8.2
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44)-1993, RA:2019	2	5	50	BDL
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg – B	0.5	2.0	---	BDL
16.	Ammonia (as total ammonia – N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	BDL
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	BDL
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	BDL
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	BDL
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	BDL
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	BDL
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	BDL
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	BDL
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	BDL
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	BDL

Report No.	: QLS/P-27/25-26/C/08
Date	: 17.05.2025

26.	Phenolic Compounds(as C ₆ H ₅ OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	BDL
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	BDL
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	BDL
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	BDL
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	BDL
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.43
32.	Boron(as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	BDL
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	BDL
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	52
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	24
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	12
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	BDL
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	BDL
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	BDL

Detection Limit:

1.Colour- 5 Hazen Unit, 2. Turbidity -1 NTU, 3. Surfactant- 0.02 mg/l, 4. Copper – 0.02 mg/l, 5. Manganese- 0.02 mg/l, 6.Mineral Oil- 0.5 mg/l, 7. Phenolic Compounds- 0.001 mg/l, 8.Cadmium- 0.002 mg/l, 9. Lead- 0.01 mg/l, 10. Mercury- 0.001 mg/l, 13. Polychlorinated biphenyls – 0.0001 mg/l, 14. Total Chromium- 0.05 mg/l, 15. Total Arsenic – 0.01 mg/l, 16.Barium-0.05 mg/l, 17. Selenium- 0.01mg/l, 18.Cyanide- 0.02 mg/l, 19.PAH- 0.0001 mg/l, 20. COD- 4 mg/l, 21. BOD- 2 mg/l, 22. DO- 1 mg/l, 23. Ammonia- 0.5 mg/l, 24.Boron- 0.5mg/l, 25.Nitrate- 0.5mg/l, 26.Fluoride- 0.1mg/l, 27.Phosphate- 0.15mg/l, 28.Iron- 0.05mg/l, 29.Zinc- 0.02mg/l, 30.Polynuclear hydrocarbons- 0.0001mg/l 31. Total Kjeldahl Nitrogen- 0.1mg/l, 32. Iron- 0.05 mg/l, 33.TSS – 2.5 mg/l

BDL- Below Detection Limit

Report Prepared By :

for Qualissure Laboratory Services
Reviewed & Authorized by

(Soumy Chakraborty, Microbiologist)
(Authorized Signatory)

for Qualissure Laboratory Services
Reviewed & Authorized by

(Bishnupriya Banerjee, Chemist)
(Authorized Signatory)

— End of Report —

Wet/Monsoon Season



Qualissure Laboratory Services

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DOC NO: QLS/SAMP/08-D/00

TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No.	: QLS/P-27/25-26/C/19
	Date	: 16.08.2025
	Sample No.	: QLS/P-27/25-26/19
	Sample Description	: Surface Water
	Source of Surface Water	: Dam Upstream
	Location Code	: SW-01
	Co-ordinates	: N 27° 7' 56.36", E 89° 32' 24.00"
	Sampling Method	: APHA 24 th Edition 2023; 1060B
	Date of Performance	: 30.07.2025-12.08.2025
	Sample Drawn On	: 26.07.2025
	Ref No. Date	: Work Order Dated. 26.03.2025

Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	4
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	11
3.	Faecal Streptococci MPN/100ml	20	1000	1000	IS 1622-1981,(RA 2019)	<2

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 2 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	8.04
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	<5
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	4
4.	Electrical Conductivity in µS/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	138
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	No Film
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	<0.5
8.	Fluoride(as F) in mg/l	APHA 24 th Edition-2023, 4500 F D	1	2.0	---	<0.1
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec 1, 2022	25	100	---	5.3
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	13.6
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	<0.02
12.	Phosphate (as PO ₄) in mg/l	APHA 24 th Edition-2023, 4500-P-D	0.5	<0.1	---	<0.15
13.	Dissolved Oxygen in mg/l	APHA 24 th Edition-2023, 4500-O-C	6	4	---	7.9
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44):1993, RA:2019	2	5	50	<2
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg-B	0.5	2.0	---	<0.1
16.	Ammonia (as total ammonia-N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	<0.5
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	<0.05
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	<0.02
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	<0.02
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	<0.01
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	<0.002
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	<0.05
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	<0.01
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	<0.01
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	<0.001

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Qualissure Laboratory Services

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Report No.	: QLS/P-27/25-26/C/19
Date	: 16.08.2025

26.	Phenolic Compounds (as C_6H_5OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	<0.001
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	<0.02
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	<0.0001
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	<0.0005
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	<0.0001
31.	Sodium Absorption Ratio	Calculation	---	---	26	1.24
32.	Boron (as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	<0.5
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	<0.02
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	82
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	23.3
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	11.6
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	<0.05
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	<1.0
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	<4

Detection Limit:

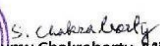
1.Colour- 5 Hazen Unit, 2. Turbidity -1 NTU, 3. Surfactant- 0.02 mg/l, 4. Copper – 0.02 mg/l, 5. Manganese- 0.02 mg/l, 6.Mineral Oil- 0.5 mg/l, 7. Phenolic Compounds- 0.001 mg/l, 8.Cadmium- 0.002 mg/l, 9. Lead- 0.01 mg/l, 10. Mercury- 0.001 mg/l, 13. Polychlorinated biphenyls – 0.0001 mg/l, 14. Total Chromium- 0.05 mg/l, 15. Total Arsenic – 0.01 mg/l, 16.Barium-0.05 mg/l, 17. Selenium- 0.01mg/l, 18.Cyanide- 0.02 mg/l, 19.PAH- 0.0001 mg/l, 20. COD- 4 mg/l, 21. BOD- 2 mg/l, 22. DO- 1 mg/l, 23. Ammonia- 0.5 mg/l, 24.Boron- 0.5mg/l, 25.Nitrate- 0.5mg/l, 26.Fluoride- 0.1mg/l, 27.Phosphate- 0.15mg/l, 28.Iron- 0.05mg/l, 29.Zinc- 0.02mg/l, 30.Polynuclear hydrocarbons- 0.0001mg/l 31. Total Kjeldahl Nitrogen- 0.1mg/l, 32. Iron- 0.05 mg/l, 33.TSS – 2.5 mg/l

BDL- Below Detection Limit

Report Prepared By:  for Qualissure Laboratory Services



Reviewed & Authorized By


Soumy Chakraborty, Microbiologist
(Authorized Signatory)



for Qualissure Laboratory Services

Reviewed & Authorized By


Bishnupriya Banerjee, Chemist
(Authorized Signatory)

-----End of Report-----

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- The reserved part of sample(s), except perishable sample(s), shall be retained for 30 days from the date of issue of the Test Report.



DOC NO: QLS/SAMP/08-D/00

TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No.	: QLS/P-27/25-26/C/22
	Date	: 16.08.2025
	Sample No.	: QLS/P-27/25-26/22
	Sample Description	: Surface Water
	Source of Surface Water	: Dam Downstream
	Location Code	: SW-02
	Co-ordinates	: N 27° 7' 37.81", E 89° 32' 21.49"
	Sampling Method	: APHA 24 th Edition 2023; 1060B
	Date of Performance	: 30.07.2025-12.08.2025
	Sample Drawn On	: 26.07.2025
	Ref No. Date	: Work Order Dated. 26.03.2025

Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	7
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	14
3.	Faecal Streptococci MPN/100ml	20	1000	1000	IS 1622-1981,(RA 2019)	<2

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 2 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.52
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	<5
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	8
4.	Electrical Conductivity in µS/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	155
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	No Film
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	<0.5
8.	Fluoride(as F) in mg/l	APHA 24 th Edition-2023, 4500 F D	1	2.0	---	<0.1
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec 1, 2022	25	100	---	5.6
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	19.4
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	<0.02
12.	Phosphate (as PO ₄) in mg/l	APHA 24 th Edition-2023, 4500-P-D	0.5	<0.1	---	<0.15
13.	Dissolved Oxygen in mg/l	APHA 24 th Edition-2023, 4500-O-C	6	4	---	7.0
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44):1993, RA:2019	2	5	50	<2
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg-B	0.5	2.0	---	<0.1
16.	Ammonia (as total ammonia-N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	<0.5
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	<0.05
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1993(RA 2019)	0.05	0.5	---	<0.02
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	<0.02
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	<0.01
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	<0.002
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	<0.05
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	<0.01
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	<0.01
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	<0.001

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Report No.	: QLS/P-27/25-26/C/22
Date	: 16.08.2025

26.	Phenolic Compounds (as C_6H_5OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	<0.001
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	<0.02
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	<0.0001
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	<0.0005
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	<0.0001
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.84
32.	Boron (as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	<0.5
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	<0.02
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	94
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	34.9
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	19.4
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	<0.05
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	<1.0
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	<4

Detection Limit:

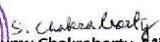
1.Colour- 5 Hazen Unit, 2. Turbidity -1 NTU, 3. Surfactant- 0.02 mg/l, 4. Copper – 0.02 mg/l, 5. Manganese- 0.02 mg/l, 6.Mineral Oil- 0.5 mg/l, 7. Phenolic Compounds- 0.001 mg/l, 8.Cadmium- 0.002 mg/l, 9. Lead- 0.01 mg/l, 10. Mercury- 0.001 mg/l, 13. Polychlorinated biphenyls – 0.0001 mg/l, 14. Total Chromium- 0.05 mg/l, 15. Total Arsenic – 0.01 mg/l, 16.Barium-0.05 mg/l, 17. Selenium- 0.01mg/l, 18.Cyanide- 0.02 mg/l, 19.PAH- 0.0001 mg/l, 20. COD- 4 mg/l, 21. BOD- 2 mg/l, 22. DO- 1 mg/l, 23. Ammonia- 0.5 mg/l, 24.Boron- 0.5mg/l, 25.Nitrate- 0.5mg/l, 26.Fluoride- 0.1mg/l, 27.Phosphate- 0.15mg/l, 28.Iron- 0.05mg/l, 29.Zinc- 0.02mg/l, 30.Polynuclear hydrocarbons- 0.0001mg/l 31. Total Kjeldahl Nitrogen- 0.1mg/l, 32. Iron- 0.05 mg/l, 33.TSS – 2.5 mg/l

BDL- Below Detection Limit

Report Prepared By:  for Qualissure Laboratory Services



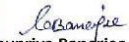
Reviewed & Authorized By


Soumy Chakraborty, Microbiologist
(Authorized Signatory)



for Qualissure Laboratory Services

Reviewed & Authorized By


Bishnupriya Banerjee, Chemist
(Authorized Signatory)

-----End of Report-----

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DOC NO: QLS/SAMP/08-D/00

TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No.	: QLS/P-27/25-26/C/21
	Date	: 16.08.2025
	Sample No.	: QLS/P-27/25-26/21
	Sample Description	: Surface Water
	Source of Surface Water	: Jhililum chhu Upstream
	Location Code	: SW-03
	Co-ordinates	: N 27° 8' 13.29", E 89° 32' 43.62"
	Sampling Method	: APHA 24 th Edition 2023; 1060B
	Date of Performance	: 30.07.2025-12.08.2025
	Sample Drawn On	: 25.07.2025
	Ref No. Date	: Work Order Dated. 26.03.2025

Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	11
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	26
3.	Faecal Streptococci MPN/100ml	20	1000	1000	IS 1622-1981,(RA 2019)	<2

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 2 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.84
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	<5
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	6
4.	Electrical Conductivity in µS/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	126
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	No Film
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	<0.5
8.	Fluoride(as F) in mg/l	APHA 24 th Edition-2023, 4500 F D	1	2.0	---	<0.1
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec 1, 2022	25	100	---	4.8
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	9.7
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	<0.02
12.	Phosphate (as PO ₄) in mg/l	APHA 24 th Edition-2023, 4500-P-D	0.5	<0.1	---	<0.15
13.	Dissolved Oxygen in mg/l	APHA 24 th Edition-2023, 4500-O-C	6	4	---	7.7
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44):1993, RA:2019	2	5	50	<2
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg-B	0.5	2.0	---	<0.1
16.	Ammonia (as total ammonia-N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	<0.5
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	<0.05
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	<0.02
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	<0.02
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	<0.01
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	<0.002
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	<0.05
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	<0.01
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	<0.01
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	<0.001

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Report No.	: QLS/P-27/25-26/C/21
Date	: 16.08.2025

26.	Phenolic Compounds (as C_6H_5OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	<0.001
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	<0.02
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	<0.0001
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	<0.0005
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	<0.0001
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.79
32.	Boron (as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	<0.5
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	<0.02
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	78
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	23.3
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	15.5
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	<0.05
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	<1.0
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	<4

Detection Limit:

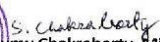
1.Colour- 5 Hazen Unit, 2. Turbidity -1 NTU, 3. Surfactant- 0.02 mg/l, 4. Copper – 0.02 mg/l, 5. Manganese- 0.02 mg/l, 6.Mineral Oil- 0.5 mg/l, 7. Phenolic Compounds- 0.001 mg/l, 8.Cadmium- 0.002 mg/l, 9. Lead- 0.01 mg/l, 10. Mercury- 0.001 mg/l, 13. Polychlorinated biphenyls – 0.0001 mg/l, 14. Total Chromium- 0.05 mg/l, 15. Total Arsenic – 0.01 mg/l, 16.Barium-0.05 mg/l, 17. Selenium- 0.01mg/l, 18.Cyanide- 0.02 mg/l, 19.PAH- 0.0001 mg/l, 20. COD- 4 mg/l, 21. BOD- 2 mg/l, 22. DO- 1 mg/l, 23. Ammonia- 0.5 mg/l, 24.Boron- 0.5mg/l, 25.Nitrate- 0.5mg/l, 26.Fluoride- 0.1mg/l, 27.Phosphate- 0.15mg/l, 28.Iron- 0.05mg/l, 29.Zinc- 0.02mg/l, 30.Polynuclear hydrocarbons- 0.0001mg/l 31. Total Kjeldahl Nitrogen- 0.1mg/l, 32. Iron- 0.05 mg/l, 33.TSS – 2.5 mg/l

BDL- Below Detection Limit

Report Prepared By:  for Qualissure Laboratory Services



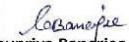
Reviewed & Authorized By


Soumy Chakraborty, Microbiologist
(Authorized Signatory)



for Qualissure Laboratory Services

Reviewed & Authorized By


Bishnupriya Banerjee, Chemist
(Authorized Signatory)

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DOC NO: QLS/SAMP/08-D/00

TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No.	: QLS/P-27/25-26/C/20
	Date	: 16.08.2025
	Sample No.	: QLS/P-27/25-26/20
	Sample Description	: Surface Water
	Source of Surface Water	: Jhililum chhu Downstream
	Location Code	: SW-04
	Co-ordinates	: N 27° 8' 13.29", E 89° 32' 43.62"
	Sampling Method	: APHA 24 th Edition 2023; 1060B
	Date of Performance	: 30.07.2025-12.08.2025
	Sample Drawn On	: 26.07.2025
	Ref No. Date	: Work Order Dated. 26.03.2025

Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	9
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	20
3.	Faecal Streptococci MPN/100ml	20	1000	1000	IS 1622-1981,(RA 2019)	<2

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 2 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.98
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	<5
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	6
4.	Electrical Conductivity in µS/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	109
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	No Film
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	<0.5
8.	Fluoride(as F) in mg/l	APHA 24 th Edition-2023, 4500 F D	1	2.0	---	<0.1
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec 1, 2022	25	100	---	4.6
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	11.7
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	<0.02
12.	Phosphate (as PO ₄) in mg/l	APHA 24 th Edition-2023, 4500-P-D	0.5	<0.1	---	<0.15
13.	Dissolved Oxygen in mg/l	APHA 24 th Edition-2023, 4500-O-C	6	4	---	7.8
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44):1993, RA:2019	2	5	50	<2
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg-B	0.5	2.0	---	<0.1
16.	Ammonia (as total ammonia-N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	<0.5
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	<0.05
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	<0.02
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	<0.02
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	<0.01
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	<0.002
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	<0.05
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	<0.01
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	<0.01
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	<0.001

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Report No.	: QLS/P-27/25-26/C/20
Date	: 16.08.2025

26.	Phenolic Compounds (as C_6H_5OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	<0.001
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	<0.02
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	<0.0001
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	<0.0005
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	<0.0001
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.79
32.	Boron (as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	<0.5
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	<0.02
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	68
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	23.3
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	11.6
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	<0.05
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	<1.0
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	<4

Detection Limit:

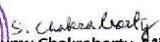
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BDL- Below Detection Limit

Report Prepared By:  for Qualissure Laboratory Services



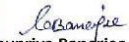
Reviewed & Authorized By


Soumy Chakraborty, Microbiologist
(Authorized Signatory)



for Qualissure Laboratory Services

Reviewed & Authorized By


Bishnupriya Banerjee, Chemist
(Authorized Signatory)

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DOC NO: QLS/SAMP/08-D/00

TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	ULR No.	: TC62712500003350F
	Report No.	: QLS/P-27/25-26/C/18
	Date	: 21.08.2025
	Sample No.	: QLS/P-27/25-26/18
	Sample Description	: Drinking Water
	Source of Surface Water	: Tsimasham Municipal Water Treatment Plant
	Location Code	: SW-05
	Co-ordinates	: N 27° 5' 0.49", E 89° 32' 38.64"
	Sampling Method	: APHA 24 th Edition 2023; 1060B
	Date of Performance	: 30.07.2025-12.08.2025
	Sample Drawn On	: 25.07.2025
	Ref No. Date	: Work Order Dated. 26.03.2025

Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Maximum permissible Limit as per: BHUTAN DRINKING WATER QUALITY STANDARD, 2016	Test Method	Result
1.	E.Coli/100ml	0	IS 15185-2016 (RA 2021)	Not Detected

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Maximum permissible Limit as per: BHUTAN DRINKING WATER QUALITY STANDARD, 2016	Result
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	7.42
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	15	<5
3.	Taste	IS 3025 Part 8: 2023	non-objectionable	non-objectionable
4.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable
5.	Free Residual Chlorine in mg/l	IS 3025 (Part 26): 2021	Target range 0.2 – 0.5	<0.1
6.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	50	<0.5
7.	Fluoride (as F) in mg/l	APHA 24th Edition-2023, 4500 F D	1.5	<0.1
8.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec 1, 2022	No permissible limit but recommended < 250	4.0
9.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	No permissible limit but recommended < 0.3	<0.05
10.	Arsenic (as As) in mg/l	IS 3025 (Part 37): 2022	0.01	<0.01
11.	Lead (as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.01	<0.01
12.	Mercury (as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.006	<0.001
13.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4* Maximum permissible limit	<0.02
14.	Calcium (as Ca) in mg/l	APHA 24th Edition-2023, 3500 Ca B	No permissible limit but recommended < 75	6.2
15.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	<1.0

Detection Limit:

1.Colour- 5 Hazen Unit, 2. Turbidity -1 NTU, 3. Manganese- 0.02 mg/l, 4. Lead- 0.01 mg/l, 5. Mercury- 0.001 mg/l, 6. Total Arsenic – 0.01 mg/l, 7. Nitrate- 0.5mg/l, 8. Fluoride- 0.1mg/l, 9. Iron- 0.05mg/l, 10. Iron- 0.05 mg/l,

BDL- Below Detection Limit

Report Prepared By:

for Qualissure Laboratory Services
Reviewed & Authorized By



Soumy Chakraborty, Microbiologist
(Authorized Signatory)



for Qualissure Laboratory Services
Reviewed & Authorized By

Bishnupriya Banerjee, Chemist
(Authorized Signatory)

-----End of Report-----

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DOC NO: QLS/SAMP/08-D/00

TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No.	: QLS/P-27/25-26/C/17
	Date	: 16.08.2025
	Sample No.	: QLS/P-27/25-26/17
	Sample Description	: Surface Water
	Source of Surface Water	: Motolum chhu (Drinking Water)
	Location Code	: SW-06
	Co-ordinates	: N 27° 7' 44.05", E 89° 33' 4.21"
	Sampling Method	: APHA 24 th Edition 2023; 1060B
	Date of Performance	: 30.07.2025-12.08.2025
	Sample Drawn On	: 25.07.2025
	Ref No. Date	: Work Order Dated. 26.03.2025

Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	<2
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	<2
3.	Faecal Streptococci MPN/100ml	20	1000	1000	IS 1622-1981,(RA 2019)	<2

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 2 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.26
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	<5
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	<2.5
4.	Electrical Conductivity in µS/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	133
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	No Film
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	<0.5
8.	Fluoride(as F) in mg/l	APHA 24 th Edition-2023, 4500 F D	1	2.0	---	<0.1
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec 1, 2022	25	100	---	4.4
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	13.6
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	<0.02
12.	Phosphate (as PO ₄) in mg/l	APHA 24 th Edition-2023, 4500-P-D	0.5	<0.1	---	<0.15
13.	Dissolved Oxygen in mg/l	APHA 24 th Edition-2023, 4500-O-C	6	4	---	7.4
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44):1993, RA:2019	2	5	50	<2
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg-B	0.5	2.0	---	<0.1
16.	Ammonia (as total ammonia-N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	<0.5
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	<0.05
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	<0.02
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	<0.02
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	<0.01
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	<0.002
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	<0.05
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	<0.01
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	<0.01
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	<0.001

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Qualissure Laboratory Services

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Report No.	: QLS/P-27/25-26/C/17
Date	: 16.08.2025

26.	Phenolic Compounds (as C_6H_5OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	<0.001
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	<0.02
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	<0.0001
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	<0.0005
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	<0.0001
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.77
32.	Boron (as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	<0.5
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	<0.02
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	76
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	27.4
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	15.7
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	<0.05
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	<1.0
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	<4

Detection Limit:

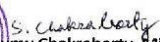
1.Colour- 5 Hazen Unit, 2. Turbidity -1 NTU, 3. Surfactant- 0.02 mg/l, 4. Copper – 0.02 mg/l, 5. Manganese- 0.02 mg/l, 6.Mineral Oil- 0.5 mg/l, 7. Phenolic Compounds- 0.001 mg/l, 8.Cadmium- 0.002 mg/l, 9. Lead- 0.01 mg/l, 10. Mercury- 0.001 mg/l, 13. Polychlorinated biphenyls – 0.0001 mg/l, 14. Total Chromium- 0.05 mg/l, 15. Total Arsenic – 0.01 mg/l, 16.Barium-0.05 mg/l, 17. Selenium- 0.01mg/l, 18.Cyanide- 0.02 mg/l, 19.PAH- 0.0001 mg/l, 20. COD- 4 mg/l, 21. BOD- 2 mg/l, 22. DO- 1 mg/l, 23. Ammonia- 0.5 mg/l, 24.Boron- 0.5mg/l, 25.Nitrate- 0.5mg/l, 26.Fluoride- 0.1mg/l, 27.Phosphate- 0.15mg/l, 28.Iron- 0.05mg/l, 29.Zinc- 0.02mg/l, 30.Polynuclear hydrocarbons- 0.0001mg/l 31. Total Kjeldahl Nitrogen- 0.1mg/l, 32. Iron- 0.05 mg/l, 33.TSS – 2.5 mg/l

BDL- Below Detection Limit

Report Prepared By:  for Qualissure Laboratory Services



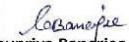
Reviewed & Authorized By


Soumy Chakraborty, Microbiologist
(Authorized Signatory)



for Qualissure Laboratory Services

Reviewed & Authorized By


Bishnupriya Banerjee, Chemist
(Authorized Signatory)

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DOC NO: QLS/SAMP/08-D/00

TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No.	: QLS/P-27/25-26/C/16
	Date	: 16.08.2025
	Sample No.	: QLS/P-27/25-26/16
	Sample Description	: Surface Water
	Source of Surface Water	: Chomteykh Spring Water (Drinking Water)
	Location Code	: SW-07
	Co-ordinates	: N 27° 8' 48.31", E 89° 32' 50.96"
	Sampling Method	: APHA 24 th Edition 2023; 1060B
	Date of Performance	: 30.07.2025-12.08.2025
	Sample Drawn On	: 25.07.2025
	Ref No. Date	: Work Order Dated. 26.03.2025

Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	<2
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	<2
3.	Faecal Streptococci MPN/100ml	20	1000	1000	IS 1622-1981,(RA 2019)	<2

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 2 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.23
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	<5
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	<2.5
4.	Electrical Conductivity in µS/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	74
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	No Film
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	<0.5
8.	Fluoride(as F) in mg/l	APHA 24 th Edition-2023, 4500 F D	1	2.0	---	<0.1
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec 1, 2022	25	100	---	4.1
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	11.7
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	<0.02
12.	Phosphate (as PO ₄) in mg/l	APHA 24 th Edition-2023, 4500-P-D	0.5	<0.1	---	<0.15
13.	Dissolved Oxygen in mg/l	APHA 24 th Edition-2023, 4500-O-C	6	4	---	7.6
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44):1993, RA:2019	2	5	50	<2
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg-B	0.5	2.0	---	<0.1
16.	Ammonia (as total ammonia-N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	<0.5
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	<0.05
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	<0.02
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	<0.02
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	<0.01
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	<0.002
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	<0.05
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	<0.01
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	<0.01
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	<0.001

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Report No.	: QLS/P-27/25-26/C/16
Date	: 16.08.2025

26.	Phenolic Compounds (as C_6H_5OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	<0.001
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	<0.02
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	<0.0001
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	<0.0005
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	<0.0001
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.3
32.	Boron (as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	<0.5
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	<0.02
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	44
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	19.4
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	11.6
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	<0.05
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	<1.0
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	<4

Detection Limit:

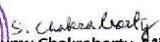
1.Colour- 5 Hazen Unit, 2. Turbidity -1 NTU, 3. Surfactant- 0.02 mg/l, 4. Copper – 0.02 mg/l, 5. Manganese- 0.02 mg/l, 6.Mineral Oil- 0.5 mg/l, 7. Phenolic Compounds- 0.001 mg/l, 8.Cadmium- 0.002 mg/l, 9. Lead- 0.01 mg/l, 10. Mercury- 0.001 mg/l, 13. Polychlorinated biphenyls – 0.0001 mg/l, 14. Total Chromium- 0.05 mg/l, 15. Total Arsenic – 0.01 mg/l, 16.Barium-0.05 mg/l, 17. Selenium- 0.01mg/l, 18.Cyanide- 0.02 mg/l, 19.PAH- 0.0001 mg/l, 20. COD- 4 mg/l, 21. BOD- 2 mg/l, 22. DO- 1 mg/l, 23. Ammonia- 0.5 mg/l, 24.Boron- 0.5mg/l, 25.Nitrate- 0.5mg/l, 26.Fluoride- 0.1mg/l, 27.Phosphate- 0.15mg/l, 28.Iron- 0.05mg/l, 29.Zinc- 0.02mg/l, 30.Polynuclear hydrocarbons- 0.0001mg/l 31. Total Kjeldahl Nitrogen- 0.1mg/l, 32. Iron- 0.05 mg/l, 33.TSS – 2.5 mg/l

BDL- Below Detection Limit

Report Prepared By:  for Qualissure Laboratory Services



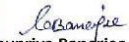
Reviewed & Authorized By


Soumy Chakraborty, Microbiologist
(Authorized Signatory)



for Qualissure Laboratory Services

Reviewed & Authorized By


Bishnupriya Banerjee, Chemist
(Authorized Signatory)

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DOC NO: QLS/SAMP/08-D/00

TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No.	: QLS/P-27/25-26/C/15
	Date	: 16.08.2025
	Sample No.	: QLS/P-27/25-26/15
	Sample Description	: Surface Water
	Source of Surface Water	: Zanteylum chhu (Drinking Water)
	Location Code	: SW-08
	Co-ordinates	: N 27° 9' 44.94", E 89° 33' 45"
	Sampling Method	: APHA 24 th Edition 2023; 1060B
	Date of Performance	: 30.07.2025-12.08.2025
	Sample Drawn On	: 25.07.2025
	Ref No. Date	: Work Order Dated. 26.03.2025

Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	<2
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	<2
3.	Faecal Streptococci MPN/100ml	20	1000	1000	IS 1622-1981,(RA 2019)	<2

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 2 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.23
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	<5
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	<2.5
4.	Electrical Conductivity in µS/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	118
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	No Film
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	<0.5
8.	Fluoride(as F) in mg/l	APHA 24 th Edition-2023, 4500 F D	1	2.0	---	<0.1
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec 1, 2022	25	100	---	4.8
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	15.5
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	<0.02
12.	Phosphate (as PO ₄) in mg/l	APHA 24 th Edition-2023, 4500-P-D	0.5	<0.1	---	<0.15
13.	Dissolved Oxygen in mg/l	APHA 24 th Edition-2023, 4500-O-C	6	4	---	7.9
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44):1993, RA:2019	2	5	50	<2
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg-B	0.5	2.0	---	<0.1
16.	Ammonia (as total ammonia-N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	<0.5
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	<0.05
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	<0.02
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	<0.02
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	<0.01
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	<0.002
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	<0.05
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	<0.01
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	<0.01
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	<0.001

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Report No.	: QLS/P-27/25-26/C/15
Date	: 16.08.2025

26.	Phenolic Compounds (as C_6H_5OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	<0.001
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	<0.02
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	<0.0001
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	<0.0005
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	<0.0001
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.76
32.	Boron(as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	<0.5
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	<0.02
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	74
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	23.3
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	15.5
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	<0.05
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	<1.0
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	<4

Detection Limit:

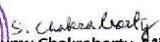
1.Colour- 5 Hazen Unit, 2. Turbidity -1 NTU, 3. Surfactant- 0.02 mg/l, 4. Copper – 0.02 mg/l, 5. Manganese- 0.02 mg/l, 6.Mineral Oil- 0.5 mg/l, 7. Phenolic Compounds- 0.001 mg/l, 8.Cadmium- 0.002 mg/l, 9. Lead- 0.01 mg/l, 10. Mercury- 0.001 mg/l, 13. Polychlorinated biphenyls – 0.0001 mg/l, 14. Total Chromium- 0.05 mg/l, 15. Total Arsenic – 0.01 mg/l, 16.Barium-0.05 mg/l, 17. Selenium- 0.01mg/l, 18.Cyanide- 0.02 mg/l, 19.PAH- 0.0001 mg/l, 20. COD- 4 mg/l, 21. BOD- 2 mg/l, 22. DO- 1 mg/l, 23. Ammonia- 0.5 mg/l, 24.Boron- 0.5mg/l, 25.Nitrate- 0.5mg/l, 26.Fluoride- 0.1mg/l, 27.Phosphate- 0.15mg/l, 28.Iron- 0.05mg/l, 29.Zinc- 0.02mg/l, 30.Polynuclear hydrocarbons- 0.0001mg/l 31. Total Kjeldahl Nitrogen- 0.1mg/l, 32. Iron- 0.05 mg/l, 33.TSS – 2.5 mg/l

BDL- Below Detection Limit

Report Prepared By:  for Qualissure Laboratory Services



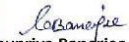
Reviewed & Authorized By


Soumy Chakraborty, Microbiologist
(Authorized Signatory)



for Qualissure Laboratory Services

Reviewed & Authorized By


Bishnupriya Banerjee, Chemist
(Authorized Signatory)

-----End of Report-----

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DOC NO: QLS/SAMP/08-D/00

TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No.	: QLS/P-27/25-26/C/14
	Date	: 16.08.2025
	Sample No.	: QLS/P-27/25-26/14
	Sample Description	: Surface Water
	Source of Surface Water	: Nayakha (Drinking Water)
	Location Code	: SW-09
	Co-ordinates	: N 27° 9' 8.52", E 89° 30' 40.07"
	Sampling Method	: APHA 24 th Edition 2023; 1060B
	Date of Performance	: 30.07.2025-12.08.2025
	Sample Drawn On	: 24.07.2025
	Ref No. Date	: Work Order Dated. 26.03.2025

Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	<2
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	<2
3.	Faecal Streptococci MPN/100ml	20	1000	1000	IS 1622-1981,(RA 2019)	<2

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 2 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.62
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	<5
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	<2.5
4.	Electrical Conductivity in μ S/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	83
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	No Film
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	<0.5
8.	Fluoride(as F) in mg/l	APHA 24 th Edition-2023, 4500 F D	1	2.0	---	<0.1
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec 1, 2022	25	100	---	4.2
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	5.8
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	<0.02
12.	Phosphate (as PO ₄) in mg/l	APHA 24 th Edition-2023, 4500-P-D	0.5	<0.1	---	<0.15
13.	Dissolved Oxygen in mg/l	APHA 24 th Edition-2023, 4500-O-C	6	4	---	7.3
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44):1993, RA:2019	2	5	50	<2
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg-B	0.5	2.0	---	<0.1
16.	Ammonia (as total ammonia-N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	<0.5
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	<0.05
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	<0.02
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	<0.02
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	<0.01
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	<0.002
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	<0.05
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	<0.01
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	<0.01
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	<0.001

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Report No.	: QLS/P-27/25-26/C/14
Date	: 16.08.2025

26.	Phenolic Compounds (as C_6H_5OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	<0.001
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	<0.02
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	<0.0001
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	<0.0005
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	<0.0001
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.44
32.	Boron(as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	<0.5
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	<0.02
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	52
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	19.4
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	13.5
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	<0.05
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	<1.0
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	<4

Detection Limit:

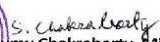
1.Colour- 5 Hazen Unit, 2. Turbidity -1 NTU, 3. Surfactant- 0.02 mg/l, 4. Copper – 0.02 mg/l, 5. Manganese- 0.02 mg/l, 6.Mineral Oil- 0.5 mg/l, 7. Phenolic Compounds- 0.001 mg/l, 8.Cadmium- 0.002 mg/l, 9. Lead- 0.01 mg/l, 10. Mercury- 0.001 mg/l, 13. Polychlorinated biphenyls – 0.0001 mg/l, 14. Total Chromium- 0.05 mg/l, 15. Total Arsenic – 0.01 mg/l, 16.Barium-0.05 mg/l, 17. Selenium- 0.01mg/l, 18.Cyanide- 0.02 mg/l, 19.PAH- 0.0001 mg/l, 20. COD- 4 mg/l, 21. BOD- 2 mg/l, 22. DO- 1 mg/l, 23. Ammonia- 0.5 mg/l, 24.Boron- 0.5mg/l, 25.Nitrate- 0.5mg/l, 26.Fluoride- 0.1mg/l, 27.Phosphate- 0.15mg/l, 28.Iron- 0.05mg/l, 29.Zinc- 0.02mg/l, 30.Polynuclear hydrocarbons- 0.0001mg/l 31. Total Kjeldahl Nitrogen- 0.1mg/l, 32. Iron- 0.05 mg/l, 33.TSS – 2.5 mg/l

BDL- Below Detection Limit

Report Prepared By:  for Qualissure Laboratory Services



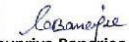
Reviewed & Authorized By


Soumy Chakraborty, Microbiologist
(Authorized Signatory)



for Qualissure Laboratory Services

Reviewed & Authorized By


Bishnupriya Banerjee, Chemist
(Authorized Signatory)

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DOC NO: QLS/SAMP/08-D/00

TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No.	: QLS/P-27/25-26/C/13
	Date	: 16.08.2025
	Sample No.	: QLS/P-27/25-26/13
	Sample Description	: Surface Water
	Source of Surface Water	: Chanachen Spring Water (Drinking Water)
	Location Code	: SW-10
	Co-ordinates	: N 27° 8' 16.01", E 89° 31' 56.35"
	Sampling Method	: APHA 24 th Edition 2023; 1060B
	Date of Performance	: 30.07.2025-12.08.2025
	Sample Drawn On	: 24.07.2025
	Ref No. Date	: Work Order Dated. 26.03.2025

Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	<2
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	<2
3.	Faecal Streptococci MPN/100ml	20	1000	1000	IS 1622-1981,(RA 2019)	<2

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 2 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.11
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	<5
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	<2.5
4.	Electrical Conductivity in μ S/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	96
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	No Film
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	<0.5
8.	Fluoride(as F) in mg/l	APHA 24 th Edition-2023, 4500 F D	1	2.0	---	<0.1
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec 1, 2022	25	100	---	6.3
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	7.8
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	<0.02
12.	Phosphate (as PO ₄) in mg/l	APHA 24 th Edition-2023, 4500-P-D	0.5	<0.1	---	<0.15
13.	Dissolved Oxygen in mg/l	APHA 24 th Edition-2023, 4500-O-C	6	4	---	7.9
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44):1993, RA:2019	2	5	50	<2
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg-B	0.5	2.0	---	<0.1
16.	Ammonia (as total ammonia-N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	<0.5
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	<0.05
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	<0.02
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	<0.02
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	<0.01
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	<0.002
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	<0.05
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	<0.01
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	<0.01
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	<0.001

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Report No.	: QLS/P-27/25-26/C/13
Date	: 16.08.2025

26.	Phenolic Compounds (as C_6H_5OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	<0.001
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	<0.02
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	<0.0001
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	<0.0005
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	<0.0001
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.27
32.	Boron(as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	<0.5
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	<0.02
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	60
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	27.2
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	19.4
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	<0.05
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	<1.0
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	<4

Detection Limit:

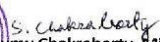
1.Colour- 5 Hazen Unit, 2. Turbidity -1 NTU, 3. Surfactant- 0.02 mg/l, 4. Copper – 0.02 mg/l, 5. Manganese- 0.02 mg/l, 6.Mineral Oil- 0.5 mg/l, 7. Phenolic Compounds- 0.001 mg/l, 8.Cadmium- 0.002 mg/l, 9. Lead- 0.01 mg/l, 10. Mercury- 0.001 mg/l, 13. Polychlorinated biphenyls – 0.0001 mg/l, 14. Total Chromium- 0.05 mg/l, 15. Total Arsenic – 0.01 mg/l, 16.Barium-0.05 mg/l, 17. Selenium- 0.01mg/l, 18.Cyanide- 0.02 mg/l, 19.PAH- 0.0001 mg/l, 20. COD- 4 mg/l, 21. BOD- 2 mg/l, 22. DO- 1 mg/l, 23. Ammonia- 0.5 mg/l, 24.Boron- 0.5mg/l, 25.Nitrate- 0.5mg/l, 26.Fluoride- 0.1mg/l, 27.Phosphate- 0.15mg/l, 28.Iron- 0.05mg/l, 29.Zinc- 0.02mg/l, 30.Polynuclear hydrocarbons- 0.0001mg/l 31. Total Kjeldahl Nitrogen- 0.1mg/l, 32. Iron- 0.05 mg/l, 33.TSS – 2.5 mg/l

BDL- Below Detection Limit

Report Prepared By:  for Qualissure Laboratory Services



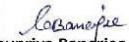
Reviewed & Authorized By


Soumy Chakraborty, Microbiologist
(Authorized Signatory)



for Qualissure Laboratory Services

Reviewed & Authorized By


Bishnupriya Banerjee, Chemist
(Authorized Signatory)

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Post-Monsoon Season



Qualissure Laboratory Services

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Mob. No. : 9831287086
9830093976

DOC NO: QLS/SAMP/08-D/00

TEST REPORT

Name & Address Of the Customer :	Report No. : QLS/P-27/25-26/C/27
Phuensum Consultancy Services	Date : 09.12.2025
4 th Floor Jattu Building, Jattu Commercial Complex,	Sample No. : QLS/P-27/25-26/27
Thimpu, Bhutan	Sample Description : Surface Water
Site: Bunakha Project	Source of Surface Water : Upstream of Dam (River Water)
	Location Code : SW-1
	Co-ordinates : 27° 7' 56"N, 89° 32' 24"E
	Sampling Method : APHA 24 th Edition 2023; 1060B
	Date of Performance : 29.11.2025-08.12.2025
	Sample Drawn On : 27.11.2025
	Ref No. Date : Work Order Dated. 26.03.2025

Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	17
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	48
3.	Faecal Streptococci MPN /100ml	20	1000	1000	APHA 24th Edition, 2023; 9230B	2

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 1.8/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.32
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	<5
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	6
4.	Electrical Conductivity in μ S/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	146
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	No Film
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	<0.2
8.	Fluoride(as F) in mg/l	APHA 24 th Edition-2023, 4500 F.D	1	2.0	---	<0.1
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec1, 2022	25	100	---	10.7
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	17.2
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	<0.02
12.	Phosphate (as PO ₄) in mg/l	APHA 24 th Edition-2023, 4500-P-D	0.5	<0.1	---	<0.15
13.	Dissolved Oxygen in mg/l	APHA 24 th Edition-2023, 4500-O-C	6	4	---	8.3
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44)-1993; RA:2019	2	5	50	0.8
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg-B	0.5	2.0	---	<0.1
16.	Ammonia (as total ammonia-N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	<0.5
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	0.03
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	<0.02
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	<0.02
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	<0.01
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	<0.002
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	<0.05
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	<0.01
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	<0.01
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	<0.001

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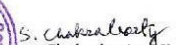
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Report No.	: QLS/P-27/25-26/C/27
Date	: 09.12.2025

26.	Phenolic Compounds (as C_6H_5OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	<0.001
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	<0.02
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	<0.0001
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	<0.0005
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	<0.0001
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.53
32.	Boron (as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	<0.5
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	<0.02
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	82
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	29.1
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	21.8
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	<0.05
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	<1.0
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	2.9

Report Prepared By:  for Qualissure Laboratory Services
Reviewed & Authorized By




Soumy Chakraborty, Microbiologist
(Authorized Signatory)



for Qualissure Laboratory Services
Reviewed & Authorized By


Bishnupriya Banerjee, Chemist
(Authorized Signatory)

-----End of Report-----

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DOC NO: QLS/SAMP/08-D/00

TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No.	: QLS/P-27/25-26/C/28
	Date	: 09.12.2025
	Sample No.	: QLS/P-27/25-26/28
	Sample Description	: Surface Water
	Source of Surface Water	: Downstream of Dam (River Water)
	Location Code	: SW-2
	Co-ordinates	: 27° 7' 37.81"N, 89° 32' 21.49"E
	Sampling Method	: APHA 24 th Edition 2023; 1060B
	Date of Performance	: 29.11.2025-08.12.2025
	Sample Drawn On	: 25.11.2025
	Ref No. Date	: Work Order Dated. 26.03.2025

Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	13
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	43
3.	Faecal Streptococci MPN /100 ml	20	1000	1000	APHA 24th Edition, 2023; 9230B	6

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 1.8 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.11
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	<5
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	8
4.	Electrical Conductivity in μ S/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	157
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	No Film
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	<0.2
8.	Fluoride(as F) in mg/l	APHA 24 th Edition-2023, 4500 F D	1	2.0	---	<0.1
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec.1, 2022	25	100	---	5.9
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	7.6
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	<0.02
12.	Phosphate (as PO ₄) in mg/l	APHA 24 th Edition-2023, 4500-P-D	0.5	<0.1	---	<0.15
13.	Dissolved Oxygen in mg/l	APHA 24 th Edition-2023, 4500-O-C	6	4	---	7.7
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44):1993, RA:2019	2	5	50	1.2
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg-B	0.5	2.0	---	<0.1
16.	Ammonia (as total ammonia-N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	<0.5
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	0.04
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	<0.02
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	<0.02
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	<0.005
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	<0.002
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	<0.05
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	<0.01
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	<0.005
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	<0.001

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Qualissure Laboratory Services

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9830093976

Report No.	: QLS/P-27/25-26/C/28
Date	: 09.12.2025

26.	Phenolic Compounds (as C_6H_5OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	<0.001
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	<0.02
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	<0.0001
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	<0.0005
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	<0.0001
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.66
32.	Boron (as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	<0.5
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	<0.02
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	88
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	32.8
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	21.8
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	<0.05
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	<1.0
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	3.8

Detection Limit:

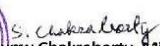
1.Colour- 5 Hazen Unit, 2. Turbidity -1 NTU, 3. Surfactant- 0.02 mg/l, 4. Copper – 0.02 mg/l, 5. Manganese- 0.02 mg/l, 6.Mineral Oil- 0.5 mg/l, 7. Phenolic Compounds- 0.001 mg/l, 8.Cadmium- 0.002 mg/l, 9. Lead- 0.01 mg/l, 10. Mercury- 0.001 mg/l, 13. Polychlorinated biphenyls – 0.0001 mg/l, 14. Total Chromium- 0.05 mg/l, 15. Total Arsenic – 0.01 mg/l, 16.Barium-0.05 mg/l, 17. Selenium- 0.01mg/l, 18.Cyanide- 0.02 mg/l, 19.PAH- 0.0001 mg/l, 20. COD- 4 mg/l, 21. BOD- 2 mg/l, 22. DO- 1 mg/l, 23. Ammonia- 0.5 mg/l, 24.Boron- 0.5mg/l, 25.Nitrate- 0.5mg/l, 26.Fluoride- 0.1mg/l, 27.Phosphate- 0.15mg/l, 28.Iron- 0.05mg/l, 29.Zinc- 0.02mg/l, 30.Polynuclear hydrocarbons- 0.0001mg/l 31. Total Kjeldahl Nitrogen- 0.1mg/l, 32. Iron- 0.05 mg/l, 33.TSS – 2.5 mg/l

BDL- Below Detection Limit

Report Prepared By:  for Qualissure Laboratory Services



Reviewed & Authorized By


Soumy Chakraborty, Microbiologist
(Authorized Signatory)



for Qualissure Laboratory Services

Reviewed & Authorized By


Bishnupriya Banerjee, Chemist
(Authorized Signatory)

-----End of Report-----

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DOC NO: QLS/SAMP/08-D/00

TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No. : QLS/P-27/25-26/C/29 Date : 09.12.2025 Sample No. : QLS/P-27/25-26/29 Sample Description : Surface Water Source of Surface Water : Jililumchhu of Upstream (Stream Water) Location Code : SW-3 Co-ordinates : 27° 5' 0.49"N, 89° 32' 38.62"E Sampling Method : APHA 24 th Edition 2023; 1060B Date of Performance : 29.11.2025-08.12.2025 Sample Drawn On : 24.11.2025 Ref No. Date : Work Order Dated. 26.03.2025
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Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	11
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	34
3.	Faecal Streptococci MPN/100ml	20	1000	1000	APHA 24 th Edition, 2023; 9230B	<1.8

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci –1.8 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.15
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	<5
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	4
4.	Electrical Conductivity in μ S/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	93
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	No Film
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	<0.2
8.	Fluoride(as F) in mg/l	APHA 24 th Edition-2023, 4500 F D	1	2.0	---	<0.1
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec.1, 2022	25	100	---	5.2
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	5.7
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	<0.02
12.	Phosphate (as PO ₄) in mg/l	APHA 24 th Edition-2023, 4500-P-D	0.5	<0.1	---	<0.15
13.	Dissolved Oxygen in mg/l	APHA 24 th Edition-2023, 4500-O-C	6	4	---	10.0
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44):1993, RA:2019	2	5	50	0.6
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg-B	0.5	2.0	---	<0.1
16.	Ammonia (as total ammonia-N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	<0.5
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	0.04
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	<0.02
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	<0.02
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	<0.005
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	<0.002
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	<0.05
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	<0.01
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	<0.005
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	<0.001

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Report No.	: QLS/P-27/25-26/C/29
Date	: 09.12.2025

26.	Phenolic Compounds (as C_6H_5OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	<0.001
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	<0.02
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	<0.0001
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	<0.0005
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	<0.0001
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.86
32.	Boron (as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	<0.5
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	<0.02
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	52
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	14.6
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	7.3
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	<0.05
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	<1.0
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	1.9

Report Prepared By: 

for Qualissure Laboratory Services
Reviewed & Authorized By




Soumy Chakraborty, Microbiologist
(Authorized Signatory)



for Qualissure Laboratory Services
Reviewed & Authorized By


Bishnupriya Banerjee, Chemist
(Authorized Signatory)

-----End of Report-----

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TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No. : QLS/P-27/25-26/C/30 Date : 09.12.2025 Sample No. : QLS/P-27/25-26/30 Sample Description : Surface Water Source of Surface Water : Jililumchhu of Downstream (Stream Water) Location Code : SW-4 Sampling Method : APHA 24 th Edition 2023; 1060B Date of Performance : 29.11.2025-08.12.2025 Sample Drawn On : 27.11.2025 Ref No. Date : Work Order Dated. 26.03.2025
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Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	11
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	40
3.	Faecal Streptococci MPN/100ml	20	1000	1000	APHA 24th Edition, 2023; 9230B	<1.8

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – <1.8 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.64
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	<5
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	4
4.	Electrical Conductivity in μ S/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	96
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	No Film
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	<0.2
8.	Fluoride(as F) in mg/l	APHA 24 th Edition-2023, 4500 F D	1	2.0	---	<0.1
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec 1, 2022	25	100	---	7.2
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	8.6
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	<0.02
12.	Phosphate (as PO ₄) in mg/l	APHA 24 th Edition-2023, 4500-P-D	0.5	<0.1	---	<0.15
13.	Dissolved Oxygen in mg/l	APHA 24 th Edition-2023, 4500-O-C	6	4	---	8.4
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44):1993, RA:2019	2	5	50	0.8
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg-B	0.5	2.0	---	<0.1
16.	Ammonia (as total ammonia-N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	<0.5
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	0.05
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	<0.02
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	<0.02
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	<0.005
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	<0.002
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	<0.05
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	<0.01
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	<0.005
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	<0.001

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Report No.	: QLS/P-27/25-26/C/30
Date	: 09.12.2025

26.	Phenolic Compounds (as C_6H_5OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	<0.001
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	<0.02
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	<0.0001
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	<0.0005
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	<0.0001
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.44
32.	Boron (as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	<0.5
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	<0.02
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025 (Part 16)-2023	500	1500	2100	54
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	18.2
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	14.6
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	<0.05
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	<1.0
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	2.9

Report Prepared By:

for Qualissure Laboratory Services
Reviewed & Authorized By



Soumy Chakraborty, Microbiologist
(Authorized Signatory)



for Qualissure Laboratory Services
Reviewed & Authorized By

Bishnupriya Banerjee, Chemist
(Authorized Signatory)

-----End of Report-----

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TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No. : QLS/P-27/25-26/C/31 Date : 09.12.2025 Sample No. : QLS/P-27/25-26/31 Sample Description : Drinking Water Source of Surface Water : Tsimasham Location Code : SW-5 Co-ordinates : 27° 5' 0.56"N, 89° 32' 38.64"E Sampling Method : APHA 24 th Edition 2023; 1060B Date of Performance : 29.11.2025-08.12.2025 Sample Drawn On : 24.11.2025 Ref No. Date : Work Order Dated. 26.03.2025
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Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	<2
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	<2
3.	Faecal Streptococci MPN/100ml	20	1000	1000	APHA 24th Edition, 2023; 9230B	<1.8

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 1.8 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.79
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	<5
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023; 2540D	25	100	---	<2.5
4.	Electrical Conductivity in μ S/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	111
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	No Film
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	<0.2
8.	Fluoride(as F) in mg/l	APHA 24 th Edition-2023; 4500 F D	1	2.0	---	<0.1
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec.1, 2022	25	100	---	5.1
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	4.8
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	<0.02
12.	Phosphate (as PO ₄) in mg/l	APHA 24 th Edition-2023; 4500-P-D	0.5	<0.1	---	<0.15
13.	Dissolved Oxygen in mg/l	APHA 24 th Edition-2023; 4500-O-C	6	4	---	8.3
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44):1993, RA:2019	2	5	50	0.5
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023; 4500 Norg-B	0.5	2.0	---	<0.1
16.	Ammonia (as total ammonia-N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	<0.5
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	<0.02
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	<0.02
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	<0.02
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	<0.005
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	<0.002
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	<0.05
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	<0.01
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	<0.005
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	<0.001

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Report No.	: QLS/P-27/25-26/C/31
Date	: 09.12.2025

26.	Phenolic Compounds (as C_6H_5OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	<0.001
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	<0.02
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	<0.0001
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	<0.0005
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	<0.0001
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.41
32.	Boron (as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	<0.5
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	<0.02
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	62
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	25.5
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	21.8
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	<0.05
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	<1.0
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	1.9

Report Prepared By:

for Qualissure Laboratory Services
Reviewed & Authorized By



Soumy Chakraborty, Microbiologist
(Authorized Signatory)



for Qualissure Laboratory Services
Reviewed & Authorized By

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-----End of Report-----

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TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No. : QLS/P-27/25-26/C/32 Date : 09.12.2025 Sample No. : QLS/P-27/25-26/32 Sample Description : Drinking Water Source of Surface Water : Motolumchhu Location Code : SW-6 Co-ordinates : 27° 7' 44.05"N, 89° 33' 4.21"E Sampling Method : APHA 24 th Edition 2023; 1060B Date of Performance : 29.11.2025-08.12.2025 Sample Drawn On : 24.11.2025 Ref No. Date : Work Order Dated. 26.03.2025
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Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	<2
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	<2
3.	Faecal Streptococci MPN/100ml	20	1000	1000	APHA 24th Edition, 2023; 9230B	<1.8

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 1.8 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.61
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	<5
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	<2.5
4.	Electrical Conductivity in μ S/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	132
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	No Film
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	<0.2
8.	Fluoride(as F) in mg/l	APHA 24 th Edition-2023, 4500 F D	1	2.0	---	<0.1
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec.1, 2022	25	100	---	18.1
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	15.3
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	<0.02
12.	Phosphate (as PO ₄) in mg/l	APHA 24 th Edition-2023, 4500-P-D	0.5	<0.1	---	<0.15
13.	Dissolved Oxygen in mg/l	APHA 24 th Edition-2023, 4500-O-C	6	4	---	9.1
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44):1993, RA:2019	2	5	50	1.0
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg-B	0.5	2.0	---	<0.1
16.	Ammonia (as total ammonia-N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	<0.5
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	0.03
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	<0.02
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	<0.02
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	<0.005
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	<0.002
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	<0.05
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	<0.01
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	<0.005
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	<0.001

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Report No.	: QLS/P-27/25-26/C/32
Date	: 09.12.2025

26.	Phenolic Compounds (as C_6H_5OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	<0.001
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	<0.02
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	<0.0001
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	<0.0005
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	<0.0001
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.61
32.	Boron (as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	<0.5
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	<0.02
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	74
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	25.5
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	14.6
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	<0.05
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	<1.0
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	2.9

Report Prepared By:

for Qualissure Laboratory Services
Reviewed & Authorized By



Soumy Chakraborty, Microbiologist
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for Qualissure Laboratory Services
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TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No. : QLS/P-27/25-26/C/33 Date : 09.12.2025 Sample No. : QLS/P-27/25-26/33 Sample Description : Drinking Water Source of Surface Water : Chomteykha of Spring Water Location Code : SW-7 Co-ordinates : 27° 8' 48.31"N, 89° 32' 50.96"E Sampling Method : APHA 24 th Edition 2023; 1060B Date of Performance : 29.11.2025-08.12.2025 Sample Drawn On : 24.11.2025 Ref No. Date : Work Order Dated. 26.03.2025
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Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	<2
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	<2
3.	Faecal Streptococci MPN/100ml	20	1000	1000	APHA 24th Edition, 2023; 9230B	<1.8

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 1.8 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.05
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	<5
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023; 2540D	25	100	---	<2.5
4.	Electrical Conductivity in μ S/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	89
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	No Film
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	<0.2
8.	Fluoride(as F) in mg/l	APHA 24 th Edition-2023; 4500 F D	1	2.0	---	<0.1
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec.1, 2022	25	100	---	6.2
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	5.7
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	<0.02
12.	Phosphate (as PO ₄) in mg/l	APHA 24 th Edition-2023; 4500-P-D	0.5	<0.1	---	<0.15
13.	Dissolved Oxygen in mg/l	APHA 24 th Edition-2023; 4500-O-C	6	4	---	9.1
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44):1993, RA:2019	2	5	50	0.9
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023; 4500 Norg-B	0.5	2.0	---	<0.1
16.	Ammonia (as total ammonia-N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	<0.5
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	<0.02
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	<0.02
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	<0.02
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	<0.005
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	<0.002
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	<0.05
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	<0.01
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	<0.005
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	<0.001

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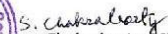
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9830093976

Report No.	: QLS/P-27/25-26/C/33
Date	: 09.12.2025

26.	Phenolic Compounds (as C_6H_5OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	<0.001
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	<0.02
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	<0.0001
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	<0.0005
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	<0.0001
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.77
32.	Boron (as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	<0.5
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	<0.02
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	50
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	14.6
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	7.3
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	<0.05
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	<1.0
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	2.9

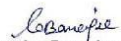
Report Prepared By:  for Qualissure Laboratory Services
Reviewed & Authorized By




Soumy Chakraborty, Microbiologist
(Authorized Signatory)



for Qualissure Laboratory Services
Reviewed & Authorized By


Bishnupriya Banerjee, Chemist
(Authorized Signatory)

-----End of Report-----

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TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No. : QLS/P-27/25-26/C/34 Date : 09.12.2025 Sample No. : QLS/P-27/25-26/34 Sample Description : Drinking Water Source of Surface Water : Zanteylumchhu Location Code : SW-8 Co-ordinates : 27° 9' 44.94"N, 89° 33' 1.45"E Sampling Method : APHA 24 th Edition 2023; 1060B Date of Performance : 29.11.2025-08.12.2025 Sample Drawn On : 24.11.2025 Ref No. Date : Work Order Dated. 26.03.2025
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Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	<2
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	<2
3.	Faecal Streptococci MPN/100ml	20	1000	1000	IS 1622-1981,(RA 2019)	<1.8

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 1.8 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	8.06
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	<5
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023, 2540D	25	100	---	<2.5
4.	Electrical Conductivity in μ S/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	154
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	No Film
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	<0.2
8.	Fluoride(as F) in mg/l	APHA 24 th Edition-2023, 4500 F D	1	2.0	---	<0.1
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec 1, 2022	25	100	---	19.5
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	17.2
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	<0.02
12.	Phosphate (as PO ₄) in mg/l	APHA 24 th Edition-2023, 4500-P-D	0.5	<0.1	---	<0.15
13.	Dissolved Oxygen in mg/l	APHA 24 th Edition-2023, 4500-O-C	6	4	---	9.3
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44):1993, RA:2019	2	5	50	1.1
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023, 4500 Norg-B	0.5	2.0	---	<0.1
16.	Ammonia (as total ammonia-N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	<0.5
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	0.02
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	<0.02
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	<0.02
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	<0.005
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	<0.002
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	<0.05
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	<0.01
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	<0.005
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	<0.001

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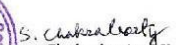
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9830093976

Report No.	: QLS/P-27/25-26/C/34
Date	: 09.12.2025

26.	Phenolic Compounds (as C_6H_5OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	<0.001
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	<0.02
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	<0.0001
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	<0.0005
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	<0.0001
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.73
32.	Boron (as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	<0.5
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	<0.02
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	86
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	25.5
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	18.2
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	<0.05
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	<1.0
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	3.2

Report Prepared By:  for Qualissure Laboratory Services
Reviewed & Authorized By




Soumy Chakraborty, Microbiologist
(Authorized Signatory)



for Qualissure Laboratory Services
Reviewed & Authorized By


Bishnupriya Banerjee, Chemist
(Authorized Signatory)

-----End of Report-----

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TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No. : QLS/P-27/25-26/C/35 Date : 09.12.2025 Sample No. : QLS/P-27/25-26/35 Sample Description : Drinking Water Source of Surface Water : Nayakhachhu Location Code : SW-9 Co-ordinates : 27° 9' 9.9678"N, 89° 30' 40.68"E Sampling Method : APHA 24 th Edition 2023; 1060B Date of Performance : 29.11.2025-08.12.2025 Sample Drawn On : 24.11.2025 Ref No. Date : Work Order Dated. 26.03.2025
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Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	<2
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	<2
3.	Faecal Streptococci MPN/100ml	20	1000	1000	APHA 24th Edition, 2023; 9230B	<1.8

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 1.8 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.62
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	<5
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023; 2540D	25	100	---	<2.5
4.	Electrical Conductivity in μ S/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	50
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	No Film
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	0.28
8.	Fluoride(as F) in mg/l	APHA 24 th Edition-2023; 4500 F D	1	2.0	---	<0.1
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec.1, 2022	25	100	---	4.9
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	3.8
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	<0.02
12.	Phosphate (as PO ₄) in mg/l	APHA 24 th Edition-2023; 4500-P-D	0.5	<0.1	---	<0.15
13.	Dissolved Oxygen in mg/l	APHA 24 th Edition-2023; 4500-O-C	6	4	---	5.6
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44):1993, RA:2019	2	5	50	0.7
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023; 4500 Norg-B	0.5	2.0	---	<0.1
16.	Ammonia (as total ammonia-N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	<0.5
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	<0.02
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	<0.02
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	<0.02
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	<0.005
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	<0.002
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	<0.05
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	<0.01
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	<0.005
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	<0.001

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Report No.	: QLS/P-27/25-26/C/35
Date	: 09.12.2025

26.	Phenolic Compounds (as C_6H_5OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	<0.001
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	<0.02
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	<0.0001
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	<0.0005
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	<0.0001
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.27
32.	Boron (as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	<0.5
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	<0.02
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	28
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	10.9
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	7.3
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	<0.05
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	<1.0
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	1.9

Report Prepared By:

for Qualissure Laboratory Services
Reviewed & Authorized By



Soumy Chakraborty, Microbiologist
(Authorized Signatory)



for Qualissure Laboratory Services
Reviewed & Authorized By

Bishnupriya Banerjee, Chemist
(Authorized Signatory)

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TEST REPORT

Name & Address Of the Customer : Phuensum Consultancy Services 4 th Floor Jattu Building, Jattu Commercial Complex, Thimpu, Bhutan Site: Bunakha Project	Report No. : QLS/P-27/25-26/C/36 Date : 09.12.2025 Sample No. : QLS/P-27/25-26/36 Sample Description : Drinking Water Source of Surface Water : Chanachen Village Spring Water Location Code : SW-10 Co-ordinates : 27° 8' 15.3846"N, 89° 32' 0.6792"E Sampling Method : APHA 24 th Edition 2023; 1060B Date of Performance : 29.11.2025-08.12.2025 Sample Drawn On : 25.11.2025 Ref No. Date : Work Order Dated. 26.03.2025
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Analysis Result

(A) Microbiological Analysis

Sl.No.	Characteristic	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Test Method	Result
		A	B	C		
1.	Faecal Coliform MPN/100ml	20	2000	50,000	IS 1622-1981,(RA 2019)	<2
2.	Total Coliform Bacteria MPN/100ml	50	5000	10,000	IS 1622-1981,(RA 2019)	<2
3.	Faecal Streptococci MPN/100ml	20	1000	1000	APHA 24th Edition, 2023; 9230B	<1.8

Detection Limit:

1. Total Coliform – 2 MPN/100 ml
2. Faecal Coliform – 2 MPN/100 ml
3. Faecal Streptococci – 1.8 MPN/100 ml

(B) Chemical Analysis

Sl.No.	Test Parameter	Test Method	Ambient Water Quality Standard as per National Environment Commission, Royal Government of Bhutan, June 2020			Result
			A	B	C	
1.	pH Value at 25°C	IS 3025 (Part 11): 2022	6.5-8.5	6.0-9.0	6.0-9.0	7.43
2.	Colour in Hazen Units	IS 3025 (Part 4): 2021	5	50	---	<5
3.	Total Suspended Solid (as TSS) in mg/l	APHA 24 th Edition-2023; 2540D	25	100	---	<2.5
4.	Electrical Conductivity in μ S/cm at 25°C	IS 14767 :2000, RA 2016	800	1000	2000	100
5.	Odour	IS 3025 (Part 5): 2018	Unobjectionable	Unobjectionable	---	Unobjectionable
6.	Mineral Oil	IS 3025 (Part 39): 2021	No film	No film	---	No Film
7.	Nitrate (as NO ₃) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	10	50	---	<0.2
8.	Fluoride(as F) in mg/l	APHA 24 th Edition-2023; 4500 F D	1	2.0	---	<0.1
9.	Sulphate (as SO ₄) in mg/l	IS 3025 (Part 24): Sec.1, 2022	25	100	---	8.5
10.	Chloride(as Cl) in mg/l	IS 3025 (Part 32): 1988 (RA 2019)	50	200	---	7.7
11.	Surfactants in mg/l	IS 13428-2005(Annex K) RA 2018	0.1	0.2	---	<0.02
12.	Phosphate (as PO ₄) in mg/l	APHA 24 th Edition-2023; 4500-P-D	0.5	<0.1	---	<0.15
13.	Dissolved Oxygen in mg/l	APHA 24 th Edition-2023; 4500-O-C	6	4	---	6.4
14.	Biochemical Oxygen Demand (as BOD) mg/l	IS 3025 (Part 44):1993, RA:2019	2	5	50	0.8
15.	Total Kjeldahl Nitrogen (as N) in mg/l	APHA 24 th Edition-2023; 4500 Norg-B	0.5	2.0	---	<0.1
16.	Ammonia (as total ammonia-N) in mg/l	IS 3025 (Part 34): 1988(RA 2019)	0.05	0.5	---	<0.5
17.	Dissolved Iron (as Fe) in mg/l	IS 3025 (Part 53): 2003 (RA 2019)	0.2	0.5	---	0.04
18.	Copper(as Cu) in mg/l	IS 3025 (Part 42): 1992(RA 2019)	0.05	0.5	---	<0.02
19.	Zinc(as Zn) in mg/l	IS 3025 (Part 49): 1994 (RA 2019)	0.2	0.5	---	<0.02
20.	Arsenic(as As) in mg/l	IS 3025 (Part 37): 2022	0.01	0.05	---	<0.005
21.	Cadmium(as Cd) in mg/l	IS 3025 (Part 41): 2023	0.003	0.003	---	<0.002
22.	Total Chromium (as Cr) in mg/l	IS 3025 (Part 52): 2014(RA 2019)	0.05	0.05	---	<0.05
23.	Lead(as Pb) in mg/l	IS 3025 (Part 47): 1994 (RA 2019)	0.02	0.02	---	<0.01
24.	Selenium(as Se) in mg/l	IS 15303: 2003 (RA 2018)	0.01	0.01	---	<0.005
25.	Mercury(as Hg) in mg/l	IS 3025 (Part 48): 1994(RA 2019)	0.0005	0.0005	---	<0.001

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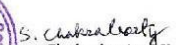
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Report No.	: QLS/P-27/25-26/C/36
Date	: 09.12.2025

26.	Phenolic Compounds (as C_6H_5OH) in mg/l	IS 3025 (Part 43): Sec 1, 2022	0.001	0.002	---	<0.001
27.	Cyanide (as CN) in mg/l	IS 3025 (Part 27): 1986(RA 2019)	0.05	0.05	---	<0.02
28.	Polynuclear hydrocarbons (as PAH) in mg/l	APHA 24th Edition, 6440:2023	0.0002	0.0002	0.001	<0.0001
29.	Total Pesticides	Calculation	0.0005	0.0005	0.001	<0.0005
30.	Polychlorinated biphenyls (as PCBs) in mg/l	ASTMD 5175-91, RA 2003	0.0002	0.0002	---	<0.0001
31.	Sodium Absorption Ratio	Calculation	---	---	26	0.96
32.	Boron (as B) in mg/l	IS 13428-2005(Annex L); RA:2018	---	---	1	<0.5
33.	Floating Materials	Observation	Absent	Absent	---	Absent
34.	Manganese (as Mn) in mg/l	IS 3025 (Part 59): 2023	0.4	---	---	<0.02
35.	Total Dissolved Solids (as TDS) in mg/l	IS 3025(Part 16)-2023	500	1500	2100	58
36.	Calcium Hardness in mg/l	APHA 24th Edition-2023, 3500 Ca B	200	---	---	14.6
37.	Magnesium Hardness in mg/l	APHA 24th Edition-2023, 3500 Mg B	200	---	---	7.3
38.	Barium (as Ba) in mg/l	APHA 24th Edition-2023, 3111 D	0.7	---	---	<0.05
39.	Turbidity in NTU	IS 3025 (Part 10): 2023	5	---	---	<1.0
40.	Chemical Oxygen Demand (COD) in mg/l	APHA 24th Edition-2023, 5220 B	5	---	---	2.4

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-----End of Report-----

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