Initial Environmental Examination

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PNG: Urban Water Supply and Sanitation Security and Resilience Improvement Project

Vanimo Water Supply and Sanitation System (Outputs 1A and 2A)

Prepared by Water Papua New Guinea (WPNG) for the Asian Development Bank (ADB).

ABBREVIATIONS

ADB	–	Asian Development Bank
AMP/QMP	-	Aggregate Extraction/Quarry Management Plan
AQ	–	air quality
BOQ	–	bill of quantities
CEMP	–	Construction or Contractor's Environmental Management Plan
CEO	–	Chief Executive Officer
CEPA	–	Conservation and Environment Protection Authority
CLO	–	community liaison officer
CSS	–	country safeguards systems
DLPP	–	Department of Lands and Physical Planning
DNPM	–	Department of National Planning and Monitoring
DO	–	dissolved oxygen
DOT	–	Department of Treasury
DSC	-.	Design Supervision Consultant
EA	–	executing agency
EHS	–	Environmental, Health and Safety
EHSO	–	Environmental, Health and Safety Officer
EIA	–	Environmental Impact Assessment
EIS	–	Environmental Impact Statement
EMP	–	Environmental Management Plan
EP	–	environmental permit
EPAR	–	Environment (Prescribed Activities) Regulation
FGD	–	focus group discussion
FTZ	–	Free Trade Zones
GBV	–	gender-based violence
GIS	–	Geographic Information System
GoPNG	–	Government of Papua New Guinea
GRM	–	Grievance Redress Mechanism
HDPE	–	high-density polyethylene
HIV	–	human immunodeficiency virus
HSP	–	Health and Safety Plan
IA	–	implementing agency
IUCN	–	International Union for Conservation of Nature
IEC	–	information, education and communication
IEE	–	Initial Environmental Examination
IP	–	Indigenous Peoples
IR	–	Involuntary Resettlement
KBA	–	Key Biodiversity Area
KCH	–	Kumul Consolidated Holdings
KII	–	key informant interviews
LLG	–	Local Level Government
OCR	–	ordinary capital resources
PIAL	–	Prohibited Investment Activities List
PM	–	particulate matter
PPE	–	personal protective equipment
MDG	–	Millennium Development Goals
MMI	–	Modified Mercalli Intensity
NOx	–	nitrogen oxide
PCR	–	project completion report
PMU	–	Project Management Unit
PNG	–	Papua New Guinea

POM	-	Port Moresby
PSC	–	Project Steering Committee
QPR	–	quarterly progress report
RP	–	Resettlement Plan
SDG	–	Sustainable Development Goals
SEAH	–	Sexual Exploitation, Abuse and Harassment
SMR	–	safeguards monitoring reports
STD	–	sexually transmitted diseases
STI	–	sexually transmitted infections
SPS	–	ADB's Safeguard Policy Statement
TA	–	Technical Assistance
TDS	–	total dissolved solids
UN-FAO	–	United Nations Food and Agriculture Organization
UWSSSRIP	–	Urban Water Supply and Sanitation Security and Resilience Improvement Project
VOC	–	volatile organic compounds
WaSH	–	Water, Sanitation and Hygiene
WHO	–	World Health Organization
WPNG	–	Water Papua New Guinea Ltd.
WQ	–	water quality

WEIGHTS AND MEASURES

%	–	percent
°C	–	degrees Celsius
dBA	–	A-weighted decibels
kL	–	kilolitre
km	–	kilometer
in	–	inches
lpd	–	liter per day
lps	–	liter per second
m	–	meter
m^3	–	cubic meter
mg/L	–	milligrams per liter
ml	–	millilitre
Mld	–	megalitres per day
mm	–	millimeters
NTU	–	Nephelometric Turbidity Unit
ppm	–	parts per million

NOTES

In this report, "$" refers to United States dollars unless otherwise stated

CURRENCY EQUIVALENTS

(as of 15 January 2025)

Currency Unit	–	Papua New Guinea Kina (PGK)
PKG1.00	=	$0. 2494
$1.00	=	PGK 3.9618

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EXECUTIVE SUMMARY

Background. The Government of Papua New Guinea (GoPNG) has requested assistance from the Asian Development Bank (ADB) in financing the Urban Water Supply and Sanitation Security and Resilience Improvement Project (the project) which is a strategic initiative designed to enhance climate resilience and ensure sustainable access to clean water and sanitation for urban communities in Papua New Guinea (PNG). The project will optimize and strengthen water and sanitation security and resilience in Port Moresby (POM) and Vanimo. It will support Water Papua New Guinea Limited (WPNG) to finance priority short to medium-term investments, conduct sector reforms, institutional capacity building, and strengthen enabling environment for a long-term water and sanitation service delivery improvement in POM and Vanimo. It is envisaged that the planned infrastructure investments envisioned under the project will (i) build resilience and adaptive capacity of the water supply and sanitation systems and communities to climate change, disasters, and other shocks and stresses; and (ii) optimize, expand and improve water supply and sanitation security in line with the utility's corporate plan and the government's sector development objectives as outlined PNG's Vision 2050[1] and the Development Strategic Plan 2010–2030[2]. The relevant key pillars of which emphasize environmental sustainability, climate change, improved institutional development, and service delivery.

Rationale. PNG faces significant challenges in providing access to improved drinking water supplies and sanitation services. As of the latest assessment, only 40% of the population has access to improved drinking water, while a mere 19% has access to improved sanitation. These figures fall short of the United Nation's 2015 Millennium Development Goals (MDGs) which indicate that PNG is not on track to meet the 2030 Sustainable Development Goals (SDGs) or its own national target of 70% access to improved water supply and sanitation by 2030. Access in provincial and district towns remains particularly inadequate. In response to these challenges, the Department of National Planning and Monitoring (DNPM) has established a Project Management Unit (PMU) to implement the National Water, Sanitation and Hygiene (WASH) Policy 2015-2030. The policy integrated key national development frameworks—including Vision 2050, the Development Strategic Plan 2010-2030, and the Medium-Term Development Plan 2015-2020—with a united focus on expanding access to safe, reliable, and sustainable water supply and sanitation services, alongside promoting hygiene practices. The Policy outlines clear objectives and targets to be achieved by 2030, aiming to transform service delivery and ensure equitable access across all regions of PNG.

Impact, Outcome, and Outputs. The project is aligned with the following impact: Inclusive and sustainable urban development, underpinned by improved infrastructure, equitable service delivery, and environmental resilience as outlined in the National Development Strategic Plan 2010-2030. The project will have the following outcome: resilience, inclusiveness, and sustainability of water and sanitation services in POM and Vanimo improved and will be delivered through the following outputs:

> Output 1: access to a resilient, inclusive and sustainable water supply system improved. This output will constitute the following 3 infrastructure investment scope of activities:

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1 https://www.treasury.gov.pg/wp-content/uploads/2023/05/Vision-2050.pdf

2 Independent State of Papua New Guinea, Department of National Planning and Monitoring. 2020. PNG Development Strategic Plan 2010-2030 *https://www.treasury.gov.pg/media/toward-the-future/development-strategic-plan/*

Output 1A – Vainimo water supply systems improvement
Output 1B – POM water source and treatment system optimization and resilience building.
Output 1C – POM NRW reduction, augmentation, and expansion of storage and distribution systems.

Output 2: Effective, resilient and safe sanitation services expanded. This output will be delivered under the following 2 scopes of activities:
2A – Vainimo on-site sanitation system improvement.
2B – Waigani sanitation system rehabilitation.

Output 3: WPNG's institutional, financial and operational sustainability improved.

Institutional Arrangements. The executing agency (EA) for the project is Kumul Consolidated Holdings (KCH), while the implementing agency (IA) is WPNG. WPNG operates as a state-owned enterprise (SOE) under the regulatory oversight of KCH. A project steering committee (PSC) will be established to provide oversight. The committee will be chaired by the Department of National Planning and Monitoring (DNPM) with representatives from KCH, the Department of Treasury (DOT), and the National Capital District Commission (NCDC) and the provincial government of Vanimo (when Vanimo-specific issues are discussed). The CEO of WPNG, supported by the head of the project management unit (PMU), will serve as the PSC secretariat and will convene regular meetings. The WPNG PMU supported by design supervision consultants (DSC) will: (i) ensure all environmental permits and government clearances for the project are obtained; (ii) implement and monitor safeguards during construction and operation; (iii) provide induction training to contractors in preparation and submission of construction environmental management plans (CEMP) for each subproject; (iv) provide assistance for review and clearance of the CEMPs prior to commencement of construction; (v) monitor compliance with the approved CEMPs of each subproject; and (v) prepare monitoring reports on environmental safeguards activities as required.

Policy, Legal and Administrative Framework. The environmental protection framework of GoPNG is contained in the Environment Act 2000 and the Environment (Prescribed Activities) Regulation 2002 which categorizes activities and projects that need environmental assessment as "Prescribed Activities" in two schedules according to the anticipated potential environmental impact. Projects that are likely to have significant adverse environmental impact (Level 2 and Level 3) are required to obtain an environmental permit (EP) from the Conservation and Environment Protection Authority (CEPA) following environmental assessment. The IEE in this context focuses on the anticipated environmental impact of civil works under Output 1, Subproject 1A for Vanimo which involves small-scale construction activities that may result in temporary and irreversible adverse environmental impacts. As such, it is expected that CEPA will classify the subproject as a Level 2A activity and WPNG will have to apply for the necessary EP. The project must also comply with ADB's Safeguard Policy Statement 2009[3] (SPS), and following the SPS guidelines, the Vainimo subproject is assessed by this Initial Environmental Examination (IEE) as category B for environment safeguards as the subproject's potential adverse environmental impacts are considered to be site-specific, temporary, and with mitigation and control measures readily available, an IEE is considered the appropriate level of assessment.

Environmental Due Diligence. This IEE presents the environmental assessment conducted for the infrastructure investment activities under the Vainimo subproject and identifies potential environmental impacts that may result from the pre-construction, construction and operational

[3] ADB. 2009. *Safeguard Policy Statement*. Manila.

phases. It also provides a detailed environmental management plan (EMP) that outlines specific actions that will be required to be undertaken to ensure minimal environmental impacts will arise from its implementation. The IEE in this context has been developed to: (i) describe the existing environmental conditions in the project area; (ii) identify and assess potential environmental impacts; (iii) evaluate and determine the significance of these impacts; (iv) formulate an EMP that outlines mitigation measures, monitoring activities, reporting requirements, institutional responsibilities, and indicative cost estimates; and (v) documents the outcomes of public consultations, including any issues or concerns raised by relevant stakeholders. The findings of the IEE have guided project design and will be revised as needed to reflect the outcomes of the detailed engineering design informed by a comprehensive hydrogeological study. The latter is a key environmental consideration with the proposed development of a new wellfield in a coastal aquifer, which poses long-term risks of saline intrusion, particularly under climate change scenarios such as sea level rise and reduced groundwater recharge. Due to limited available data on the aquifer's hydrogeological characteristics, a detailed investigation will be undertaken early in implementation to inform the design and operation of the proposed climate-resilient water supply system. The IEE will be updated accordingly, and the final IEE report will be disclosed to the public on ADB's website, made available upon request by WPNG, and provided to CEPA.

Environmental Management Plan. The EMP has been prepared to identify, avoid, minimize, and mitigate any potential adverse impacts by the subproject whether it be through erosion and sedimentation control, responsible sourcing of materials, spoil and waste management, and minimizing disturbance of natural habitats. The comprehensive environmental assessment conducted, established baseline data related to fauna, flora, and the presence of any critical habitats or species that are threatened, endemic, or have restricted range. The assessment concludes that the potential environmental impacts of the project are minimal and can be effectively managed through the implementation of the EMP. The EMP also outlines environmental monitoring and reporting capacity development for the design, construction, and operation phases of the project. The WPNG PMU supported by the DSC will be tasked with updating the EMP during detailed design and upon completion of the hydrological study and will oversee the subprojects environmental management system, including inspection, monitoring, reporting, and initiating corrective actions when necessary. The EMP will form part of the construction contract documents and the winning contractor will be required to prepare a construction environmental management plan (CEMP) based on the project EMP. The contractor is obligated under the CEMP to ensure appropriate environmental management during the entire construction period including all mobilization and demobilization activities and the opening and closing of any quarries or materials sources. In responding to the project's EMP, the CEMP is to be site and activity specific reflecting the contractor's construction methodology and approach, and include all sub-plans as required and as set out in the EMP section of this IEE. The contractor will submit the CEMP to the PMU and ADB for review and comment and then approval prior to commencement of any works.b

Information Disclosure, Consultation and Participation. Environmental information related to the project was shared with the public and key stakeholders through a series of consultations. A summary of these consultations is provided in Appendix 1. In accordance with the ADB's Access to Information Policy (2018)[4], the IEE will be made publicly available for interested parties, including CEPA. The main purpose of the consultation process was to present the proposed subproject plan, receive feedback on issues, and concerns that the people, stakeholders, and concerned parties in the impact area may have, and provide a mechanism for addressing these concerns. No significant environmental concerns were raised during the consultations.

[4] ADB. 2018. *Access to Information Policy*. Manila.

Stakeholders in Vanimo expressed strong support for the subproject and welcomed anticipated benefits, particularly improved access to clean and safe water supply and sanitation improvements. To maintain transparency and inclusiveness throughout implementation, a Stakeholder Communication Strategy and Consultation Plan will be developed to ensure timely, meaningful participation of all relevant stakeholders during all phases of the project. This will be further supported through the project's grievance redress mechanism (GRM). All project documents, including the IEE and subsequent monitoring reports, will be subject to public disclosure and made accessible via ADB's website, in line with the provisions of the Access to Information Policy.

Grievance Redress Mechanism. A Grievance Redress Mechanism (GRM) has been developed and will be established early in the project implementation phase to receive, assess, and facilitate the resolution of concerns, complaints, and grievances raised by affected individuals and communities with the project's environmental and social performance. The GRM is designed in line with established and accepted practices in PNG, ensuring that it is accessible, transparent, and time bound. The mechanism will provide a structured platform for affected people to express their concerns and seek resolution in a fair and responsive manner. WPNG's PMU, the DSC, and contractors will each maintain a complaints registry, which will be regularly monitored and reported on to ensure accountability and timely resolution of issues.

Monitoring and Reporting. Monitoring and reporting activities will be guided by the environmental monitoring plan included in this IEE to determine whether critical factors are within acceptable environmental limits or being exceeded. It also helps to determine whether mitigation measures are effective or should be modified or improved to address the observed and measured change in impacts. Contractors will submit monthly reports summarizing the results of daily and weekly compliance checks conducted by their Environment, Health and Safety Officer (EHSO). The WPNG PMU supported by the DSC will report on subproject progress to ADB on a quarterly and semi-annual basis and both progress reports will contain a section on compliance of the contractor with the CEMP based on the contractor's monthly reports and field inspections, and spot checks during site visits by WPNG and ADB. The WPNG PMU and DSC will include environmental specialists to review and approve the CEMP and to monitor the contractor's implementation of the approved CEMP. The costs of mitigation and monitoring as well as the preparation and implementation of the CEMP will be included in the contractor's bidding price. As noted above, the GRM and complaints/ issues registry maintained at the site project office will also be subject to monitoring. This monitoring and reporting framework ensures consistent oversight, transparency, and accountability throughout the project lifecycle.

Conclusion. The IEE concludes that the potential environmental impacts of the Vanimo subproject—arising from its design, construction, and operation— will not result in significant adverse impacts on the biodiversity habitats, natural environment or people in the subprojects area of influence. Apart from completion of the hydrological study to inform design, the primary adverse impacts are anticipated mainly during the construction phase and include pollution risks, waste generation, and localized disturbances. The effective implementation of the EMP will ensure that all assessed impacts during construction and operation will be managed to reduce or minimize any residual impacts within acceptable levels. The classification of category B for environment with regards to the subproject, according to ADB's SPS, is confirmed.

I. INTRODUCTION

A. Report Structure

1. The report consists of the following sections: (i) executive summary; (ii) introduction; (iii) policy and legal framework; (iv) project description; (v) description of the environment; (vi) anticipated environmental impact and mitigation; (vii) public consultation and disclosure; (viii) grievance redress mechanisms; (ix) environmental management plan; and (x) conclusions.

B. Rationale

2. **National Context and Sector Challenges**. PNG has a rapidly growing population of about 12 million. It is estimated that 14% live in urban areas, which can be expected to increase to 2025 by 2050.[5] The National Capital District (NCD), the country's largest urban area, includes PNG's capital city, Port Moresby, and surrounding urban areas. It is estimated to have a population of over 500,000. Vanimo, the capital of the West Sepik Province in northwestern PNG, has a population of around 27,000.[6] Unplanned growth in the country's urban centers makes poses a significant challenge in meeting rising demand for basic infrastructure and essential services. PNG thus faces significant challenges in providing access to improved drinking water and sanitation. As of the latest assessments, only 40% of the population has access to improved drinking water, and just 19% to improved sanitation. These figures fall short of the United Nation's 2015 Millennium Development Goals (MDG) and indicate that PNG is not on track to meet the 2030 United Nation's Sustainable Development Goals (SDGs) or its own national sector target of 70% access to improved water supply and sanitation by 2030. Provincial and district towns remain severely underserved.

3. **Water Supply and Sanitation Services in Vanimo.** Vanimo is West Sepik's Provincial capital located around 35 kilometers east of the border with Indonesia, approximately 100 kilometers by road to the Indonesian city of Jayapura. Vanimo's town center has a population of about 10,000 and lacks a reticulated water supply system. Residents currently use a combination of rainwater harvesting (primary source of water in wet season), shallow dug wells, springs and water extracted from rivers. Water is often scarce in the dry season, with rainwater tanks needing to be topped up with water from springs or groundwater. Around 85% of the population in the town area are serviced by flush toilets connected to septic tanks. Areas outside of the town boundary, including villages and settlements, are mostly serviced by onsite dry pit latrines. Water PNG has prioritized water and sanitation investments in Vanimo because of the high-water security risks facing the residents and the town's strategic role as PNG's cross border trade and investment hub with neighboring Indonesia.

4. **Government Response and Policy Framework**. PNG's water and sanitation sector is governed primarily by the National Water, Sanitation and Hygiene (WaSH) Policy 2015–2030, which sets ambitious targets to improve access to safe water and sanitation across the country. The policy aims for 95% of the urban population to have access to safe, convenient, and sustainable water supply, and 85% to sanitation services by 2030. It emphasizes inclusive service delivery, institutional strengthening, and climate resilience, aligning with broader national frameworks such as Vision 2050 and the Development Strategic Plan 2010–2030.

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[5] National Statistics Office. 2021. National Population Estimate 2021; and United Nations Department of Social and Economic Affairs. 2018. World Urbanization Prospects. The 2018 Revision.

[6] National Statistics Office. 2021. National Population Estimate: West Sepik Results. 2021. Project feasibility study conducted for Vanimo in 2019 used the previous 2011 NSO population projections.

5. **Institutional.** Water PNG is the state-owned enterprise mandated to operate on a commercial basis, responsible for water supply and sewerage services provision for POM, 13 provincial towns, and 8 district towns around the country. It is wholly owned by the government of PNG, through KCH, the trustee of state assets. WPNG was corporatized on 31 March 2017 under the National Water Supply and Sanitations Act (2016). Under its corporate investment plan, it aims to expand under its corporate investment plan, which is aligned with the government's long-term agenda of improving access to resilient and sustainable water supply and sanitation services. However, WPNG faces financial, operational, and human resource constraints, including a shortage of skilled staff and limited training opportunities, which hinder its ability to scale services.

C. The Project

6. The proposed project will support WPNG to strengthen existing systems and construct new and/or expanded water supply and sanitation systems to maintain climate resilience, inclusive, and sustainable measures, with a phased approach in line with GoPNG and WPNG's masterplans, WASH policy, and corporate plans. The project will not only significantly increase water and sanitation security, health and hygiene outcomes and economic and social benefits of estimated 400,000 urban settlements currently living in Port Moresby and Vanimo; but also, significantly expand customer base and revenue.

7. **Impact, Outcome, and Outputs.** The project is aligned with the following impact: Inclusive and sustainable urban development, underpinned by improved infrastructure, equitable service delivery, and environmental resilience (National Development Strategic Plan 2010-2030).[7] The project will have the following outcome: resilience, inclusiveness, and sustainability of water and sanitation services in POM and Vanimo improved and will be delivered through the following outputs:

Output 1: Access to resilient, inclusive, and sustainable water supply system improved.

Output 1A—Vanimo water supply systems improvement. A new climate-resilient, inclusive, and sustainable water supply system to serve at least 80% of the town's residents will be constructed and made operational. The proposed water supply system will include production bores and spring development, storage reservoirs, treatment facility, pumping station, trunk mains, reticulation mains, household connections, and meters. The proposed groundwater source will create water source diversity to increase the system and the town population's water security, resilience, and adaptive capacity by reducing dependency on rainwater harvesting, which is highly vulnerable to climate change. Major spring sources will be developed as alternative water sources for the population.

Output 1B—Port Moresby water source and treatment system optimization and resilience building. Refurbishment of the existing raw water delivery system and treatment plant will be carried out to optimize and build resiliency in the system. The WTP in Mt. Eriama will be refurbished for essential functionality and resilience improvement, such as converting the standby filters and future clarifier into duty process units, thereby increasing treatment throughput capacity by 10MLD and by automating prioritized processes for improved efficiency. Inspection and critical repairs

[7] Independent State of Papua New Guinea, Department of National Planning and Monitoring. 2020. PNG Development Strategic Plan 2010-2030 *https://www.treasury.gov.pg/media/toward-the-future/development-strategic-plan/*

of the existing raw water mains will be carried out to improve resilience of raw water transmission system.

Output 1C—Port Moresby NRW reduction, augmentation, and expansion of storage and distribution systems. NRW reduction will be achieved by minimizing both physical and commercial losses, formalizing all customers including in informal settlements, and improving billing and collection. Implementation of a comprehensive NRW program will include replacement of failed equipment to re-establish flow and pressure monitoring, installation of bulk and flow meters, expansion and upgrading of the storage and distribution network, formalizing and expanding household connections and meter replacements, leakage detection and capacity building for effective management of distribution metering areas (DMAs). The subproject will introduce fit-for-purpose digital solutions and improvements in network monitoring and control; customer engagement (i.e., customer expansion/ formalization, metering, billing, and collection); early warning and response systems; and other operational optimization to help achieve the intended outcomes and further build the communities' and system resilience.

The construction of three new storage reservoirs and rehabilitation of one existing reservoir along high pressure trunk mains will be carried out, which will improve supply, reduce losses, and facilitate efficient redistribution of available water. The distribution network will be expanded to facilitate redistribution of available water downstream of the selected DMA boundaries, to serve around 60,000 additional people. The institutionalization of service delivery to all citizens, including informal settlements, coupled with extensive NRW programs, digitalized billing and collection, customer management, and community engagement will be carried out.

Output 2: Effective, resilient, and safe sanitation services expanded.

Output 2A—Vanimo on-site sanitation system improvement. Access to improved and inclusive sanitation will be implemented through the adoption of a town-wide sanitation management plan and associated training needs that will develop functional service chain components consisting of fecal sludge collection, transport, treatment, and disposal or reuse. In consultation with all stakeholders, the project will strengthen the fecal sludge treatment system in partnership with private sector. Communities will be gradually supported to safely manage sanitation through an on-site sanitation and/or an off-site piloting program, with the goal of enabling these solutions and capacities to be extended to the residents of Vanimo and be demonstrated to other provincial towns in future.

Output 2B—Waigani sanitation system rehabilitation. This will include the prioritized components for the optimization and rehabilitation of the existing Waigani sewage ponds and sewerage system. The project will cover implementation of the priority works for the phased refurbishment of the sewage ponds to include (i) removal of sludge and vegetation in the 4 anaerobic ponds, (ii) establishment of a facultative pond, (iii) upgrading of inlet works, and (iv) establishment of receiving facilities. These proposed interventions are aimed at improving the quality of effluent discharged to the Tareko Lagoon, complementing the wastewater quality improvements for the broader Waigani catchment areas. In parallel, WPNG will invest its own funds in additional sanitation services improvement.

Output 3: WPNG's institutional, financial, and operational sustainability improved.

Output 3—WPNG's institutional, financial, and sector sustainability. The project will support WPNG in conducting comprehensive sector, institutional, financial reforms and strengthening, including of its systems and human resources, to increase efficiency and revenues, sustainably expand and serve its customers, and reduce commercial losses. The project will support WPNG in carrying out critical policy reforms, such as revising its connection policy and simplifying connection processes to enable all customers – formal or informal – to connect to the network and receive water and sanitation services. WPNG will be further supported in extensively streamlining and strengthening its information management systems, digitalizing its billing, collection, and customer management, conducting energy audits to minimize energy costs and reduce greenhouse gas emissions, human resource management and extensive capacity building through focused technical and non-technical trainings throughout the project. A training center will be established at WPNG's existing facilities and a comprehensive capacity development plan, including technical, financial, and other training courses, will be developed and implemented with support from project consultants. Systems integration and training provided to WPNG staff will pave the way for progressive digital transformation to sustain financial and operational efficiency, improve resilience, customer services and community engagement. A new office of WPNG is being constructed through WPNG's own resources. Project will assist WPNG in providing inclusive space for women and staff trained to manage the services.

D. Purpose, Objectives and Scope of IEE

8. **Purpose and objectives**. ADB requires the consideration of environmental and social issues in all aspects of its operations, and the requirements for environmental protection and management are prescribed in ADB's SPS. The SPS requires environmental assessment of the appropriate level for all investments irrespective of financing modality. This IEE report documents the environmental assessment for the proposed project and assesses the social and environmental issues to be considered in project planning design and implementation stages. The IEE also addresses the environmental assessment and management requirements of the CSS following CEPA's requirements. The main objective of the IEE is to identify, assess, and mitigate potential adverse environmental impacts throughout the project cycle, ensuring that the project is environmentally sound and sustainable. Specifically, the IEE:

(i) Assess the existing environmental conditions in the project area including the identification of environmentally sensitive areas;
(ii) Assess the proposed planning and development activities to identify their potential impacts, evaluate the impacts, and determine their significance;
(iii) Propose appropriate mitigation measures that can be incorporated into the proposed activities to minimize any adverse impacts, ensuring that residual impacts are acceptable and propose monitoring and planning of project;
(iv) Provide guidance as to the assessment and suitability for construction locations;
(v) Review any legislative and approval requirements under which construction activities can occur; and
(vi) Prepare an EMP incorporating mitigation and monitoring measures that will guide environmental management during project construction and operation.

9. **Scope of the IEE.** The scope of the IEE covers all the components of the water supply (Output 1A) and sanitation (Output 2A) subprojects in Vanimo including the water bore holes, water treatment and distribution network. The sanitation or wastewater disposal for both brown

water and black water are also assessed, however it is noted that for this activity there will be no infrastructure investment component. In accordance with ADB's SPS, the overall Vanimo Subproject is assessed as Category B for environment based on its most environmentally sensitive impacts, requiring an IEE and an EMP to be prepared. The environmental assessment was conducted through site visits, field surveys, stakeholder consultations, and review of primary and secondary data. The IEE primarily addresses the anticipated environmental impacts of civil work associated with Output 1, while Outputs 2 and 3 are not expected to generate environmental impacts, as they do not involve ADB-financed civil works. To ensure compliance with ADB's SPS and the CSS, the Vanimo Subproject 1A IEE has been prepared and will be implemented in alignment with these environment safeguards requirements.

10. In the case of PNG's CEPA, the proposed water project is expected to fall under Level 2, category A activities, specifically related to water extraction, which requires the preparation of an environment impact assessment (EIA). Upon review of the WPNG's EP application, CEPA will confirm the project's classification and determine the appropriate permitting requirements. If confirmed as Level 2A, the project will require an Environment (Water Extraction) Permit. Additionally, for activities involving drilling and borehole investigations, an Environment (Water Investigation) Permit will also be necessary. These requirements will be confirmed based on CEPA's assessment of the submitted application and supporting documentation.

11. The project is anticipated to have site-specific and localized impacts, most of which are construction related, and which can be readily mitigated and managed through the implementation of the measures identified in the EMPs and good international practice. Where required, the IEE and the EMP will be updated after the detailed design has been finalized.

12. **IEE Methdology**. The IEE is based on primary and secondary information and data obtained onsite through investigation, survey, and interviews as well as existing sources. The original feasibility study for the preparation of this IEE was initially conducted in 2019 and updated with further studies undertaken in June 2024 and again in early 2025. Given that the subproject area of influence is mainly in an urban environment, there was no need to carry out an in depth inventory of flora and fauna in the project area. The preparatory team however conducted on the ground interviews with local communities in the subproject areas to gather information/data needed for this report. During field studies the natural environment, including watercourses, were also inspected, and photo documentation of the existing environment where the methodologies used in the preparation of this IEE report. Public consultations with government stakeholders and communities within the project site were also undertaken as part of the IEE process to determine community attitudes to the development and obtain relevant information.

II. POLICY AND LEGAL FRAMEWORK

13. The implementation of the project will be governed by the environmental laws and regulations of Papua New Guinea and the safeguard policies of ADB.

A. Country Safeguard System

14. The Environment Act 2000, the Environment (Amendment) Act 2014 and the Environment (Prescribed Activities) Regulation (EPAR) 2002 addresses environmental impact assessment and management of economic and development activities in the country. CEPA, as the government's environmental management and regulatory agency, operates with the mission statement: To ensure PNG's natural and physical resources are managed to sustain environmental quality and

human well-being. CEPA functions consists of three divisions: (i) Protected Areas Management concerned with the establishment of national parks and protected areas; (ii) Conservation Management concerned with conservation of flora and fauna and species management; and (iii) Administration of PNG's regional and international environmental conventions.

15. **The Environment Act 2000**. This Act prescribes requirements for proponents seeking approval for new developments or changes to existing departments and is administered by CEPA. The Environment (Amendment) Act 2014 strengthens the regulatory requirements through improved definitions of the permits, environmental management plans and audits, and takes a firmer stance on the legal penalties towards individuals who cause and/or generate environmental harm. The Act includes provisions for undertaking environmental impact assessments (EIA) and employs a three-tiered system (i.e., Level 1, Level 2 and Level 3) to classify projects according to the anticipated environmental impact. Projects classified as Level 1 include those with minimal environmental impact. These do not require an EP or license but must comply with environmental codes of practice, environmental protection orders, clean-up orders and emergency directions if issued under the Act. Projects that are likely to have significant adverse effects are classified as Level 2 and Level 3 and are required to obtain an EP from CEPA following the environmental assessment process. Level 2 projects are further categorized into Level 2 (Category A)[8] and Level 2 (Category B).

16. Level 2 (Category A) activities are exempted from notification and referral process because they are deemed to not pose a high risk of causing environmental harm. Whereas Level 2 (Category B) activities must go through the notification and referral requirements. Detailed EIAs are required for all Level 3 projects, while they are only required for Level 2 projects that may present adverse environmental impacts or significantly impact matters of national importance. The Environment Act 2000 and EPAR 2002 address environmental impact assessment and management. CEPA administers both the Act and the EPAR. The EPAR categorizes projects as "Prescribed Activities" in two schedules according to the anticipated potential environmental impact. Schedule 1 consists of Level 2 activities that are subdivided into two categories (Category A and B). Category B has 13 sub-categories with sub-category 12 addressing Infrastructure Development. While item 12.3 includes Operation of potable water treatment plants with a design capacity of greater than 1 million liters per day.

17. **CEPA.** The CEPA, as the government's environmental management agency, operates under the mission statement: To ensure PNG's natural resources are managed to sustain environmental quality, human well-being and support improved standards of living (CEPA Corporate Plan (2009-2012). CEPA consists of three divisions: (i) Environment Protection responsible for environmental approvals; (ii) Sustainable Environment Management; and (iii) Policy Coordination and Evaluation. CEPA issues a guideline for submission of an application for an EP to discharge waste (GL-Env/03/2004) which covers (i) noise discharges (IB-ENV/03/2004); (ii) air discharges (IB-ENV/02/2004); and (iii) water and land discharges (IB-ENV/04/2004). CEPA has also published the Guideline for Conduct of Environmental Impact Assessment and Preparation of an Environmental Impact Statement (2004) which provides guidance on fulfilling the requirements of the EPAR.

18. CEPA operates at the national level from its office based in Port Moresby. It does not have offices and staffs in the provinces. All environmental approvals are done in the central office in Port Moresby. As part of the GoPNG decentralization policy, CEPA must work in close consultation with the provincial governments through the respective provincial administrations to

[8] Note: This relates to Environment Act classification. This is not the same as ADB project classification.

ensure implementation of environmental legislation at the provincial level. Certain environmental management and monitoring functions are delegated to provincial administrations on an “if and when” they have the resources and capacity basis to conduct these activities.

19. **EIA procedures**. The EIA process involves the proponent notifying the Director of CEPA in writing of its intention to carry out preparatory works. The format and information required in this notification is set out in the Guideline for Notification of Preparatory Work on Level 2 Activities. Accordingly, formal notification will be prepared for the subprojects under consideration in this IEE, and it is expected that CEPA will advise WPNG to submit EP application (which is in a similar format to this IEE). Following approval, CEPA will issue a Level 2A EP for the subprojects. No work can commence until the EP is issued, as shown in Figure 1.

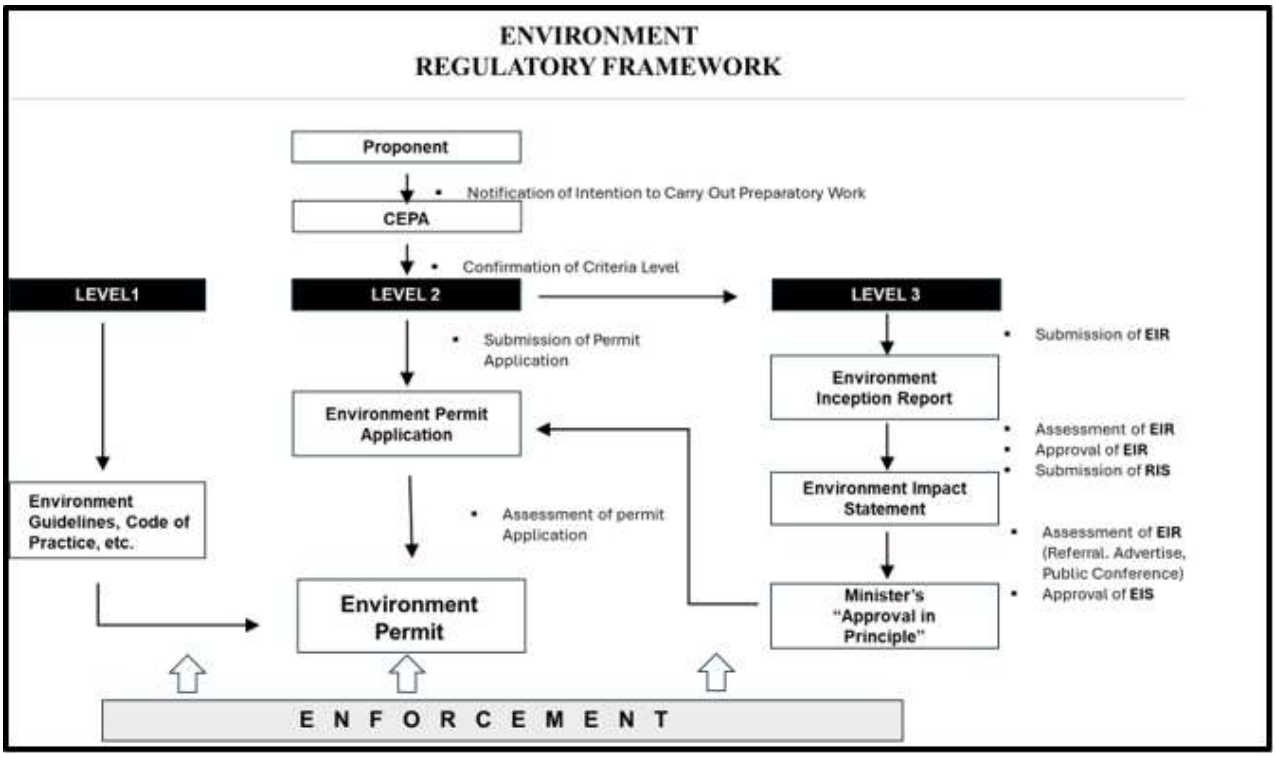


Figure 1: Environmental Regulatory Framework in PNG

20. **Relevant legislations**. Table 1 summarizes other relevant environmental and social legislations in PNG that will also apply to the project.

Table 1: Relevant Environmental and Social Legislations

Policy and/or legislation	Description	Relevance
Forestry Act 1991	The Forestry Act 1991 has the objective of managing, developing and protecting PNG’s forest resources and environment in such a way as to conserve and renew them as an asset for succeeding generations.	This Act supports water supply and sanitation projects by promoting sustainable forest management, which helps protect water catchments, maintain water quality, and ensure environmentally responsible land use.
Conservation Areas Act 1978	The Act provides for the preservation of the environment and of the national cultural	The Conservation Areas Act will be used in the site development phase,

Policy and/or legislation	Description	Relevance
	inheritance, gives effect to PNG's five national goals and directive principles and establishes the National Conservation Council. The national goals and directive principles include the following: (i) Integral human development (ii) Equality and participation (iii) National sovereignty and self-reliance (iv) National resources and environment (v) Papua New Guinea ways	construction phase and operational phase to ensure preservation of PNG's environment and cultural inheritance.
Fauna (Protection and Control) Act 1966	The Act makes provision for the protection, control, harvesting and destruction of fauna, and for related purposes. The Act recognizes establishments and controls over: (i) Sanctuaries (ii) Protected Areas (iii) Wildlife Management Areas	Investigation of land used for the project should be undertaken in line with the Fauna Act. Discovery of native animals and plants should be dealt with in accordance with the Act.
International Trade (Fauna and Flora) Act 1979	The Act furthers the conservation of the natural environment of Papua New Guinea and its native animals and plants by promoting their sustainable use, and to implement the State's obligations as a party to the Convention on International Trade in Endangered Species of Wild Fauna and Flora by controlling and regulating the trade, possession, transport, exportation and importation of certain species of fauna and flora, and for related purposes (PacLII, n.d.).	An investigation of land used for the project should be undertaken in line with the Act. Discovery of native animals and plants should be dealt with in accordance with the Act.
Water Resource Act 1982	The Act provides for the protection of national resources whilst giving effect to PNG's fourth national goal, directive principle and provided provisions for regulation and management of national water resources including the management and its responsibilities (PacLII, n.d.).	Protection and management of water resources should be undertaken in line with the Water Resource Act.
Land Act 1996	The Act is the principal legislation that deals with land matters occurring on either state, freehold or customarily owned land. Further, it sets out the legal framework and procedures for the Government to acquire land both from voluntary and compulsory land registration	Should any of the customary, freehold, or state-lease land be required for the project, compensation or lease terms be undertaken in line with the requirements of the Land Act.
Land Disputes Settlement Act 2000	The Act serves as a legal framework for the settlement of disputes in relation to interests in customary land.	Should customary land be required for the project and a dispute occurs, settlement will be undertaken in line with the requirements of the Land Disputes Settlement Act.
Land Groups Incorporation Act 1974	The Act provides a basis for customary groups to hold, manage and deal with land	Negotiations with customary landowners can be conducted through the relevant ILGs.

Policy and/or legislation	Description	Relevance
Land Groups Incorporation (Amendment) Act 2009	in their customary names through an incorporated land group (ILG). Under the 2009 amendment, ILGs are required to include two female representatives.	
Employment Act 1978	The Act establishes the legal framework for employment and work conditions in PNG. The Act provides for the protection of women from discrimination in employment conditions. However, under the Act there are limitations on the employment of females at night, and the Act prohibits the employment of females in heavy labor. Further, it provides for maternity leave. The Act provides limitations on the employment of people under 16 years of age. Specifically, employment of young people under the age of eleven is prohibited. Employment of young people aged between 11 and 16 is permitted with parental permission, a certificate from a medical practitioner indicating that the person is fit for the type of employment proposed, and as long as the employment does not negatively affect school attendance. Young people of 14 or 15 years of age may be employed in any industry other than an industrial undertaking or the fishing industry.	Employment contracts and the conditions of laborers or workers engaged by the project must abide by the Act.
Industrial Safety, Health, and Welfare Act of 1961 Industrial Safety, Health, and Welfare (Amendment) Act 2016	The Act includes provisions for the occupational health and safety of workers.	Working conditions must conform with the requirements of the Act, including the provision of emergency and housing facilities.
PNG Biosecurity Act 2025	The PNG Biosecurity Act 2025 consolidates several outdated laws into a robust, unified system aimed at enhancing national resilience - environmentally, agriculturally, economically, and socially. It has far-reaching impacts: from protecting the country's rich biodiversity, ensuring food security, to unlocking new trade and investment opportunities through international compliance.	Ensure that stakeholders conform with biosecurity obligations of PNG during procurement of construction materials from overseas, movement of foreign workers, etc.
Lukautim Pikinini Act 2015	The Act includes provisions for the protection and promotion of the rights and wellbeing of children. The Act stipulates the protection of children from all forms of violence, abuse, neglect, exploitation, and discrimination.	Under the Act, child labor is prohibited for infrastructure projects. Further, children in communities which may be affected by project implementation should be protected from exploitation.

Policy and/or legislation	Description	Relevance
	The Act incorporates penalties for person(s) (parents and employers) involved in child labor that is hazardous, interferes with the child's education, and harmful to the safety, health, and wellbeing of the child. Under the Act, a child is defined as a person under the age of 18 years.	
Public Health Act 1973 Public Health (Amendment) Act 2020	The Act includes provisions for the protection of public health. Under this Act and its Amendments, there are provisions for the containment of infectious diseases.	During construction, the project contractor and social impact management framework will incorporate measures to support the prevention and management of infectious diseases into workforce management and planning.
HIV/AIDS Management and Prevention Act 2003	The Act includes provisions for the prevention of the spread of HIV/AIDS; management of the lives and protection from discriminatory practices of people living with HIV/AIDS and of people who are affected by or believed to have HIV/AIDS.	The project contractor and social impact management framework will incorporate HIV/AIDS prevention and management into workforce management and planning.
Fairness of Transaction Act 1993	The Act includes provisions to ensure the fair distribution and adjustment of rights, benefits, duties, advantages, and disadvantages arising out of a transaction.	Land access payments are fair to all parties.
National Cultural Property Act 1965	The Act covers the preservation and protection of objects of cultural or historical importance. This act is administered by the National Museum and Art Gallery.	Should "chance finds" be made during construction this act will be triggered, provisions for this have been made in the EMP.
National Museum and Gallery Act, 1992.	The Act aims to protect and preserve PNG's unique culture including both tangible and heritage items.	Any areas of cultural or heritage significance identified are dealt with in accordance with the Act.
Public Health Drinking Water Quality Standards 1984 and Environment (Water Quality Criteria) Regulation 2002	Drinking water quality standards for raw (untreated) water are contained in the Public Health Drinking Water Quality Standards 1984 while the standards for aquatic life protection are listed in the Environment (Water Quality Criteria) Regulation 2002. Ranges of criteria are given for several parameters including turbidity, which should not exceed 25 NTU. Since many of the water courses in PNG are naturally quite turbid, this standard appears to be unrealistic as it is close to drinking water standard. Therefore, the pre-project turbidity in the watercourse is suggested as the standard for assessing turbidity during construction.	These water quality standards are applicable to the water supply project to ensure safe and compliant service delivery.

21. **International agreements** (treaties and conventions). In addition to national legislation and regulations, PNG is a signatory to several international agreements that carry important environmental and social safeguarding obligations. Table 2 outlines the key international treaties and conventions to which PNG is a party.

Table 2: International Agreements relevant to the Project

Relevant Environment and Social legislation
Climate Change (UN Framework Convention on Climate Change), New York 1992
Convention for the Protection of Natural Resources and Environment of the South Pacific, 1986 (SPREP Convention)
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES Treaty), Washington 1973
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES Treaty), Washington 1973
Convention on the Elimination of all Forms of Discrimination Against Women (CEDAW), 1958
Discrimination (Employment and Occupation) Convention, 1958
International Convention on the Conservation of Nature in the South Pacific, Apia 1976
International Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter, London, Mexico City, Moscow 1972
International Covenant on Economic, Social and Cultural Rights (ICESR), 1976
International Plant Protection Convention, Rome 1951
ILO Minimum Age Convention, 1973
ILO Worst Forms of Child Labor Convention, 1999
Kyoto Protocol, Kyoto 1997
Paris Agreement, Paris 2015
Plant Protection Agreement for Asia and Pacific Region, London 1956
Protocol Concerning Co-operation in Combating Pollution Emergencies in the South Pacific Region, 1986
UN Convention on Biological Diversity, Rio de Janeiro 1992
UN Convention on the Rights of Persons with Disabilities
UN Convention on the Rights of the Child, 1990
World Heritage Convention, Paris 1972

B. ADB Safeguard Requirements

22. **Safeguard Policy Statement**. The goal of ADB's SPS is to promote the sustainability of project outcomes by protecting the environment and people from any potential adverse impacts of the project. The SPS contains three safeguard requirements (SR); SR1 Environment; SR2 Involuntary Resettlement; and SR3 Indigenous Peoples. Each of the safeguard requirements comprises an objective, scope and triggers, and a set of policy principles that must be met. Each of the safeguard requirements follows a due diligence process of screening, categorization, scoping, consultation, impact assessment, management, and monitoring and reporting. Documentation of the due diligence is subject to disclosure as per the requirements of the Access to Information Policy 2018.The SPS thus has the objectives to (i) avoid adverse impacts of projects on the environment and affected people; (ii) where possible; minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and (iii) help borrowers/clients to strengthen their own safeguard systems and develop the capacity to manage environmental and social risks. To help achieve the desired outcomes, ADB adopts eleven policy principles for guiding the assessment of projects that trigger environmental risks and impacts.

23. **Environment Safeguards**. The SPS Environment Safeguard Requirement 1 (SR1) involves due diligence which commences with screening a project to determine its category of

impact and to determine the level of environmental assessment required to address these potential impacts. ADB classifies projects into categories A, B, C, and FI according to the significance of likely impacts. As per SR1, the proposed Vanimo Subprojects has been classified as Category B. Category B projects are assessed to have some adverse impacts, but of lesser degree and/or significance than Category A, the impacts are site-specific and can be managed or mitigated to satisfactory levels with the proposed mitigations measures identified in the environmental management plan (EMP). ADB's SPS applies pollution prevention and control technologies and practices consistent with good practices as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety (EHS) Guidelines. The EHS provides the context of international best practice and contributes to establishing targets for environmental performance. Standards incorporated into the EHS will be used in parallel with local PNG environmental standards (where they exist) throughout this document with the principles of due diligence and a precautionary approach adopted. Application of occupational and community health and safety measures, as laid out in the EHS is also required under the SPS.

24. It is noted that if gaps exist between ADB's requirements and the CSS, or where gaps in borrower's capacity are apparent, the safeguards due diligence will include the details of the specific gap-filling requirements to ensure that policy principles and safeguard requirements are achieved. This will include an assessment of the capacity of the borrower/client to properly manage the environmental and social impacts and risks of the project and to implement the relevant national laws and regulations and the ADB requirements. ADB will not finance projects that do not comply with the SPS and the host country's social and environmental laws and regulations, including those laws implementing host country obligations under international law. The SPS also contains a prohibited activities list identifying specific activities that ADB will not finance.

III. DESCRIPTION OF THE PROJECT

A. Vanimo Water Supply System (WSS) Scope of Works

25. The Vanimo WSS is designed to enhance water supply and management in PNG's provincial town of Vanimo through the development of a comprehensive water infrastructure system. The subproject aims to meet the increasing demand for potable water, improve access to clean and safe water, and promote effective water resource management. Key components of the subproject include the installation of (i) water resource development and abstraction facilities; (ii) water supply mains; (iii) raw water disinfection systems; (iv) clear water pump station, including pump machinery; (v) clear water transmission mains; (vi) storage reservoirs; and (vii) a distribution network as illustrated in Figure 2. This integrated approach is expected to significantly improve water service delivery and contribute to the long-term resilience and sustainability of Vanimo's urban water system.

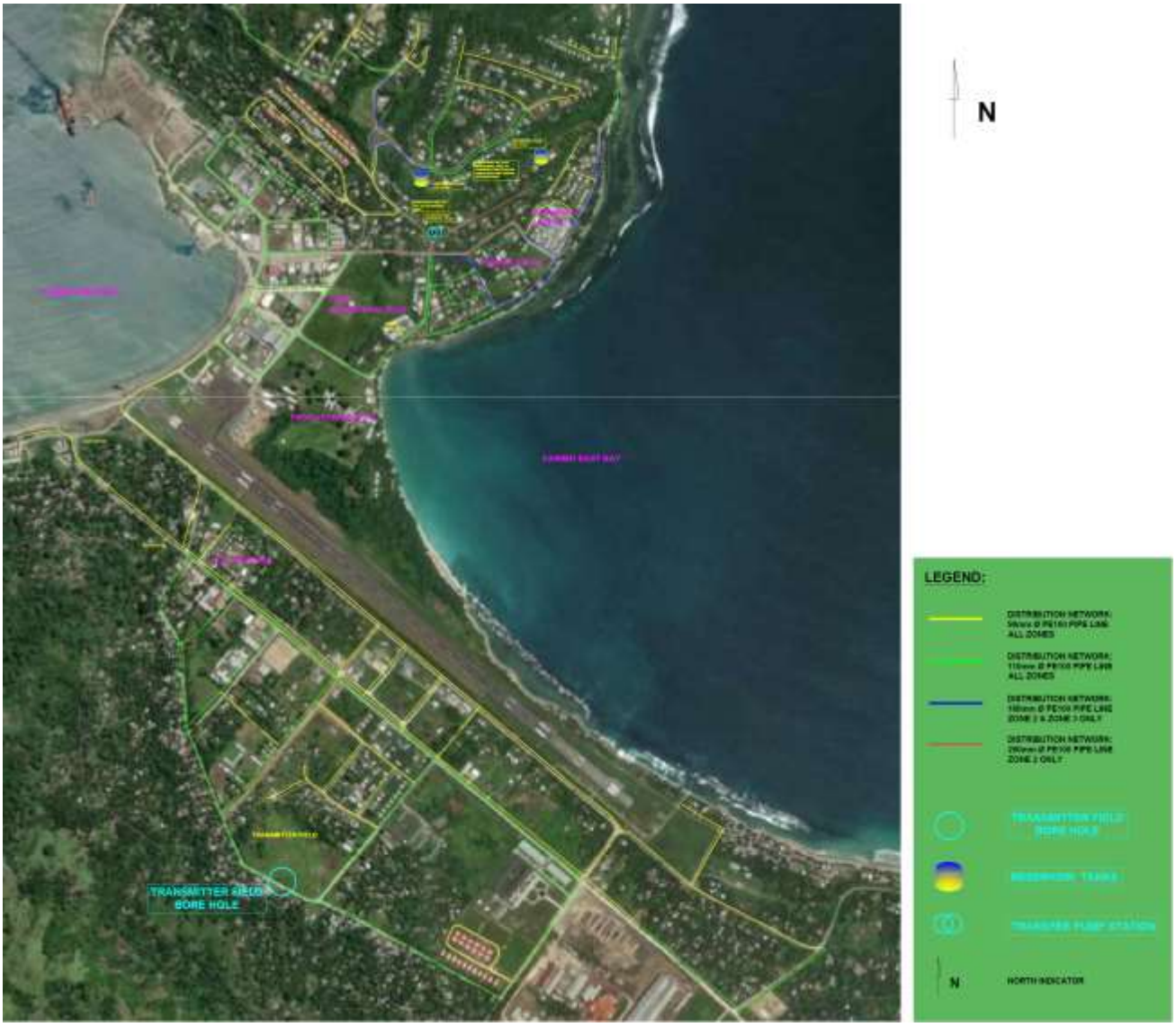


Figure 2: Project Components and Distribution Network

B. Vanimo WSS Components

26. **Development of water source and abstraction.** This component involves the development of water sources and the abstraction of water from both groundwater and spring sources. It will include conducting geological surveys and hydrological studies to assess the feasibility and sustainability of extracting water from these sources. If proven viable, identified groundwater and spring sources will serve as key raw water inputs for the overall water supply system.

Table 3: Proposed Water Source and Abstraction Components

Infrastructure	Function	Description	Location
Deep tube wells for abstraction of groundwater	• Raw water abstraction from tube wells • Submersible pumps for pumping to holding tank for disinfection	• Tube wells will be drilled to the depth of 80m–100m (to be finalized based on hydrogeological investigations). • Tube wells will be spaced at a distance of 150m–200m to avoid interference • Assessed Discharge: 5 Lps for each tube well • Abstraction requirement: 1.5–2.0 Mld	• Transmitter field • Waraboil well field
Raw water intake / pump station for abstraction from spring source	• Raw water abstraction from spring source • Centrifugal pumps for pumping to raw water collection sump	• Raw water pump station near the spring / cave with suction and delivery pipes • Suction pipes to be extended into the spring source / sump with adequate submergence • Assessed abstraction: balance of abstraction requirement to be supplemented from the spring source	• Waraboil Spring / Stoney Cave
Raw water collection sump and raw water pump station	• Collection of raw water at Waraboil Field in the sump • Pumping raw water abstracted from Waraboil site to Transmitter field	• Raw water collection sump (500 Kl) will collect raw water from Waraboil field for groundwater and raw water from spring source • Raw water collected at Waraboil will be pumped to Transmitter field	• Waraboil well field

27. **Raw water mains.** This component involves the transfer of raw water to a collection or holding sump through the installation of high-density polyethylene (HDPE) pipelines. The scope includes:

(i) Within the Transmitter and Waraboil fields, HDPE pipes (80–100mm in diameter) will be laid over approximately 150m from each tube well to the respective collection or holding tank;

(ii) An HDPE pipeline (200mm in diameter) will be installed to convey water from the Spring Source to Waraboil field; and

(iii) A larger HDPE pipes (250mm in diameter) will be laid along the designated easement, spanning approximately 2,150m, to connect the Waraboil field to the Transmitter field.

28. **Disinfection of raw water.** Following successful water source abstraction, raw water will then undergo disinfection either in-pipe or within a holding tank using chlorine. Chlorine cylinders will be installed at the Transmitter field site as part of the disinfection facility. This facility will include a raw water holding tank, chlorine cylinders with associated piping, a chlorine analyzer, and a chlorine leak detector, all designed to comply with local public health and safety regulations.

29. **Clear water pump stations and pump machinery.** This involves the pumping of disinfected water to designated storage reservoirs through two strategically located clear water pump stations:

(i) At the Transmitter field, Clear Water Pumping Station-1 will be installed to transfer water to two locations: the Elevated Storage Reservoir at Zone-1A and the Ground-level Reservoir situated above the Vanimo Hospital; and
(ii) Below Tower Hill, Clear Water Pumping Station-2 will be constructed to pump water to the Elevated Storage Reservoir at Zone-3.

30. **Clear water transmission mains.** This involves the conveyance of disinfected water from the clear water pump stations to designated reservoirs through three transmission mains. These transmission mains are critical for ensuring efficient and reliable water supply across the service zones.

(i) Transmission Main-1: A 200mm diameter pipeline, approximately 50m in length, will transport water from Clear Water Pump Station (PS)-1 to the Elevated Storage Reservoir at Zone-1A, located at the Transmitter field;
(ii) Transmission Main-2: A 250mm diameter pipeline, approximately 4,350m long, will convey water from Clear Water PS-1 to the Ground Level Reservoir at Zone-2; and
(iii) Transmission Main-3: A 160mm diameter pipeline, approximately 1,090m in length, will deliver water from Clear Water PS-2 to the Elevated Storage Reservoir at Zone-3.

31. **Installation of storage reservoirs.** Three treated water storage reservoirs will be installed to ensure a consistent and reliable water supply, particularly during peak demand periods. The elevation of these reservoirs is strategically designed to optimize gravitational flow, thereby enhancing pressure and distribution efficiency across various areas of Vanimo.

(i) Zone-1A Transmitter field: An Elevated Storage Reservoir with a capacity of 600kL at a staging height of 20m to serve Zone-1A command area;
(ii) Zone-2 Vanimo Hospital: A Ground Level Storage Reservoir with a capacity of 1000kL will be constructed at the top of Vanimo Hospital to supply Zone-2 command area; and
(iii) Zone-3 Tower Hill: An Elevated Storage Reservoir with a capacity of 300kL will be installed at the top of Tower Hill to serve Zone-3 command area.

32. **Development of distribution network.** An extensive water distribution network spanning approximately 30km will be constructed using HDPE pipes ranging from 90mm to 250mm in diameter. This network is designed to efficiently deliver clean and potable treated water to residential and commercial consumers throughout Vanimo. The coverage of the water supply distribution system in Vanimo town is shown in **Error! Reference source not found.**.

33. The pipelines will be installed along designated easement and road edges using cut-and-cover method, ensuring minimal disruption to existing infrastructure and accessibility for future maintenance. This infrastructure is critical to ensuring reliable water access and pressure management across all service areas. The distribution coverage by zone is as follows:

(i) Zone-1A: Approximately 15km of pipeline network;
(ii) Zone-2: Approximately 9km; and
(iii) Zone-3: Approximately 3km.

Figure 3: Project Scope of Distribution Network

C. Service and Design Standards

34. The service and design standards proposed in the 2019 feasibility study were thoroughly reviewed and validated by Water PNG. These standards were confirmed to be suitable and appropriate across various operational and regulatory contexts, including the Sustainable Development Goals (SDGs), World Health Organization (WHO) guidelines, and PNG national standards. The adopted high-level service design standards, which form the foundation of feasibility study, are summarized in Table 4.

Table 4. Project Design Standards

Description	Level of Service
Service Continuity:	
- Continuity of service	24 hours/day
- Customers with discontinuous supply during normal operations	0%
Water Demands:	125 L/person/day
- Per Capita Demand – dwellings (with rainwater tanks)	50 L/person/day
- Per Capita Demand – dwellings (villages / settlements)	20% of Average Day
- Non-Revenue Water (NRW) allowance	1.4 x Average Day
- Peak Day (PD) demand	
Maximum Pressures (normal operations):	
- Maximum allowable pressure at customer water meter	60m
- Desirable maximum pressure at customer water meter	50m
Minimum Pressures (normal operations):	
- Minimum allowable pressure at customer water meter	15m
- Desirable minimum pressure at customer water meter (residential)	20m
- Desirable minimum pressure at customer water meter (non-residential)	
- Desirable minimum pressure at village standpipe	25m
	15m
Minimum Pressures (with fire flows):	
- Minimum flow and pressure at hydrant on a peak day (residential)	10 L/s @ 15m
- Minimum pressure at hydrant on a peak day (non-residential)	20 L/s @ 15m
- Minimum residual pressure on a peak day (anywhere in system)	5m
Drinking Water Quality:	100%
- Microbiological compliance (% samples with nil E-coli)	100%
- Chlorine residual compliance (% samples passing on residual chlorine)	
Water Security:	
- Frequency of water restrictions / rationing due to raw water capacity limitations	6 months in 10 years

Note: These standards are considered appropriate for the planned water supply system at Vanimo.

D. Design Scope

35. The proposed water supply system is designed to accommodate the projected population growth through to the year 2040. At this stage of development of Subproject 1A—the system does not include coverage for households located outside the proposed network area. However, provisions for future expansion will be considered to ensure long-term serviceability.

IV. DESCRIPTION OF THE ENVIRONMENT (BASELINE CONDITIONS)

36. The environmental context of the project is detailed in the following sections of this report, which cover the physical, biological, and socio-economic environments. It is derived from desktop analysis, consultation with key stakeholders and the community, and field inspections. The project area is defined as the provincial township of Vanimo, but the area of influence of this specific subproject will be limited to the proposed water supply system components. Surveys were conducted to gather information for the socio-economic baseline as well as field and site investigations whereby no significant ecosystems or resources were observed and the probability of any being present is considered very low as the project area is already a highly modified urban environment. The project location map is provided in **Error! Reference source not found.** to visually support the environmental overview.

Figure 4: Project Location, Components and Environment Sensitive Receptors

A. Physical Environment

The geomorphology of the coastal region of West Sepik province is characterized by uplifted landforms, narrow coastal plains, extensive alluvial plains, freshwater and brackish swamps. The geology, especially the lithological composition of the region, depicts the geomorphology of the area and the landform as lowland troughs, uplifted landforms, and mountain ranges. The soil composition consequently is closely associated with the vegetation and the topography of the region. Vanimo in this context is situated on a well-drained alluvial plain, predominantly covered by lowland rainforest and the following physical environment description consists of an analysis

of various Geographic Information System (GIS) maps which are translated into various thematic maps (geomorphology, topographic and geological characteristics).

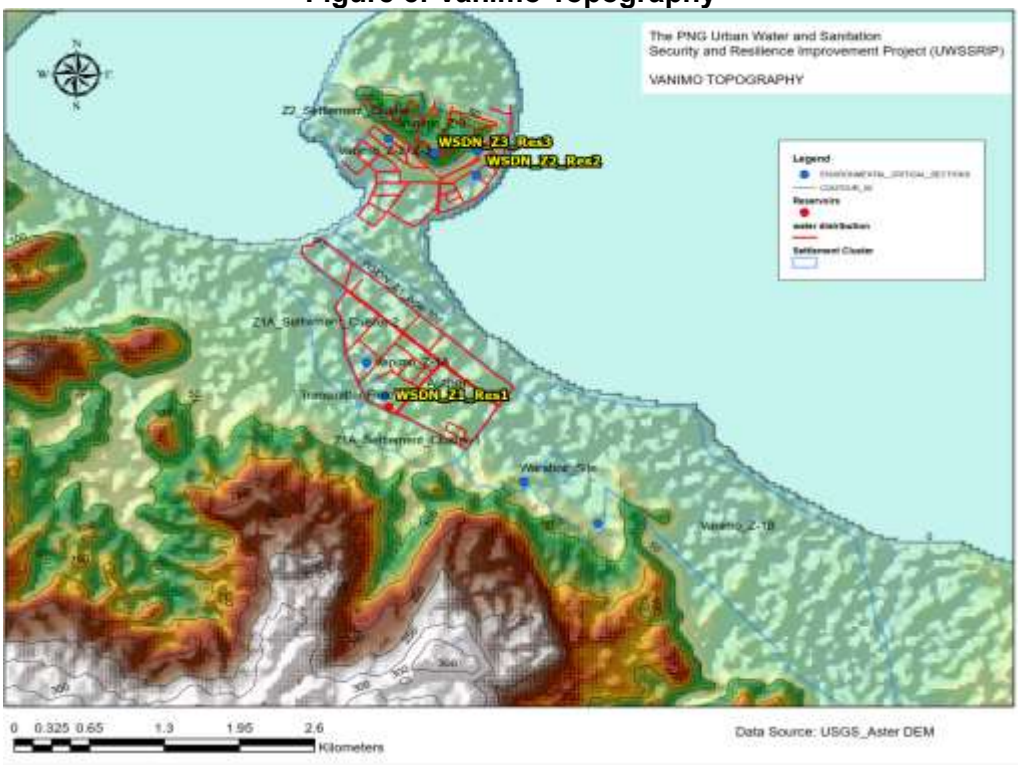
1. Geomorphological, Topographic and Geological Characteristic

37. The island of New Guinea is located right over the southwest boundary of the 'Pacific Rim of Fire'. The southwest boundary marks the frontier of the continental Indo-Australian Plate and the oceanic Pacific Plate. The convergence of the two major plates within the southwest Pacific is facilitated through several micro-plates such as the Bismarck Plate, the Solomon Plate, the Woodlark Plate, and the Caroline Plate. As a result of these numerous and continuous geotectonic events and processes the regional setting, especially the geology and the geomorphology of the West Sepik Province, is very complex. The region in particular was formed offshore and later got accreted to mainland PNG as an allochthonous formation, the subduction of the two major plates has resulted in the upthrust and emergence of volcanic formations within the hinterlands producing the Bewani and the Torricelli Mountains as well as Prince Alexander Range. Following the major geotectonic events, recent quaternary events produced surface cover sequences within the region. Most of the lowland formations in the region thus developed flood and swamp plains.

a. Topography

38. The topography of Vanimo is predominantly flat to gently sloping along the coastline, transitioning to mountainous terrain further inland (**Error! Reference source not found.**). The watershed areas surrounding the town serve a critical function as a recharge zone for Vanimo's groundwater resources, supporting both ecological balance and water supply sustainability.

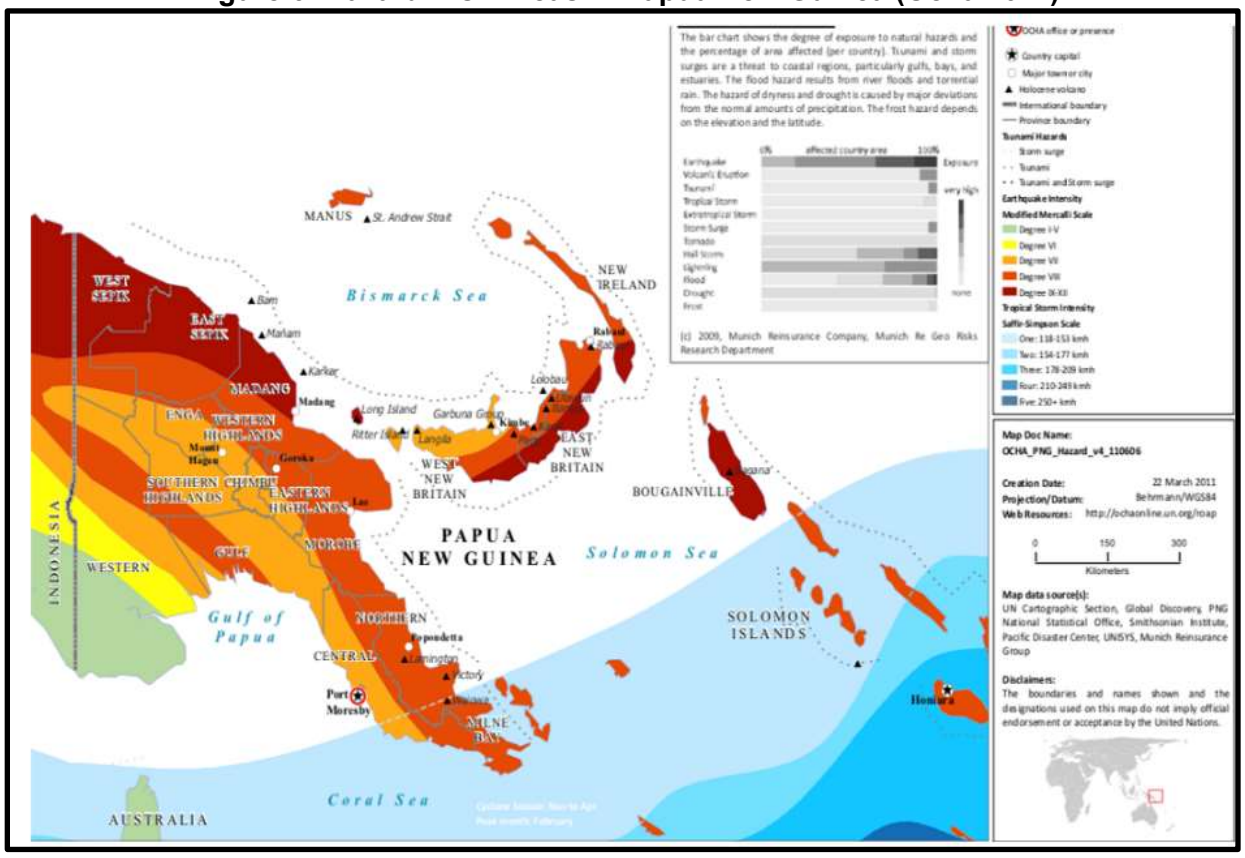
Figure 5: Vanimo Topography



b. Hazard (Nature or Induced)

39. PNG is prone to myriad natural hazards, and climate variability and change may increase their incidence. Some of these include landslides, soil erosion, deforestation, loss of biodiversity, as well an increased occurrence of recurrent floods and droughts. The hazard map, sourced from secondary data including Ocha (2011), indicates that the project area is exposed to high seismic risk. Based on the Modified Mercalli Intensity (MMI) scale, earthquake intensity in the region could reach very high levels, posing potential risks to infrastructure and public safety in the project area (**Error! Reference source not found.**).

Figure 6: Hazard Risk Areas in Papua New Guinea (Ocha 2011)



2. Climatic Regime (Rainfall, Temperature)

40. The average monthly temperature in the West and East Sepik region is 26.9 degrees Celsius, whereas the maximum and minimum monthly temperatures reach 29.8 and 22 respectively. The temperature seasonality is not strong, as temperature values (average, minimum and maximum) do not vary significantly throughout the year. The annual rainfall in the region ranges between 1850 and 2700 mm. The annual mean rainfall is 2450 mm. The peak of the rainy season is mainly between December and March, nevertheless, on average every month there is more than 100 mm of rain. Vanimo in this context experiences a tropical rainforest climate classified as Köppen Af, characterized by consistently warm to hot temperatures and high humidity (wet weather) throughout the year. The region receives substantial rainfall, with an average annual precipitation of approximately 2,601 mm (102 in).

3. Baseline Environmental Conditions – Air and Noise

41. The baseline air quality and noise monitoring locations as well as water quality (WQ) sampling stations undertaken in the project's area of influence as part of subproject site investigations are shown in **Error! Reference source not found.**.

42. **Air quality**. The parameters measured during the baseline air quality monitoring include particulate matter that is less than 10 micrometers or less in diameter (PM_{10}) and particulate matter that is less than 2.5 micrometers in diameter ($PM_{2.5}$). Particulate matter is a complex mixture of solid particles and liquid droplets in the air that are small enough to pass through the nose and throat and enter the lungs and can cause serious health effects.

43. A summary of the baseline measurement indicates that for PM_{10} this has been exceeded at South Reservoir sampling station. In the case of $PM_{2.5}$ exceedance was recorded at South Reservoir and Wara Boil sampling stations (Table 5).

Figure 7: Environmental Sampling Stations for Air, Noise, and Water

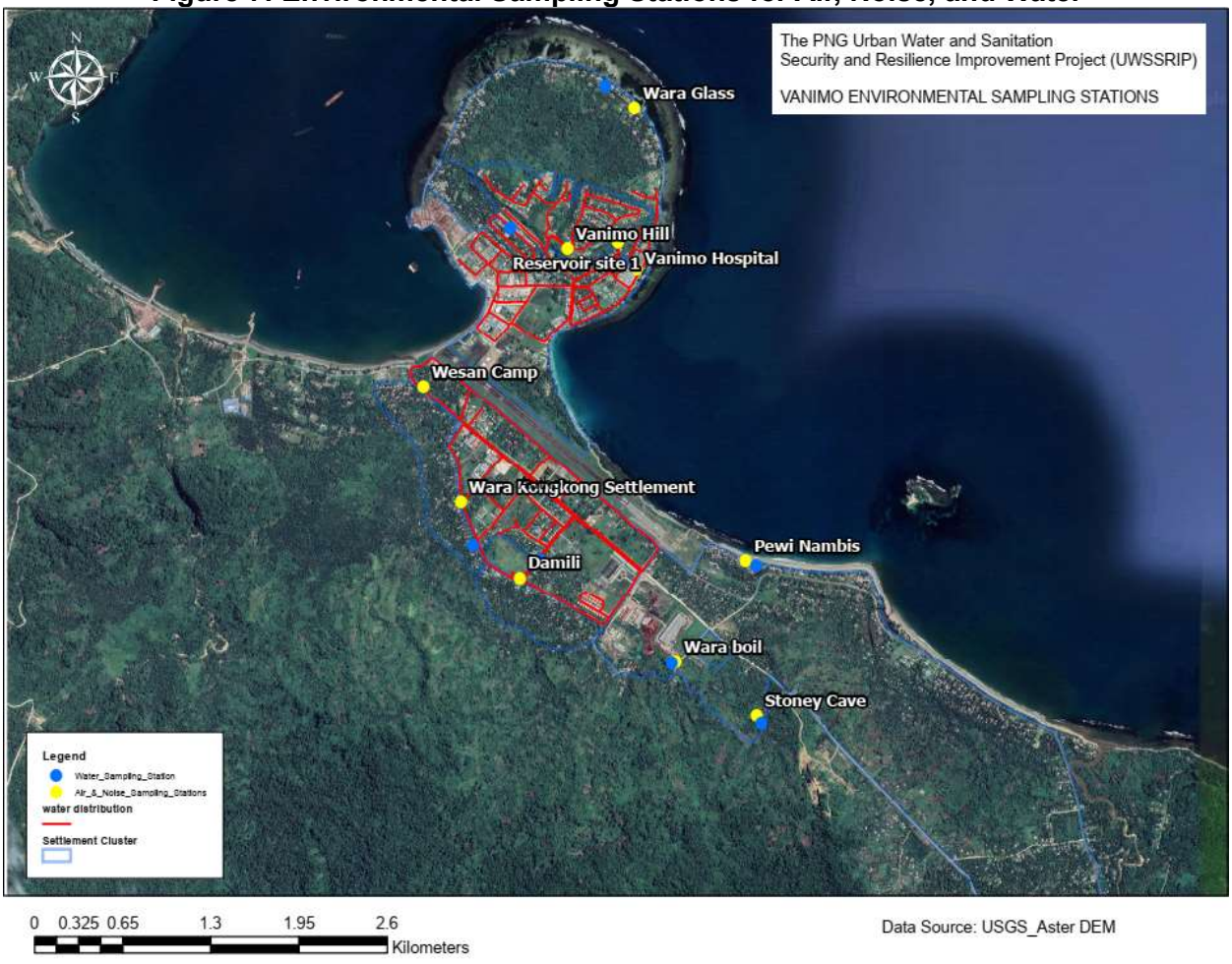


Table 5: Baseline Air Quality Monitoring Results

			Air quality results	
Parameters			PM_{10}	$PM_{2.5}$
WHO Ambient Air Quality Guidelines (24-hour)			(50 µm/m^3)	(25 µm/m^3)
Sampling Stations	Latitude	Longitude		
Stoney Cave	-2.711806611	141.3175516	3	2
South Reservoir	-2.710117028	141.3200313	51	44
Wara Boil	-2.708474444	141.3119325	44	51
Damili Junction	-2.702684778	141.3018213	2	2
Pewi Nambis	-2.701939917	141.3206781	2	2
Wara Kongkong	-2.697431889	141.2978579	3	3
Wesan Camp	-2.690513556	141.2956459	4	4
Vanimo Town -Shopping Centres	-2.683354056	141.3016996	4	3
Vanimo Hospital	-2.683	141.3086465	8	9
Reservoir 2 Site	-2.680294222	141.3083365	8	9
Vanimo Hill (Reservoir 1)	-2.680698528	141.3047613	8	8
Wara Glass	-2.669955889	141.307395	2	2

44. **Noise levels**. The baseline for noise level was measured *in-situ*, using handheld noise level equipment. As shown in Table 6, two sampling sites—South Reservoir and Wara Boil—recorded noise levels exceeding the PNG standard of ≤ 50 dB. The elevated ambient noise levels at these locations are primarily attributed to the presence of young residents and associated community activities in the surrounding area.

Table 6: Noise Level Results

Sampling Stations	Latitude	Longitude	Noise Level (Dba)	PNG standards
Stoney Cave	-2.711806611	141.3175516	33.6	≤ 50 dB
South Reservoir	-2.710117028	141.3200313	55.4	
Wawa Boil	-2.708474444	141.3119325	55.5	
Damili Junction	-2.702684778	141.3018213	44.6	
Pewi Nambis	-2.701939917	141.3206781	46.5	
Wara Kongkong	-2.697431889	141.2978579	45.7	
Wesan Camp	-2.690513556	141.2956459	46.7	
Vanimo Town	-2.683354056	141.3016996	46.8	
Vanimo Hospital	-2.683	141.3086465	46.7	
Reservoir 2 Site	-2.680294222	141.3083365	46.8	
Vanimo Hill (Reservoir 1)	-2.680698528	141.3047613	38.7	
Wara Glass	-2.669955889	141.307395	32.5	

4. Baseline for Surface Water Quality (PNG Water Quality Standards)

45. ***In-situ* baseline–physical and chemical.** *In situ* water quality measurements were taken using handheld monitoring equipment. The parameters measured include temperature, pH, TDS (Total Dissolved Solids), DO (Dissolved Oxygen) and Salinity. Exceedances from the PNG standards were recorded for DO for all the sampling stations recording a value of <6.5 mg/L except for Stoney Cave and Wara Kongkong Creek (Table 7). Low DO values indicate that aquatic organisms specially fishes will find the environment uninhabitable.

Table 7: *In-situ* Water Quality Baseline Results

	Location		Water Quality Parameters				
Sampling location	Latitude	Longitude	Temperature	pH	TDS (ppm)	DO	Salinity (%)
Stoney Cave	-2.711796139	141.317554	28.2	7.96	286	6.7	0.02
Wara Boil	-2.708475583	141.3119375	26.5	7.31	263	4.1	0.01
PEWI 1	-2.701898806	141.3184606	29.6	6.86	226	5.1	0.02
PEWI 2	-2.701904167	141.3189702	27.9	6.74	302	5.1	0.03
PEWI 3	-2.702049	141.3195228	28.6	6.6	301	5.2	0.02
PEWI 4	-2.702547889	141.3187396	28.1	7.29	303	5.1	0.02
Damili Well	-2.701617889	141.303023	27.3	7.4	203	5.1	0.01
Wara Kongkong Creek	-2.700844333	141.2984426	26.8	7.58	308	7.8	0.02
Stream (Hospital)	-2.681696028	141.3086563	27.2	7.5	286	4.7	0.02
Wara Glass	-2.672013028	141.3064312	27.2	7.6	286	4.7	0.02
WHO/PNG Guidelines & Standards			**No alteration greater than 2^0C**	**6.5-8.5**	**≤500 mg/L**	**≤6.5 mg/L**	**<600MG/L**

* - PNG water quality standards

** - based on WHO Water Quality Guideline

46. **Laboratory analysis**. Water quality analysis was conducted in accordance with the PNG Drinking Water Standards. Results indicate that most of the parameters remain within acceptable limits, including those for heavy metals, as detailed in Table 8. The most significant exceedances were observed in E. coli and Faecal coliform levels. In six water samples, E. coli levels exceeded the standard by over 1,500%, while Faecal coliform levels reached 200 MPN/100mL, far above the permissible limit. E. coli is a type of coliform bacteria commonly found in the intestines of animals and humans. Faecal coliform serves as a more specific indicator of faecal contamination. The presence of E. coli in drinking water indicates recent faecal contamination and suggests a potential risk of harmful bacteria or pathogenic microorganisms, posing a serious public health concern. An exceedance in turbidity was recorded at one sampling station. However, this is not a major concern, as elevated turbidity in surface water is a natural occurrence in PNG, often due to sediment runoff during rainfall.

47. Two samples showed exceedances in Antimony levels. Given the absence of industrial activity at the sampling sites, the likely source is natural soil erosion. While naturally occurring, antimony in drinking water must be carefully monitored as prolonged exposure can lead to a number of health problems including diarrhea, stomach ulcers as well as damage to heart, lungs, liver, and blood. It is therefore recommended that further water quality testing be conducted on boreholes to be developed for the project, to ensure compliance with safety standards and to mitigate potential health risks.

Table 8: Water Quality Laboratory Analysis Results Sampled on 14 June 2024

	Measurement Unit	Stoney Cave	Wara Boil	Pewi Well 1	Pewi Well 2	PNG Drinking Water Standard
Test Description	Units	Results of Parameters sampled on site				
pH (Lab)	pH Units	7.7	7.6	7.4	7.6	*5-9.2*
Temperature (Lab)	°C	24	24	24	24	No alteration greater than 2°C (for both fresh and seawater)
Turbidity (Lab)	NTU	0.44	0.77	0.34	0.49	<0.5 NTU
True Color	PtCo	<5.0	<5.0	<5.0	<5.0	50 units
Taste	Report	Not Objectionable	Not Objectionable	Not Objectionable	Not Objectionable	Unobjectionable
Odor	Report	Not Objectionable	Not Objectionable	Not Objectionable	Not Objectionable	Unobjectionable
Free Chlorine	mg/L	<0.10	<0.10	<0.10	<0.10	0.005 at pH 6
Total Chlorine	mg/L	<0.10	<0.10	<0.10	<0.10	0.005 at pH 6
Total Dissolved Solids, TDS	mg/L	240	230	170	280	1, 500 mg/L
Total Suspended Solids, TSS	mg/L	<5.0	<5.0	<5.0	<5.0	*25 units*
Mineral Oils	mg/L	<0.010	<0.010	<0.010	<0.010	1 mg/L
Total Hardness	mg/L	44.0	40.0	39.0	36.0	*600 mg/L (CaCo3)*
Chloride	mg/L	<5.0	<5.0	<5.0	<5.0	*1, 000 mg/L*
Fluoride	mg/L	0.20	0.26	1.4	0.96	5 mg/L
Sulphate	mg/L	<2.0	<2.0	<2.0	<2.0	400 mg/L
Nitrate	mg/L	0.70	0.60	3.9	2.7	50 mg/L
Cyanide	mg/L	0.0090	0.0090	0.0030	0.0040	0.05 mg/L
Total Coliforms	MPN/100 mL	>2,000	>2,000	>2,000	>2,000	20,000 per 100ml
E_Coli	MPN/100 mL	0	>2,000	>2,000	1,986	0 in 100ml
Faecal Coliforms	MPN/100 ml	0	344	416	127	>10 per 100ml
Total Calcium	mg/L	11.0	10.0	9.8	10.0	*75 mg/L*
Total Magnesium	mg/L	4.1	3.7	3.6	2.7	*150 mg/L*
Total Aluminum	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.1-0.2 mg/L
Total Antimony	mg/L	0.011	<0.0030	<0.0030	0.010	0.006 mg/L
Total Arsenic	mg/L	<0.0060	<0.0060	<0.0060	<0.0060	0.05 mg/L
Total Cadmium	mg/L	0.0012	<0.00020	0.00075	0.0011	0.01 mg/L
Total Chromium	mg/L	0.0038	0.0019	<0.0010	<0.0010	0.05
Total Cobalt	mg/L	<0.0010	<0.0010	0.0011	<0.0010	Limit of delectability (for both fresh and seawater)
Total Copper	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	*5 mg/L*
Total Iron	mg/L	0.0020	0.018	0.027	0.10	1 mg/L
Total Lead	mg/L	<0.0020	<0.0020	0.0020	<0.0020	0.10 mg/L
Total Manganese	mg/L	0.0013	0.0026	0.0051	0.14	0.5 mg/L
Total Selenium	mg/L	<0.010	<0.010	<0.010	<0.010	0.01 mg/L
Total Silver	mg/L	0.039	0.037	0.011	0.012	0.05 mg/L

	Measurement Unit	Stoney Cave	Wara Boil	Pewi Well 1	Pewi Well 2	PNG Drinking Water Standard
Test Description	Units	Results of Parameters sampled on site				
Total Tin	mg/L	<0.030	<0.030	<0.030	<0.030	0.5
Total Zinc	mg/L	0.031	<0.0010	0.0053	0.022	*15 mg/L*
Total Mercury	mg/L	$<1.0 \times 10^{-5}$	$<1.0 \times 10^{-5}$	$<1.0 \times 10^{-5}$	$<1.0 \times 10^{-5}$	0.001 mg/L
	Sample Description	Pewi Well 3	Pewi Well 4	Damili Well 1	Vanimo Hospital	PNG Drinking Water Standard
Test Description	Units	Results of Parameters sampled on site				
pH (Lab)	pH Units	7.4	7.6	7.2	7.5	*5-9.2*
Temperature (Lab)	°C	24	25	25	25	No alteration greater than 2C (for both fresh and seawater)
Turbidity (Lab)	NTU	0.75	4.6	17.0	1.2	<0.5 NTU
True Color	PtCo	<5.0	12.0	29.0	13.0	50 units
Taste	Report	Not Objectionable	Not Objectionable	Not Objectionable	Not Objectionable	Unobjectionable
Odour	Report	Not Objectionable	Not Objectionable	Not Objectionable	Not Objectionable	Unobjectionable
Free Chlorine	mg/L	<0.10	<0.10	<0.10	<0.10	0.005 at pH 6
Total Chlorine	mg/L	<0.10	<0.10	<0.10	<0.10	0.005 at pH 6
Total Dissolved Solids, TDS	mg/L	250	250	92	230	1, 500 mg/L
Total Suspended Solids, TSS	mg/L	<5.0	9.0	18.0	10.0	*25 units*
Mineral Oils	mg/L	<0.010	<0.010	<0.010	<0.010	1 mg/L
Total Hardness	mg/L	41.0	38.0	32.0	42.0	*600 mg/L (CaCo3)*
Chloride	mg/L	<5.0	<5.0	<5.0	<5.0	*1, 000 mg/L*
Fluoride	mg/L	0.070	0.073	0.070	1.0	5 mg/L
Sulphate	mg/L	<2.0	<2.0	<2.0	<2.0	400 mg/L
Nitrate	mg/L	2.3	4.2	5.9	3.0	00 mg/L
Cyanide	mg/L	0.0060	0.018	0.012	0.011	0.05 mg/L
Total Coliforms	MPN/100 mL	>2,000	>2,000	>2,000	>2,000	20,000 per 100ml
E_Coli	MPN/100 mL	0	921	>2,000	435	0 in 100ml
Faecal Coliforms	MPN/100 ml	0	33	288	54	>10 per 100ml
Total Calcium	mg/L	11.0	9.9	9.5	11.0	*75 mg/L*
Total Magnesium	mg/L	3.3	3.2	2.1	3.6	*150 mg/L*
Total Aluminum	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.1-0.2 mg/L
Total Antimony	mg/L	0.0050	<0.0030	<0.0030	<0.0030	0.006 mg/L
Total Arsenic	mg/L	<0.0060	<0.0060	<0.0060	<0.0060	0.05 mg/L
Total Cadmium	mg/L	<0.00020	0.0061	0.00025	<0.00020	0.01 mg/L
Total Chromium	mg/L	0.0019	0.0018	<0.0010	0.0012	0.05
Total Cobalt	mg/L	0.011	<0.0010	0.0019	<0.0010	Limit of delectability (for both fresh and

	Measurement Unit	Stoney Cave	Wara Boil	Pewi Well 1	Pewi Well 2	PNG Drinking Water Standard
Test Description	Units	Results of Parameters sampled on site				
						seawater)
Total Copper	mg/L	<0.0020	<0.0020	0.0028	<0.0020	*5 mg/L*
Total Iron	mg/L	1.0	1.0	1.5	0.072	1 mg/L
Total Lead	mg/L	<0.0020	<0.0020	<0.0020	0.0057	0.10 mg/L
Total Manganese	mg/L	0.058	0.17	0.35	0.0086	0.5 mg/L
Total Selenium	mg/L	0.010	<0.010	0.010	<0.010	0.01 mg/L
Total Silver	mg/L	0.011	0.012	0.012	0.015	0.05 mg/L
Total Tin	mg/L	<0.030	<0.030	<0.030	<0.030	0.5
Total Zinc	mg/L	0.017	0.027	0.018	0.011	*15 mg/L*
Total Mercury	mg/L	$<1.0 \times 10^{-5}$	$<1.0 \times 10^{-5}$	$<1.0 \times 10^{-5}$	$<1.0 \times 10^{-5}$	0.001 mg/L

48. **Pollution sources**. At present, there are no pollutive industries in Vanimo that could impact the water distribution system. However, potential pollution sources include undifferentiated solid waste generated by hotels, households, restaurants and other establishments which are disposed of at the municipal dumpsite and the possible biohazardous waste from the Vanimo General Hospital, which poses a potential risk if not properly managed. The limited availability of sanitary facilities in Vanimo could become a significant concern in the future, especially with anticipated population growth due to in-migration linked to the proposed Frieda Gold and Copper Project. Without adequate infrastructure, this increase could elevate public health risks, particularly related to waterborne diseases and sanitation-related illnesses. The provincial health center has reported high morbidity rates for waterborne diseases, particularly during the dry season. Estimates suggest between 150 to 300 cases per 1,000 children, although many cases are likely underreported. This underscores the urgent need for improved water quality monitoring, sanitation infrastructure, and public health interventions.

5. Seasonal Groundwater Quality

49. The water balance of the watershed was estimated employing the BROOK90 hydrologic model (Federer, 2002, Federer *et al.*, 2003). Hydrological modeling becomes an indispensable tool and cost-effective process to understand the movement of water loss in the watershed. The BROOK90 model has a strong physically-based description, which simulates the above and below liquid phases of the precipitation–evaporation-streamflow-ground water flow part of the hydrological cycle for a point scale stand at a daily time-step. Mathematically, the BROOK90 model water distribution is expressed as follows:

$$P = EVAP + FLOW + SEEP$$

where P is the precipitation (mm), EVAP is the evaporation (mm), FLOW is the corresponding simulated total streamflow (mm) derived from surface flow and the ground water flow, and SEEP is the deep seepage loss from ground water (mm).

50. **The water balance distribution of the Vanimo Watershed**. Precipitation is the immediate source of all water entering the land phase of all hydrologic cycles. The average annual rainfall for the ten years (2014-2023) was 2,373 mm. On a yearly basis, approximately 45% of the precipitation turned into evaporation, 41% became streamflow, and 14% into deep seepage loss. Most precipitation remains in streamflow, mainly through surface and groundwater flows. The canopy, the understory, and ground vegetation intercepted a portion of rain falling on a watershed and then evaporated back into the atmosphere. e

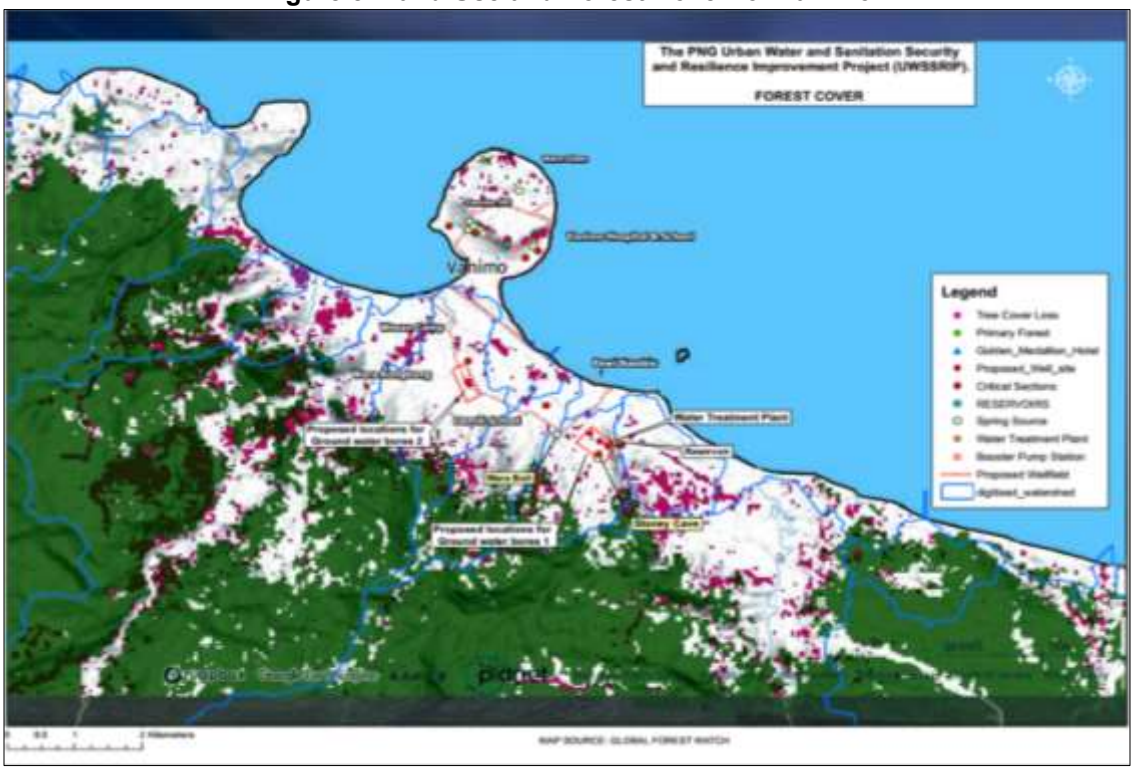
51. The total seepage loss estimated was about 340 mm for the ground component. The distribution of hydrologic components is primarily reflected in a pronounced seasonal variation and the fluctuating patterns in precipitation. It can be seen that the mean monthly streamflow also fluctuates up and down, closely following that of the mean monthly rainfall. However, streamflow during the earlier months was higher because of the groundwater saturation and strongly responded to high rainfall events. An average streamflow of 82 mm was accounted for by a distinct peak flow in January (150 mm), while the lowest was recorded in October (38 mm). The groundwater flow and seepage have analogous patterns, with a high flow from June to September and a little decline for the rest of the year. Overall, there is a continuous streamflow throughout the year, and its fluctuation pattern directly depends on the amount of precipitation in the watershed.

B. Biological Environment

1. Land Use

52. The majority of the project site is composed of built-up areas, including residential zones, business establishments, and the airport runway. These developments place increasing pressure on the surrounding watershed, which plays a critical role in protecting and replenishing ground water resources–the primary source of water for the project. While the project site itself consists of built-up areas, the surrounding forest cover remains along the watershed fringes, providing essential ecological functions (**Error! Reference source not found.**). In migration to Vanimo has been observed and is expected to continue, driven by economic opportunities and regional development. This trend is placing growing pressure on land use, natural resources, and infrastructure capacity, underscoring the need for sustainable planning and resource management to mitigate future environmental and social impacts.

Figure 8: Land Use and Forest Cover for Vanimo



2. Flora and Fauna

53. The sampling stations for the flora and fauna assessment was conducted in the fringes of the watershed as illustrated in **Error! Reference source not found.** and detailed in Table 9. However, due to ongoing in-migration and land use changes, many native species of flora and fauna have been removed or exploited, which may result in reduced biodiversity in the surveyed areas. The identified flora and fauna species are based on tree identification and local key informant interviews respectively.

Table 9: Flora and Fauna Sampling Sites

ID	Name	Latitude	Longitude	Description
1	Wara Glass	-2.67112997	141.30671413	Spring outflow area, Sago palms are common in the area. The spring has a continuous flow all year round and is accessed by the residents for drinking and other domestic uses.
2	Wesan Camp	-2.69198683	141.29469784	This site is inhabited by the settlers moving in from Osim, Osol and Bewani. These is no significant forest cover in this area as it has been occupied by the human settlement. Trees common in the area are the rain tree (*Samanea saman*) and regrowth of *Piper aduncum* (wild daka). Coconut palms were also planted for domestic use.
3	Wara Kongkong	-2.69773749	141.29589947	This site is inhabited by the settlers moving in from Lumi, Green River and Nuku. These is no significant forest cover in this area as it has been occupied by the human settlement. Trees common in the area are the rain tree (*Samanea saman*) and regrowth of *Piper aduncum* (wild daka). Coconut palms were also planted for domestic use.
4	Damili	-2.70280150	141.30087765	This site is inhabited by the settlers moving in from Lumi, Green River and Nuku. These is no significant forest cover in this area as it has been occupied by the human settlement. Trees common in the area are the rain tree (*Samanea saman*) and regrowth of *Piper aduncum* (wild daka). Coconut palms were also planted for domestic use.
5	Wara Boil	-2.70880964	141.31049069	This site is inhabited by the settlers moving in from Lumi, Green River and Nuku. These is no significant forest cover in this area as it has been occupied by the human settlement. Trees common in the area are the rain tree (*Samanea saman*) and regrowth of *Piper aduncum* (wild daka) and Kunai Grass (*Imperata cylindrica*). Coconut palms were also planted for domestic use.
6	Stoney Cave and Proposed wellfield 1	-2.71189955	141.31049069	This site is inhabited by the settlers moving in from Yangkok. These is no significant forest cover in this area as it has been occupied by the human settlement. Trees common in the area are the rain tree (*Samanea saman*) and

ID	Name	Latitude	Longitude	Description
				regrowth of *Piper aduncum* (wild daka) and Kunai Grass (*Imperata cylindrica*). Coconut palms were also planted for domestic use. There are also patches of sago palms within the area.

Figure 9: Flora and Fauna Sampling Sites

Table 10: Bird Species Observed at the Project Site

	
Dwarf Cassowary (*Casuarius Bennetti*). Due to human settlement along the site, these bird species have migrated further inland from the project site.	Columbidae (Bronze ground Dove) – (*Alopecoenas beccari*). Feeds on fallen fruits and nuts which are abundant in the forest further inland from the human settlement, however sightings of this birds are common whenever there is a season of ripe fruits in the settlements.
	
Papuan Eagle (*Harpyopsis novaeguineae*)	Long-billed Honeyeater (*Melilestes megarhynchus*)

New Guinea Bronzewing (*Henicophaps albifrons*)

MacGregor's Bowerbird (*Amblyornis macgregoriae*)

Papuan Logrunner (*Orthonyx novaeguineae*)

Sclater's Whistler (*Pachycephala soror*). These birds come around in search of food around the human settlement whenever the laulau fruits are ripe.

Magnificent Bird-of-paradise (*Diphyllodes magnificus*). These birds of Paradise have migrated further inland from the human settlements due to continuous exploitation by human	Palm Cockatoo (*Probosciger aterrimus*) - Locally known as the Black Cockatoo.
	
Papuan King Parrot (*Alisterus chloropterus*)	Blyth's Hornbill (*Rhyticeros plicatus*)

Table 11: Mammals Observed at the Project Site

	
Goodfellow's Tree Kangaroo (*Dendrolagus goodfellowi*). Used as food during special occasions. It is now a valuable food source and is sold for a good sum of money.	Raffray's Bandicoot (*Peroryctes raffrayana*). It is also a food source for the locals.

	
Eastern White-eared Giant Rat. (*Hyomys goliath*)	Slender Rat. (*Rattus verecundus*)
	
Feral Pig (*Sus scrofa*). Used as food during special occasions. It is now a valuable food source and is sold for a good sum of money. Due to continuous human exploitation, these animals have now moved further inland	New Guinea Fruit Bat (*Dobsonia magna* or *Dobsonia moluccensis magna*).

Table 12: Local Fish Species Observed at the Project Site

	
Freshwater Lungfish (*Epinephelus polystigma*) - Local name is Kastor. This is an introduced fish species and is an invasive fish species. The presence of this fish has diminished as all other local fish population.	Flathead catfish (*Platycephalus fuscus*) This is also an introduced fish species (Fresh water fish). It is also being used as a protein source by the locals

Table 13: Flora Species Observed at the Project Site

	
Rain tree (*Samanea saman*)	Spike pepper (*Piper aduncum*) or wild daka
	

Kunai Grass (*Imperata cylindrica*)	Watery rose apple (*Syzygium aqueum*) is a tropical tree grown for its edible pear-shaped fruit.
	
Noni (*Morinda citrifolia*). A medicinal plant	Edible Banana (*Musa acuminata*)-a staple food source in the area
	
Coconut palm (*Cocos nucifera*). Grown for domestic uses.	Tulip Leaves (*Gnetum gnemon*) Edible leaves

	
Kwila Tree (*Intsia bijuga*) used as a building material. (pic: png Buzz)	Okari Nut tree (*Terminalia kaernbachii*). Produces edible nuts, which the locals consume or sell. (pic: png Buzz)
	
Eucalyptus trees (*Eucalyptus deglupta*) Commonly used as building material. (pic: png Buzz)	

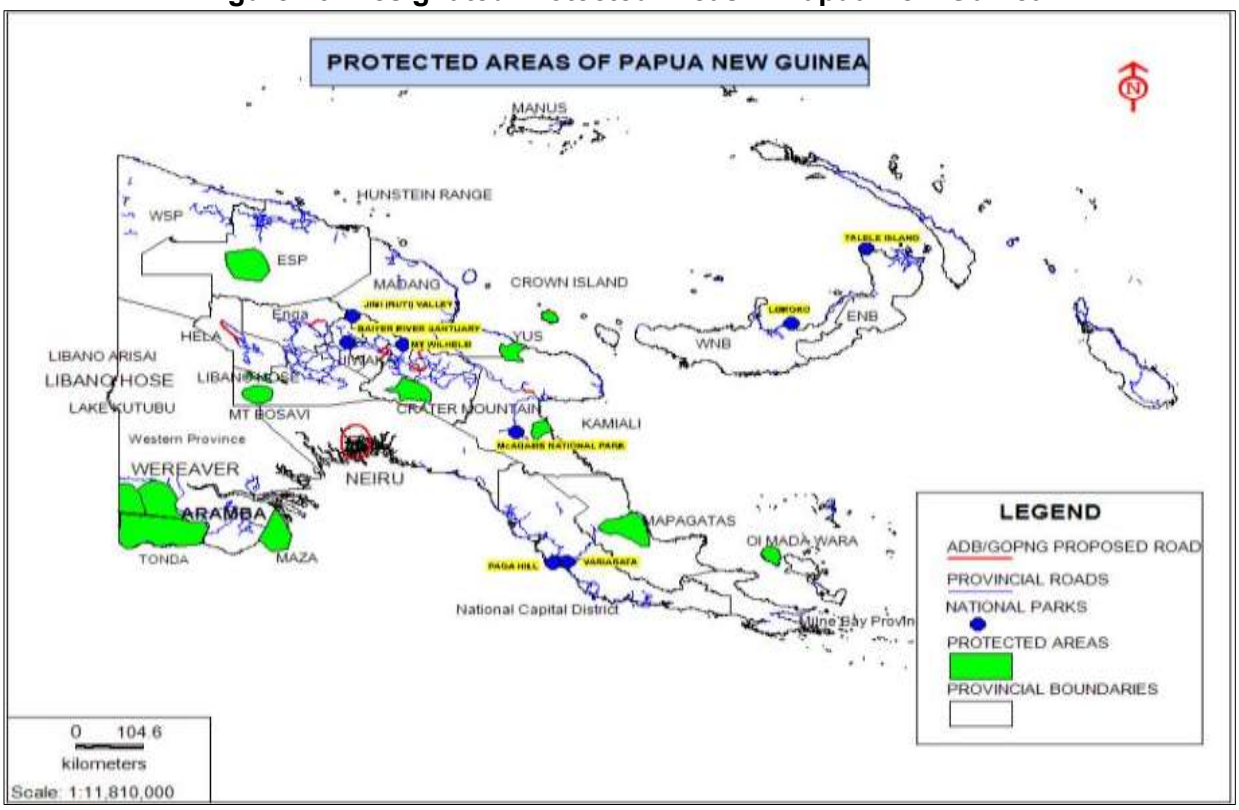
Source: Photographs from Identification-Guide-to-Flora-and-Fauna-of-Hides-Ridge and PNG Buzz.

3. Protected Areas

54. Designated protected areas are located at a considerable distance from the project site, as shown in **Error! Reference source not found.**. The nearest protected areas include the West Bewani Mountains Key Biodiversity Area (KBA) and the East Bewani Key Biodiversity Area, both illustrated in

55. .

Figure 10: Designated Protected Areas in Papua New Guinea



4. Special Purpose Area

56. PNG's International Trade and Investment Office has proposed the establishment of Free Trade Zones (FTZs) under the Special Economic Zone policy. The proposed FTZ initiative offers attractive incentives targeting Vanimo and other designated zones, including corporate tax exemptions through extended tax holidays. However, to successfully attract investors to Vanimo FTZ, it is essential to develop critical infrastructure and create a business-friendly environment.

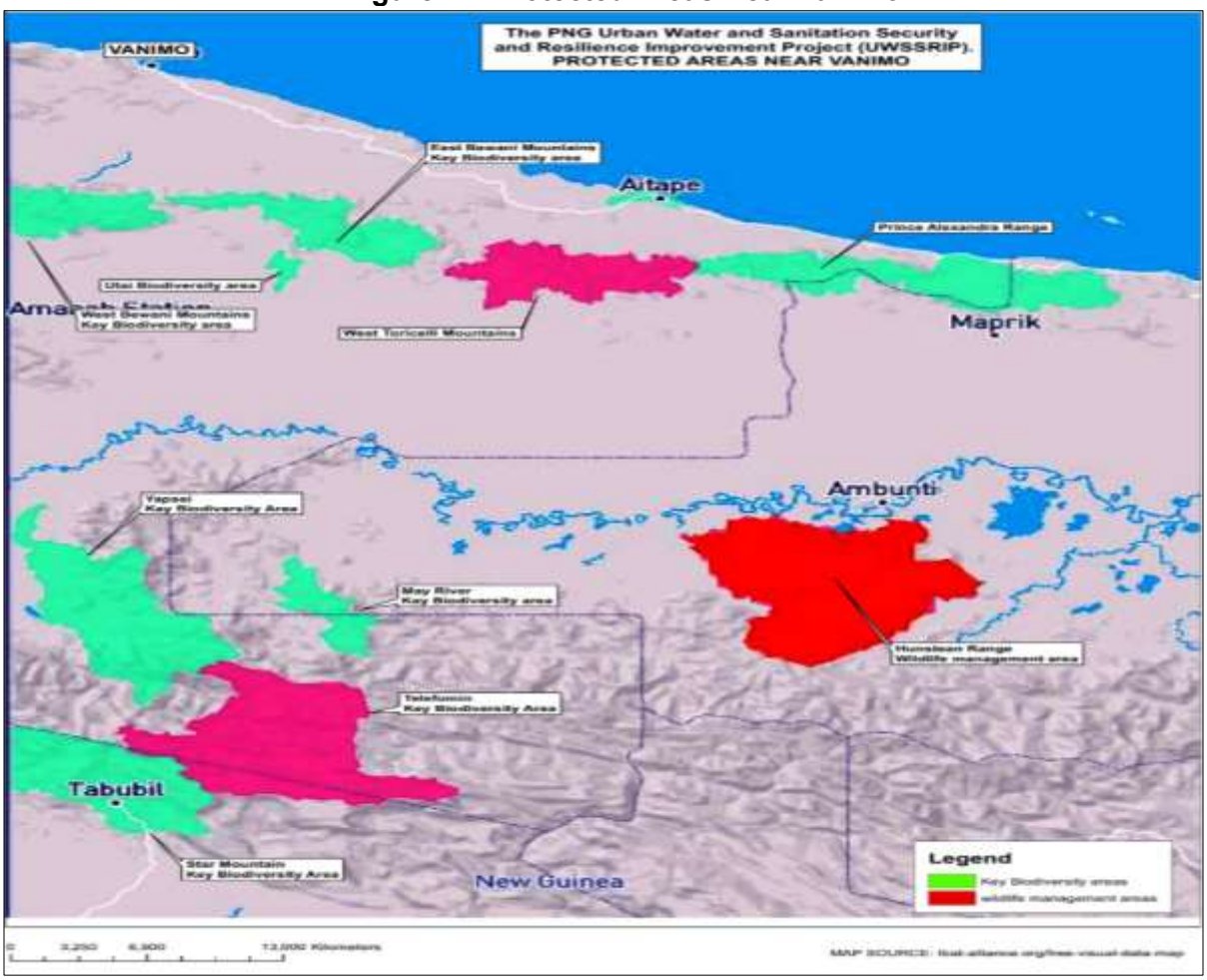
5. Aquatic and Terrestrial Ecology of the Area

57. The aquatic and terrestrial flora and fauna are predominantly composed of introduced or invasive species. No endangered or threatened species were identified in accordance with the IUCN Red List.

6. Information on Vulnerable and Endangered Species

58. Risk screening conducted for the Vanimo subproject indicated a very low likelihood of encountering endangered or critically endangered terrestrial and aquatic species at the project sites. No vulnerable or endangered species were identified within the subproject areas.

Figure 11: Protected Areas Near Vanimo



C. Socioeconomic Environment

1. Economy and Livelihoods

59. Vanimo township serves as a hub for the timber industry, hosting sawmills and a port that facilitates overseas shipment of timber. In the late 1990s, an industrial and commercial free-trade zone was established at Vanimo, offering exemptions from import and export duties. By the early 21st century, the zone began attracting foreign investments prompting planned infrastructure upgrades in the port area. The biggest employer in the region is Vanimo Forest Products Co. Log exports from West Sepik which peaked in 2007 and 2010, with volumes of 291,623 m3 and 289,853 m3, respectively. However, from 2013 to 2022, log exports have declined to almost nil based on the government's forest website. The other crops present in the area include some copra that is produced along the coast with some subsistence fishing activities. Agricultural activity in Vanimo is for subsistence with some crops reaching the market mostly bananas, mango, and leafy vegetables. The UN-FAO has initiated a cocoa and vanilla export depot project to export these commodities that are intended to support more than 20,000 vanilla and cocoa farming households. Fisheries are an important source of revenue for the city with dried sea cucumber being processed and exported by a local company. Fishery processing facilities including cold

storage have also been established. Tuna processing has been proposed and could contribute further to the local economy.

60. It is noted that with the proposed establishment of Vainimo as a FTZ under the Special Economic Zone policy. The proposed water supply system is designed to meet the projected population demand through to 2040. However, this projection does not cover informal settlers and households located outside the planned network coverage. Provision for future expansion of the system to cover housing and network expansion will be considered and design provision for this expansion will be incorporated into the design when considered economic to do so.

2. Population and Demography

61. Estimates of the population were determined from the 2019 feasibility study and from historical census data available at the time, as collected by the PNG National Statistics Office. The census data has not been updated for use in this report, and this remains the best source of population data available at this time. Census figures for population and dwelling numbers in the Vanimo Urban Local Level Government (LLG) area are available for 2000 and 2011 and provide some guidance on growth rates. The 2019 population data study is presented in Table 14.

Table 14: Historical Population Growth

Census Data	2000 Census	2011 Census	Change	Growth (% pa)
Households	1,850	2,370	+520	2.3%
Population (Total)	9,778	13,970	+4,192	3.3%
Population (Male)	5,437	7,404	+1,967	2.8%
Population (Female)	4,341	6,566	+2,225	3.8%
Average Household Size	5.3	5.9	+0.6	-

62. The estimated 2023 population and projections for 10 and 20 years are shown based on the 2011 census baseline and growth rate from 2000 to 2011. The growth rates between the 2000 and 2011 census periods have been used to project the population of Vanimo out to 2038 for planning purposes as shown in Table 15.

Table 15: Population Projection

Population	**Estimated 2023**	**+10 years (2028)**	**+20 years (2038)**
TOTAL POPULATION	20,625	24,261	33,566
Housing (25%)	*5,156*	*6,065*	*8,392*
Housing (Villages / Settlements)	*15,469*	*18,195*	*25,175*

63. The detailed age- and gender-disaggregated data from the 2024 PNG Census for provinces or towns (including Vanimo/West Sepik) are not yet publicly available. According to the National

Statistical Office, the full census process is still underway, and comprehensive data releases at subnational levels have not been published. Based on the most recent estimates and projections, while acknowledging these are not final figures from the 2024 census, the population of East Sepik Province is estimated to exceed 250,000. The projected figure for 2025 ranges between 280,000 and 310,000 people, consistent with the country's historically high population growth rate of around 2–3% annually. Vanimo's current population is projected at 12,893. Of these, approximately 51% are male and 49% are female. The average age in Vanimo is 23 years. The number of children under the age of four is estimated at 1,522, comprising 735 girls and 787 boys.

3. Poverty

64. According to the United Nations Development Programme (UNDP), Papua New Guinea's Multidimensional Poverty Index (MPI) in 2019–2020 was 0.263. At that time, around 37.8% of the population were classified as multidimensionally poor, facing deprivation across key areas such as health, education and living standards.[9] The 2009 Household Income and Expenditure Survey (HIES) reported that roughly 37% of the population lived below the national income poverty line. No more recent income-specific data are available at the provincial or Vanimo level.[10] Poverty in PNG is largely a rural issue, with most people relying on subsistence agriculture. In West Sepik Province, many residents live in remote communities along the Sepik River, in mountainous regions or informal settlements. These households often face limited access to safe drinking water, proper sanitation, electricity, quality education and health care—conditions that place them in a state of high vulnerability. Overall, poverty remains widespread, with an estimated 23% of households living below the basic need's threshold.[11]

4. Water Demand Projections

65. As noted, one of the key findings of the review of the 2019 feasibility study, based on consultations with Water PNG and the Vanimo local administration, was the scope of the proposed distribution network. The 2019 feasibility study proposed a scope of the distribution network to cover a large area, servicing areas outside the formal township and covering a school south of the town. However, this extension was deemed high-cost, and due to budget constraints under Subproject 1A, it was agreed to implement the water supply network in stages. The limited budget also restricts the inclusion of a sanitation infrastructure component, which would typically follow a water supply project. This component is expected to be addressed in future development plans for Vanimo. The following summarizes the rationale behind the scope reduction following the feasibility study appraisal:

(i) Evidence existing from similar regional town water supply projects is that an over investment in the scale of new water supply infrastructure is likely inefficient,
(ii) that a staged approach to the development is recommended in order to have a progressive uptake of new customers as the network expands into peri urban areas.
(iii) Inflation and cost against overall program budget.

66. Vanimo's population growth is summarized below from the 2019 feasibility study and has not been updated due to a lack of new census information.

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[9] UNDP. Multidimensional Poverty Index (MPI) https://hdr.undp.org/content/2024-global-multidimensional-poverty-index-mpi#/indicies/MPI . Accessed June 27, 2025.

[10] National Statistical Office – PNG Household Income and Expenditure Survey, https://www.nso.gov.pg/census-surveys/household-and-income-expenditure-survey/ . Consulted on June 27, 2025.

[11] World Bank Group. Papua New Guinea Economic Update . https://documents1.worldbank.org/curated/en/316811468146072921/pdf/PID-Appraisal-Print-P155087-04-05-2016-1459829496403.pdf . Accessed June 27, 2025.

(i) 2018 – 17,500
(ii) 2023 – 20,500
(iii) 2028 – 24,300
(iv) 2038 – 33,500

67. The water demand forecast, expressed in liters per person, per day, is considered reasonable, with a figure of 125L/person/day adopted for residential and formal housing areas. Based on this estimate, the current average daily demand is calculated at approximately 1.43 million liters per day (ML/d). Following the revised project scope and updated water demand assessment, the current population and demand estimates are presented in Table 16.

5. Health and Education

68. Life expectancy in Papua New Guinea has gradually improved over recent decades, though it remains well below the global average. By 2025, life expectancy at birth is projected to be between 65.3 and 66.5 years—approximately 63.4 to 64.5 years for men and 67.4 to 68.5 years for women. There is no disaggregated data available for Vanimo specifically. However, given the persistent burden of infectious diseases, limited access to healthcare, and challenges related to infrastructure and sanitation, local life expectancy may be somewhat lower than the national average. Waterborne diseases remain a critical concern. In 2019, the mortality rate from diarrhoeal illness linked to unsafe drinking water and poor sanitation was estimated at 24.9 deaths per 100,000 people.[12] Cholera has also recurred periodically in the region.[13] Health outcomes in Vanimo and across West Sepik Province should be viewed within the broader national context, as available statistics for provincial or municipal levels are scarce. The region continues to grapple with high prevalence rates of malaria, tuberculosis, HIV/AIDS, diarrhoeal illnesses, and other vector-borne diseases. Maternal and infant mortality rates remain elevated—largely driven by malnutrition, limited prenatal care, and a shortage of skilled birth attendants. While communicable diseases are dominant, non-communicable conditions such as diabetes and hypertension are also steadily on the rise.[14]

69. Education in Papua New Guinea, particularly in rural areas like the Sepik region, continues to face significant challenges in both access and quality. The rollout of the new education system is hindered by poor infrastructure, a shortage of trained teachers, limited classroom resources, inadequate sanitation facilities, and underinvestment in teacher development. Due to low levels of public funding, these issues have a direct impact on learning outcomes. In West Sepik Province, there are 531 elementary schools and 255 primary schools, operated either by the government or faith-based organisations known as Agency Schools. While some schools are located in more accessible areas, others—such as those on isolated islands in the Kandrian area—remain difficult to reach.[15]

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[12] World Health Organization Data. https://data.who.int/countries/598 . Accessed June 27, 2025.
[13] Fides Agency. https://www.fides.org/en/news/28040-OCEANIA_PAPUA_NEW_GUINEA_A_cholera_epidemic_is_threatening_the_country_in_February_only_45_people_have_died . (Published: 15 February 2010)
[14] World Health Organization (WHO) . Papua New Guinea - NCD Country Profiles 2018. https://cdn.who.int/media/docs/default-source/country-profiles/ncds/png-es.pdf?sfvrsn=d0c2b16f_38&download=true Accessed June 27, 2025.
[15] PNG National Research Institute (NRI). West Sepik Province Universal Basic Education in 2019. https://pngnri.org/atlasNRI/index.php/ube-status/momase-region/2-uncategorised/17-west-sepik-province Accessed June 27, 2025.

6. Gender

70. The situation of women in Papua New Guinea is complex and shaped by strong traditional roles that continue to influence gender dynamics. Women's involvement in the economy is markedly divided, with the majority participating in the informal sector and only a small proportion engaged in formal employment. Women play a critical role in informal economic activities, particularly in the cultivation and sale of fresh produce in local markets. Gender-based violence remains widespread. National data indicate that 56% of women aged 15–49 have experienced physical violence since age 15, while 28% have faced sexual violence. Eighteen percent of women who have ever been pregnant report experiencing violence during pregnancy.[16] In Vanimo, a Family Support Centre at the provincial hospital provides medical and psychosocial services for women who have experienced violence. However, access to these services is limited in rural areas, and many women refrain from reporting abuse due to fear or mistrust of institutions.

16 IDEM.

Table 16: Projected Population and Demands

Population, Commercial & Industrial Demand	2018	2023	2028	2038	2040	Remarks
		+ 5 years	+ 10 years	+ 20 years	+22 years	
Domestic & Institutional Population						
Town Domestic Population	4384	5157	6066	8392	8955	
Squatters Settlers Population (50%)	6576	7735	9098	12588	13433	
High School Boarding Students (Vanimo Sec & Don Bosco)	540	635	747	1034	1103	Located at South-East end, Outside Project boundary
High School Day Students (Vanimo Sec & Don Bosco)	699	822	967	1338	1428	
CIS Prison Population	121	142	167	232	247	
Total Population	12320	14491	17045	23584	25166	
Commercial & Industrial area (m2 and Ha.)						
Officers' area (m2)	7352	8648	10172	14074	15018	
Commercial - Shops / Supermarkets area (m2)	11397	13406	15769	21817	23281	
Industrial area (m2)	10035	11804	13884	19210	20499	
Number of hospital beds	130	153	180	249	266	
Hotel / Lodges no. of rooms	273	321	378	523	558	
Water Demand Projection - (In MLD)	**2018**	**2023**	**2028**	**2038**	**2040**	**Remarks**
		+ 5 years	**+ 10 years**	**+ 20 years**	**+22 years**	
Daily Water Consumption						
Town Domestic Demand	0.55	0.64	0.76	1.05	1.12	@ 125 Lpcd
Squatters Settlers Demand	0.33	0.39	0.45	0.63	0.67	@ 50 Lpcd
High School Boarding Students Demand	0.04	0.04	0.05	0.07	0.08	@ 70 Lpcd
High School Day Students Demand	0.03	0.04	0.05	0.07	0.07	@ 50 Lpcd

Population, Commercial & Industrial Demand	2018	2023	2028	2038	2040	Remarks
		+ 5 years	+ 10 years	+ 20 years	+22 years	
CIS Prison Population Demand	0.01	0.01	0.01	0.02	0.02	@ 70 Lpcd
Commercial & Industrial area Demand						
Officers' area Demand	0.05	0.06	0.07	0.10	0.11	@ 110 L/15m2/day
Commercial - Shops / Supermarkets Demand	0.03	0.04	0.04	0.06	0.06	@ 40 L/15m2/day
Industrial area Demand	0.07	0.09	0.10	0.14	0.15	@ 110 L/15m2/day
Hospital Demand	0.03	0.04	0.05	0.06	0.07	@ 250 L/bed/day
Hotel / Lodges- Demand	0.04	0.05	0.06	0.08	0.08	@ 150 L/room
Unaccounted for Water	0.24	0.28	0.33	0.46	0.49	
Average Day Flow	1.43	1.68	1.97	2.73	**2.92**	
Peak Demand	1.4	1.4	1.4	1.4	1.4	
Peak Day Flow	2.00	2.35	2.76	3.83	**4.08**	

7. Identification of Environmental Sensitive Receptors

71. Environmentally sensitive receptors are illustrated in
72. . The identification of these sensitive receptors is based on the nature of project activities and their potential impacts on surrounding communities, schools, hospitals and other essential infrastructure. A summary of these receptors is provided in Table 17, which includes a description of each sensitive site, its location, and corresponding photographs.

Figure 12: Identified Environmental Sensitive Receptors for Vanimo

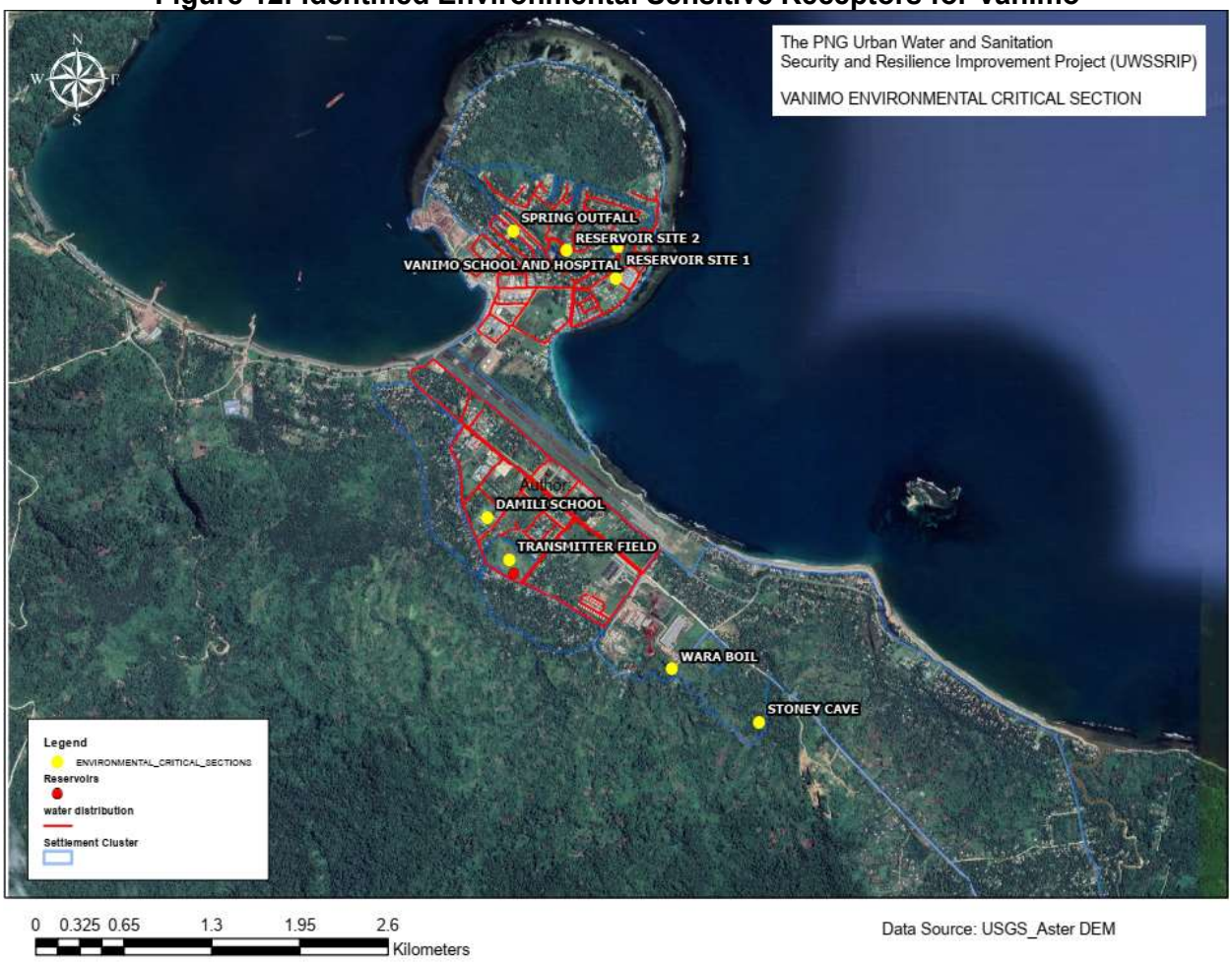


Table 17: Identified Sensitive Receptors at the Vanimo Subproject Site

Sensitive Receptor	Latitude	Longitude	Description	Site Photo
1. Vanimo Hospital and Vanimo School	2.682346694	141.3089044	Situated along the coastline and opposite to the Vanimo School. The hospital's water supply is extracted from the spring outlet. The hospitals liquid hazardous wastes are piped out and disposed in the sea. The Vanimo School is adjacent to the Vanimo hospital. The school accesses its drinking water from a well within the school. Latrines and sanitation facilities are not hygienic due to the lack of consistent supply of water.	
2. Reservoir 2	2.680737389	141.3049133	The proposed Reservoir site 2 is located north and upslope from Vanimo hospital and reaching an altitude of 20 meters above sea level (masl).	
3. Reservoir 3 (high level)	2.680200944	141.3084753	The proposed site is located at Vanimo Hill overlooking Vanimo Town. This is the highest point within the project site reaching up to 60masl.	

Sensitive Receptor	Latitude	Longitude	Description	Site Photo
4. Damili School	2.698039833	141.2996401	The Damili primary school is situated within the proposed well bore site 2 and is approximately 300m south of the Vanimo main market. Drinking water is accessed through a well within the school.	
5. Transmitter Field	2.711359897	141.3170028	The proposed well field 2 is situated in the Damili area (Wara Kongkong). The proposed site covers the Damili school, the NBC station and the Wara Kongkong settlement, which is inhabited by the settlers from Green River and Nuku.	
6. Spring Outfall 1-5	2.679869553	141.3006035	All 5 spring outfall areas are situated at the foot of Vanimo hill facing the town area and are a few meters apart. The springs have a continuous flow even in the dry months of the year and serves the residents in the area.	

Sensitive Receptor	Latitude	Longitude	Description	Site Photo
7. Wara Boil	-2.70880964	141.31049069	Wara Boil is a spring situated 300m south of the main Sepik Highway and approximately 200m from the timber yard. It is available all year-round and is used by the community living throughout the area.	
8. Stoney Cave	-2.71189955	141.31049069	Stoney Cave is a natural spring that flows all year round. It is situated within the proposed well field 1 and serves the communities within the area as well as communities living along the coast during dry periods.	

V. ANTICIPATED ENVIRONMENTAL IMPACT AND MITIGATION

73. The proposed Vanimo Water Supply Subproject involves the development of water sources and the abstraction of water from both groundwater and spring sources. The extracted water will be conveyed to a disinfection system for treatment before distribution to residential and commercial consumers. This process is expected to result in several environmental impacts. A comprehensive understanding of these potential impacts is essential for formulating effective mitigation strategies that support the sustainability of the local ecosystem while meeting the water needs of Vanimo.

74. The following section provides an assessment of the likely impacts of the proposed infrastructure works for the proposed Vanimo Water Supply Project on the physical, biological, socioeconomic, and physical cultural resources in Vanimo. It identified mitigation measures to ensure all environmental and social impacts will be avoided or managed to acceptable levels. The criteria for assessment are in line with ADB SPS and national CSS and where PNG has no set standard or guideline, the standards given in the World Bank Environmental Health and Safety (EHS) General Guidelines are used.

A. Environmental Impacts and Mitigation Strategies

1. Key Environmental Impacts

75. **Groundwater Depletion**. Water extraction from bore fields may significantly reduce groundwater levels, potentially affecting nearby wells, surface water bodies, and ecosystems dependent on groundwater. Over-extraction could also alter aquifer dynamics, increasing the risk of land subsidence.

76. **Alteration of Hydrology**. Diverting water from natural sources can disrupt local hydrological patterns. Changes in flow rates may impact wetlands, streams, and rivers, threaten aquatic habitats and biodiversity, and disturb the natural balance of ecosystems that rely on consistent water availability.

77. **Soil and Sedimentation**. Construction activities, such as drilling boreholes and pipeline installation, can lead to soil erosion. Resulting sedimentation in nearby water bodies may degrade water quality, harm aquatic life, and reduce the efficiency of water treatment systems.

78. **Pollution Risks**. Transporting water through pipeline poses risks of contamination from spills or leaks. Additionally, improper handling of treatment chemicals could lead to environmental pollution, affecting soil and water quality.

79. **Impact on Local Flora and Fauna**. Land clearing and increased human activity during construction may disturb wildlife habitats. Sensitive species could face displacement or population decline due to habitat disruption.

80. **Climate Chance Considerations**. Changes in precipitation patterns due to climate change may affect groundwater availability and alter water demand. This can pose long-term risks of saline intrusion, particularly under climate change scenarios such as sea level rise and reduced groundwater recharge. This variability underscores the need for adaptive management strategies.

2. Key Mitigation Strategies

81. **Sustainable Water Management**. Adopt responsible extraction practices by regularly monitoring groundwater levels and withdrawal rates based on seasonal variations in recharge rates.

82. **Environmental Impact Assessments**. Conduct thorough environment assessments prior to implementation to identify potential impacts early. Include stakeholder consultations to incorporate community concerns and insights.

83. **Erosion Control Measures**. Use erosion control techniques, such as silt fences, sediment basins, or vegetation cover, during construction to minimize soil loss and protect waterways from sedimentation.

84. **Pipeline Monitoring Systems**. Install leak detection systems to promptly identify and address contamination risks, preventing significant environmental damage.

85. **Habitat Restoration Plans**. After construction is completed, implement post-construction habitat restoration plans to rehabilitate disturbed areas and support the recovery of local flora and fauna.

86. **Adaptive Management Frameworks**. Establish a framework for continuous monitoring and adjustment of environmental strategies based on observed impacts and changing conditions.

87. **Community Engagement Programs**. Engage local communities throughout all phases of the project to ensure transparency, build trust, and collaboratively address environmental concerns.

B. Impacts and Mitigation Measures for Design and Pre-construction

88. These impacts relate to management at the design and pre-construction stage of the project with consideration of the appropriate implementation of mitigation measures, to monitor and ensure compliance with environmental regulations and provide environmental and social protection. Inclusion of mitigation measures in contract documents for all subprojects, and assurance that the PMU has adequate capacity to implement the EMPs, including training of contractor personnel in the requirements of the EMP. It also includes the need for environmentally responsible procurement; climate change vulnerability; grievance redress, potential damage to archaeological and cultural assets; sourcing of materials and biosecurity matters.

89. **Review and update of the EMP.** Based on the EMP in this assessment and following detailed design and the completed hydrological assessment, the EMP will be updated as required and integrated into bid and contract documentation (BCD). Experience shows that inadequate application of the EMP by the contractor may occur due to weak linkages of the EMP with the contract document. The EMP is an integral part of the work program and will be addressed by the contractor. An outline of the requirements is provided below:

(i) For the BCD section “Special Conditions of Contract” the following will be included: (i) prior to the tender being called the EMP will be revised and updated as required based on the detailed design and findings of the hydrological study; (ii) the updated EMP and provisions from the EMP section of the IEE will be extracted and will be attached as supplementary specifications to the BCD - Section 6 - Employer’s Requirements; (iii) in Part 1 the Price Schedule 4 - Bill of Quantities, provisional sums will be included for the

preparation and implementation of the CEMP and for monitoring; and, (iv) in the BCD section “Special Conditions of Contract” the construction section of the EMP will form part of the BCD; and

(ii) Inclusion of SPS Appendix 5 - Prohibited Investment Activities List in the BCD. In order that the subproject to comply with the SPS, it will be necessary to include in the BCD, reference to Appendix 5 of the SPS.

90. **Environmental management system**. For implementation of environmental safeguards to be effective throughout the project, an environmental management and monitoring system will be established. The PMU will ensure that the EMPs is updated, as required, based on detailed design, and incorporated into the bid documents. The bid documents will also specify other environmental management requirements such as: (i) requirements to comply with applicable standards (i.e., ADB SPS and CSS); (ii) the contractor will designate an environmental, health and safety officer (EHSO) and describe the reporting/communication lines and channels; (iii) the monitoring and reporting requirements; and (iv) delivery of induction, training and awareness sessions for workers and the community.

91. Prior to work commencing at the project site, the contractors will prepare and submit site-specific construction environmental management plans (CEMPs) to the WPNG PMU. The CEMPs will be based on project EMPs and detail the construction methodology and compliance program to be undertaken at the site, identifying the risks associated with the construction methodology and detail mitigation measures to avoid or reduce identified risks. The WPNG PMU supported by the DSC will review and approve the CEMPs. The WPNG PMU’s no objection is required before the Contractor can commence civil works. The Contractor may also need to obtain relevant EPs from the CEPA and other regulatory authorities before commencing civil works.

92. Upon project commencement, the EHSO will conduct monitoring of compliance of activities with the approved CEMPs, and the WPNG PMU will undertake inspections and audits of the effectiveness of the contractor’s implementation of the approved CEMPs. The WPNG PMU supported by the DSC will devise the checklist to be used for the inspections and audits and will consolidate the inspection/audit findings along with summaries of the contractor’s monthly reporting into inputs into the project’s quarterly progress reports and compiled into the semiannual safeguards monitoring report (SMR), which will be submitted to ADB. ADB will undertake review missions which will report inter alia, on overall implementation of social and environmental safeguard requirements.

93. **Grievance redress mechanism.** The project will also establish a grievance redress mechanism (GRM) to address concerns and resolve complaints and issues raised on any aspect of subproject implementation. Safeguards concerns will be addressed through the GRM. The CEMPs will outline how the contractor will implement the relevant elements of the GRM and how and when they will provide information about construction activities and timing to the community. The contractor will provide information about the work, impacts and mitigation/control measures to the community in a timely and effective manner. The contractor’s liaison and communication with the community will be guided by the subproject’s communication strategy and consultation plan.

94. **Induction of contractors to site**. Once construction contractors have been selected, the CEMP has been approved, and relevant environmental permitting requirements have been obtained, the contractor, along with their assigned EHSO, will meet with the WPNG PMU Safeguards Specialist on-site. During this meeting, the CEMP requirements will be reviewed and confirmed with the contractor. Once the Safeguards Specialist is satisfied that the contractor

comprehends and can adhere to the CEMP, they will inform the site Project Engineer that the contractor is ready to commence work. The contractor and its staff will also be trained in the grievance redress mechanism (GRM), its recording and resolution requirements and protocols for addressing all complaints, issues and concerns raised by the stakeholders during the construction.

95. **Climate change considerations**. Climate change resilience is a critical consideration because PNG is exposed to a variety of climate change impacts which could impact on the urban water sector. This include increasing temperature which is likely to reduce water availability in surface and groundwater resources, increase in intensity/frequency/duration of the El Nino events which could result in greater intensity/frequency/duration of drought, increase rainfall intensity that can increase turbidity of surface water resources, and sea level rise that could increase the risk of saline intrusion to coastal groundwater resources. In this context, Subproject 1A in Vanimo will (i) provide a sustainable and climate resilient water supply to at least 1,500 households, which currently rely on rainwater harvesting that is becoming unreliable; (ii) the wellfield will be designed and built for resilience; and (iii) a multi-stakeholder watershed protection plan will be prepared and implemented under the project.

96. **Land access and use**. There is a potential impact on landowners when private or customary land will need to be accessed for the placement of infrastructure investments. This impact can be minimized by designing the location of the network to follow existing road corridors where possible, and for the design and location of site-specific investments to consider the ownership and value of land. Due diligence has confirmed that project activities will mostly be implemented on government-owned lands. However, there are privately-owned or customary lands also identified for siting utility infrastructure, and as such lease agreements will be made to acquire land and establish formal easements. A Resettlement Plan (RP) has been prepared to this effect.

97. **Site clearance, archaeological and cultural assets**. While there is no information at present about any archaeological and cultural assets that may be affected by project work, precautions will be taken to avoid potential damage to any archaeological and cultural assets found during land clearing. These will include:

(i) inclusion of a chance finds procedure in the CEMP; and
(ii) inclusion of provisions in tender and contract documents requiring the contractors to immediately stop excavation activities and promptly inform the relevant local authorities of the presence of any unknown archaeological and cultural assets.

98. If there is a chance-find of cultural resources during the construction process, construction must immediately cease, and the engineer/site supervisor informed. If for example an artifact is discovered, the contractor and engineer/site supervisor will consult the appropriate community leaders and members and collectively determine the most appropriate way to treat the discovery with respect. No work will commence until all clear is given.

99. **Sourcing of construction materials.** Construction materials will be sourced by the contractor from local suppliers. Should other sources be sought, the contractor should identify all quarry (sand/gravel) extraction sites and prepare quarry management plans that meet CEPA's requirements, which may include payment of a royalty to the landowners to extract materials from each site and the satisfactory closure and rehabilitation of each extraction site. Detailed information on the establishment of quarries shall be disclosed to the CEPA and follow the requirements of the Environment Act and regulations to obtain an EP. Only permitted/licensed facilities and operations may provide material for the project.

100. **Biosecurity of imported material (invasive species)**. All construction equipment, i.e., bulldozers, excavators, backhoes, etc. will be sourced locally, which will limit any bio-security concerns focusing on plant invasive species/disease control. National and international bio-security controls for shipping machinery and materials are required to meet the acceptable cleanliness standards of the relevant authorities or be refused entry into that country in line with PNG Biosecurity Act 2025. It is the importer's responsibility to ensure all machinery and project supplies that arrive in Vanimo to be free from biosecurity risk material, such as soil, seeds, plant, and animal material.

101. **Prohibited activities**. The contractor should be fully aware of Appendix 5 of the ADB SPS, which contains the Prohibited Investment Activities List (PIAL). It is crucial to note that any activity listed in Appendix 5 is strictly prohibited, and no ADB funds can be utilized to finance such activities. The contractor will be informed of these requirements through explicit inclusion in the contract, emphasizing that none of the prohibited activities will be authorized or permitted during the construction phase.

C. Impacts and Mitigation Measures for Construction Phase

102. The construction phase starts when the contractor commences mobilization to the work sites and the establishment activities such as setting up of site office and preparing to extract and stockpile construction materials. In this context, the contractor shall take full responsibility for the adequacy, stability and safety of all site operations and methods of construction throughout the construction period. The contractor must also ensure the movement of all workers, construction equipment, construction materials, waste etc. between work sites, quarries and access routes minimize any impact on the community and property. The contractor shall be solely responsible for any damage to the natural environment, any social infrastructure and community property resulting from its operations.

1. Impacts on Physical Environment

103. The proposed Vanimo subproject components will be implemented in a modified environment, and it is acknowledged that the environmental impacts assessed are confirmed to specific locations, relatively small in scale, and temporary in nature. These activities should align with Best Construction Practices with typical environmental disturbances associated with construction works, such as dust, noise and waste management.

104. **Preparation of site and establishment of contractor's facilities**. It is deemed that establishment of temporary construction sites, storage areas, and labor camps are not anticipated as local workers will be engaged, and they can travel daily to the site. However, where these temporary facilities are deemed needed during the construction phase, the following requirements will be followed: contractor's on-site facilities shall (i) be contained within an adequate security fence; (ii) not interfere with the welfare of the surrounding communities in terms of social proximity of labor camps or noise, dust and vibration from construction activities; (iii) be limited in size to reduce unnecessary clearing of vegetation; (iv) not release sanitary waste or grey water untreated into surface water systems; (v) be properly drained, including paved areas, vehicle parking areas, workshops and fuel storage areas draining to an oil and water separator; and (vi) have fuel storage areas not located within 20 m of a water course.

105. **Air quality**. The implementation of a subproject can impact air quality, particularly during the construction phase. Dust emissions from excavation, transportation of materials, and

machinery operation can lead to increased particulate matter in the air. Additionally, emissions from construction vehicles may contribute to elevated levels of nitrogen oxides (NOx) and volatile organic compounds (VOCs). To mitigate these impacts, the contractor shall prepare and implement a plan for the management, minimization and suppression of dust created by construction activities in all the affected work areas. This plan will be based on the identification of sensitive locations and areas including schools, settlements, hospital, and markets, and all areas where people congregate as well as dwellings adjacent to the subproject sites and along all haul routes. Open burning of waste will be prohibited, and a regular vehicle maintenance and repair program will be implemented to reduce the emission of fumes from equipment exhaust. Furthermore, scheduling construction activities during periods of low wind can help reduce airborne dust dispersal.

106. **Noise and vibration**. Construction activities associated with subproject often generate significant noise and vibration, which can adversely affect local communities and wildlife. Heavy machinery, drilling operations, and transportation activities contribute to elevated noise levels that may exceed acceptable limits set by local regulations. To mitigate these effects, project planners should conduct noise assessments prior to construction to identify sensitive receptors such as residential areas or schools. Implementing noise barriers, scheduling noisy activities during daytime hours, and using quieter equipment can help minimize disturbances. Additionally, monitoring noise levels throughout the project can ensure compliance with established thresholds. Contractors will be required to:

(i) Provide prior notification to the community on the schedule of construction activities;
(ii) Whenever appliable, provide noise reduction covers;
(iii) Position stationary equipment that produces elevated noise levels, such as generators, as far as practicable from houses and other sensitive receptors;
(iv) Prohibit operation of noisy equipment and construction works in populated areas and where sensitive receptors are found during nighttime (7:00pm – 7:00am);
(v) In necessary nighttime operations, ensure prior notification and consultation will be made with local officials and communities, and implement suitable noise reduction measures; and
(vi) Where required, conduct regular noise level monitoring to determine compliance with WHO guidelines for noise which should not exceed 55 dBA near residential areas during daytime and 45 dBA during nighttime.

107. **Traffic Management.** The laying of the pipeline will follow the road corridor and existing easements, hence the potential effects on traffic will need to be avoided through an appropriate traffic management plan provided by the contractor. Locations for the proposed site-specific investments have all been chosen within proximity of access to trunk main transmissions so again impacts will be minimal yet considered in the traffic management plan.

108. **Water quality and water extraction**. Water quality is a critical concern in any water supply project. The extraction of groundwater or surface water must be carefully managed to prevent contamination from construction activities or operational processes. Potential sources of pollution include runoff from construction sites containing sediments or chemicals that could leach into nearby water bodies. To mitigate these risks, best management practices (BMPs) should be employed, including silt fencing around construction sites to control erosion and prevent sedimentation in waterways. Regular monitoring of water quality before, during, and after project implementation is also crucial to detect any changes in parameters such as turbidity, pH levels, or the presence of harmful contaminants.

109. **Groundwater quality**. Considering that groundwater is shallow and sandy soils are highly permeable, there is a medium but short-term pollution risk to groundwater in the event of any leaks or spills due to the use of fuel, oil, chemicals, and hazardous materials during construction works. The risk for construction activities to cause groundwater pollution is considered minimal, provided that adequate mitigation measures on appropriate use and storage of hazardous materials as well as management of solid wastes are adopted and consistently implemented on-site. The CEMP will include a detailed erosion and sedimentation control plan, a waste management plan and hazardous material management plan that sets out all measures for the control and mitigation measures for all work sites.

110. **Soil erosion and sedimentation**. Potential sources of sediment runoff include site clearing, ground levelling, excavations, and pipelaying. These activities can release soil materials to the surrounding areas during rainy periods if not provided with sediment control measures. The contractor will be required to have a sediment erosion control plan, which will be included in the CEMP, that details each construction activity. Where required, the contractor will design sediment control measures, which may include but not be limited to small interceptor dikes, pipe slope drains, grass bale barriers, silt fence, sediment traps, and temporary sediment basins to divert runoffs away from the exposed areas. The material removed during trenching, pipe laying, backfilling, and compaction will, in the event of rainfall, be contained by grass bale barriers, silt fences, sediment traps, and temporary sediment basins, preventing sediment from moving offsite.

111. **Waste management**. Effective waste management is vital for minimizing environmental impacts associated with water supply and sanitation projects. Construction activities typically generate various types of waste including solid waste (e.g., packaging materials), hazardous waste (e.g., fuels or lubricants), and wastewater from site operations. A comprehensive waste management plan should be developed prior to project initiation that outlines strategies for reducing waste generation through recycling initiatives and proper disposal methods for hazardous materials. Training workers on waste segregation practices can further enhance compliance with environmental regulations. Additionally, establishing partnerships with local waste management facilities ensures that all generated waste is handled responsibly.

112. **Storage, use and transportation of hazardous materials**. Oil products and other hazardous materials may be used during the construction phase. Fuel, oil, grease, and other hazardous substances associated with the operation of heavy equipment and vehicles may accidentally be released to the environment and adversely affect soil and water quality. Mitigation measures include (i) preparation of hazardous material management plan and an emergency response plan as part of the CEMP; (ii) ensure all storage containers are in good condition with proper labelling; and (iii) store waste oil, used lubricant and other hazardous wastes in tightly sealed containers.

2. Impacts on the Biological environment

113. **Land use**. The implementation of a water supply and sanitation project can significantly alter land use patterns in the affected areas. Construction activities may require the clearing of land, which can lead to soil erosion, changes in hydrology, and disruption of existing land uses such as agriculture or residential areas. The conversion of natural landscapes into developed areas can result in habitat loss for various species. To mitigate these impacts, careful planning is essential. The majority of the project site is composed of built-up areas, including residential zones, business establishments, and airport runway. Therefore, land use change is not anticipated as these locations are considered modified and disturbed habitats.

114. **Forest resources**. Water supply projects often necessitate the extraction of resources from forested or catchment areas, either directly through logging or indirectly through increased access leading to deforestation. This can diminish forest cover, disrupt local ecosystems, and reduce carbon sequestration capabilities. To mitigate these effects, it is crucial to incorporate reforestation initiatives as part of the project design. Establishing buffer zones around sensitive forest areas can help protect them from encroachment. Additionally, engaging local communities in sustainable forestry practices can ensure that forest resources are managed responsibly while still meeting the demands of the water supply project.

115. **Biodiversity and wildlife management**. Water supply and sanitation projects can pose threats to biodiversity by fragmenting habitats and altering ecosystems. Species that rely on specific habitats may decline if their environment is disrupted by construction or changes in water availability. Effective wildlife management strategies must be integrated into project planning to minimize these impacts. This could involve creating wildlife corridors that allow animals to move safely between fragmented habitats, monitoring populations of vulnerable species before and after project implementation and establishing conservation programs that focus on protecting endemic species at risk due to habitat alteration.

116. Site clearance and vegetation removal will be required for the project. The pipeline will be constructed along a modified easement corridor by trenching, then backfilling after the pipe has been laid. No modification of overland flow parts is proposed. The proposed storage reservoirs will be located on land where regrowth has occurred. There are no protected sites in the subproject areas. Given the limited impacts of subproject construction on terrestrial habitat, no mitigation is required rather than the implementation of soil erosion and sediment control plan (see above) to minimize potential impacts on surrounding terrestrial habitats.

117. **Fauna**. It is noted that there are no Red Listed terrestrial or aquatic species in the subproject's area of influence. The fauna within the project area may experience direct and indirect impacts due to changes in their habitat caused by construction activities or altered water flow patterns. Species dependent on aquatic ecosystems might face challenges such as reduced water quality or quantity, which could affect their survival rates. To mitigate these impacts on fauna, it is important to implement measures such as constructing artificial wetlands to enhance habitat quality for aquatic species and ensuring that any discharge from sanitation systems meets environmental standards to prevent pollution of natural waterways. Additionally, conducting regular assessments of animal populations will help gauge the effectiveness of mitigation efforts.

3. Impacts on the Socioeconomic Environment

118. Impacts on the human and built environments are primarily impacts from the project that may affect the local population. This includes impacts on individuals, landowners, communities, on sensitive locations (sensitive receptors), community health and safety, workers health and safety and the use of community facilities or infrastructure. Therefore, particular care must be taken to ensure that project work does not cause harm or nuisance and is mitigated. The main ways these impacts will be mitigated will be through specific provisions in the CEMP and the development of subplans, codes of conduct and practice, and other procedures that are implemented and monitored for effectiveness.

119. **Impacts on local infrastructure**. These include impacts on existing services such as landfill or dump sites, utilities (power and water supplies) all of which may adversely affect local communities. The establishment of power and water supply to work sites is the responsibility of the contractor and cannot reduce or curtail or adversely affect community use of these utilities.

Similarly, the use of local landfills or dump sites for construction waste cannot reduce the intended lifespan of the community's use of these facilities. Feeder roads and other infrastructure, for example roads and culverts along haulage routes from quarries or between work sites must always remain passable to the public and be included in the traffic management plan. In addition, the contractor will consult with all relevant authorities to ensure that they minimize any disruptions to existing infrastructure and services. This includes village or community or private water supplies, telecommunications infrastructure and electricity supply wherever applicable. Plans (if available) will be obtained from utility/ service providers showing all underground facilities and/or services in order to avoid damage or disruption during works.

120. Mitigation measures to be included in the CEMP will require the contractor to: (i) inform affected communities well in advance; (ii) reconfirm power, water supply, telecommunications and irrigation systems likely to be interrupted by the works and any additional trees to be cut near utilities; (iii) contact all relevant local authorities for utilities and local village groups to plan re-provisioning of power, water supply, telecommunications and irrigation systems; (iv) relocate and reconnect utilities well ahead of commencement of construction works and coordinate with the relevant utility company at the district level for reconnection well before works commence and include for compensatory planting for trees; (v) arrange reconnection of utilities and irrigation channels in the shortest practicable time before construction commences; and (vi) if utilities are accidentally damaged during construction, it shall be reported to the PMU and utility authority and repairs arranged immediately at the contractor's expense. All roads used by the contractor are to be actively managed and monitored and fully restored prior to demobilization.

121. **Potential social issues due to influx of workers**. A small number of workers is anticipated to work on the Vanimo subproject. Where capacity is available, labor will be hired locally from Vanimo town. However, for skills not available in the town and for specialist jobs, workers from POM and specialist migrant workers will be hired. Limited impacts of migrant workers are anticipated, and a plan will be required from the contractor to address amongst others:

(i) measures to minimize contact with local residents to prevent the risk of spreading communicable diseases including sexually transmitted infections (STI) and human immunodeficiency virus (HIV) in line with HIV/AIDS Management and Prevention Act 2003;
(ii) induction of all workers on project requirements regarding safeguards (including child protection and sexual exploitation, abuse and harassment, SEAH) and GRM requirements;
(iii) agreement to and implementation of protocols (including the code of conduct) concerning the workers' contact with the local communities in line with the Public Health Act of 1973 and 2020 (Amendment);
(iv) ensuring that sufficient water supply and temporary sanitation facilities are provided for workers at work sites in order that community infrastructure is not over- burdened; and
(v) security at contractor's yard to control unauthorized access and prevent entry of the public (especially children).

122. **Occupational health and safety**. Health and safety will be managed in accordance with the PNG's Industrial Safety, Health and Welfare Act of 1961 and 2016 (Amendment) and where gaps exist, best practice will be employed. The contractor is required to have a full-time health and safety representative that will be responsible for ongoing compliance including regular auditing and updates to project specific health and safety documentation. The Contractor will be required to: (i) prepare and implement a health and safety plan (HSP) as part of their CEMP; (ii) ensure that a properly equipped and resourced first aid station is available at all times; (iii) provide potable water and adequate sanitation facilities; (iv) provide personal protective equipment (PPE)

suitable to tasks and activities undertaken to minimize exposure to a variety of hazards; (v) provide fire-fighting equipment and fire extinguishers in workshops, fuel storage facilities and any sites where fire hazard and risk are present; (vi) ensure that all workers are aware of emergency response and medical evacuation procedures; (vii) ensure that only suitably qualified and experienced staff are utilized on the project works; and (viii) guarantee the work practices, skills, qualifications and experienced of all subcontractors engaged to work on the project works. To this end where the subcontractors' systems, rules and policies are of a lesser standard to that of the head contractor, the head contractor shall require their subcontractors to abide by their systems, rules, and policies.

123. The contractor's HSP will provide guidance to its staff on how good work practices can be carried out on every activity at the construction site to prevent accidents to the workers and the public. This will include emergency procedures and the required resources, clear description of responsibilities and management, specific requirements of occupational health and safety policies and regulations, training requirements, and site safety rules.

124. **Community health and safety**. Many of the measures to manage occupational health and safety will help mitigate the risk to the community. The movement of construction equipment, excavations, pipelaying and various activities may pose hazards to the public. Contractors will be required to: (i) implement the various plans to minimize health and safety risks to the public; (ii) use barriers and install signage to keep the public away from constructions sites and excavation sites; (iii) provide prior notification to the community on schedule of construction activities; (iv) provide security personnel in hazardous areas to restrict public access; (v) operate construction night lights in the vicinity of construction sites; (vi) provide adequate safe passage for public, as necessary, across construction sites; and (vii) ensure that any access to properties or establishments that have been disrupted or blocked by the ongoing construction activities, are reinstated as quickly as possible or alternative access is provided. Directly affected people such as those living in proximity with the subproject sites will be consulted prior to the start of works on site through community consultation and awareness sessions.

125. **Sites of significance**. Construction works can cause an impact on sites of significance such as cultural or historic sites, particularly where earthworks are required. For this project, most of the pipeline installation will be in locations that are already highly modified, and most often use the same footprint of the existing road corridor. However, some works may be in areas where it is possible that unidentified sites may be uncovered during construction. To avoid impacts on sites of significance, a discovery/chance finds protocol is to be put in place and contractors educated on its use. The discovery protocol will direct what actions are to be taken in the event of uncovering a site of potential significance. Appropriate actions to be included in the protocol include the contractor immediately ceasing works if anything is uncovered during earthworks and contacting appropriate national authorities so they can advise on the appropriate course of action. This will avoid any impact on the site and provide information on appropriate measures to be taken to preserve the site.

D. Impacts and Mitigation Measures for Operation Phase

126. Operational phase impacts will be minimized particularly if ongoing measures are extended to maintenance and are appropriately implemented by WPNG.

1. Impacts on Physical Environment

127. **Air quality**. The access to clean and safe water will spur the growth of communities within the project site especially due to in-migration from neighboring provinces. Presently, even without the project, people have been observed to have settled in vacant land with their own communities. Increased population would also increase air pollution from cooking fires where forests are also going to be utilized for firewood. The conclusion in respect of air quality is that the subproject investment is likely to continue to operate with no significant air quality impacts that warrant mitigating actions.

128. **Runoff and soil erosion**. Soil erosion will be minimized by engineering controls in the designs of the reservoir, piping distribution and other structures. Construction of rip raps or rock walls for the reservoir would ensure that erosion and sedimentation will be controlled. Apart from affecting the community lands and resources, this would otherwise cause natural streams and irrigation channels to become silted.

129. **Water resources**. Potential impacts on water quality from water leakages or damages to the piping, reservoir contamination and lack of maintenance in water treatment are expected to occur and needs to be properly maintained following existing protocols. It is noted that the ongoing physical effects of the pipeline network and site-specific investments will be minimal, and any effects will be mitigated by routine monitoring of water quality as well as education initiatives to ensure that water use is managed responsibly.

130. **Maintenance**. WPNG and any maintenance contractor will be responsible for regular clearing of the water system from groundwater and surface water extraction to household distribution. Regular maintenance activities are required to ensure the sustainability of clean drinking water to the communities. Maintenance activities should likewise be provided during intense rainfall events.

131. **Awareness of watershed importance**. The ground water source could only be made sustainable if its recharge zone is protected, conserved and managed. Tree planting and watershed enrichment initiatives should therefore be part of the operations and maintenance activities.

2. Impacts on the Biological Environment

132. **Flora and fauna**. The operation of the project is not likely to induce people to the area to poach or hunt fauna since these areas are built up sites and as such have not much wildlife left. It is possible, however, that cutting timber in the watershed and catchment areas could be caused by more people migrating to Vanimo and could cut timber and destroy wildlife habitats and threaten the recharge zone's properties. The project needs to ensure that regular information, education and communication (IEC) campaigns together with monitoring are part of the WPNG's activities.

3. Impacts on the Social Environment

133. **Community Health and Safety.** Upon completion the project will result in significantly improved health measures by improved access to a safe water supply and less reliance on potentially contaminated groundwater taken from wells. There will also be more community resilience to the effects of climate change in times of drought.

134. **In-migration**. The operation of the project would induce in-migration from neighboring towns and provinces seeking economic opportunities. The influx of people could cause conflicts from increased pressure on resources including land, jobs, agriculture and water. This could be prevented with proper town planning and zoning.

135. **Spread in communicable disease**. This impact is also caused by increased population from in-migration and programs on HIV-AIDS, tuberculosis and other sexually transmitted diseases (STDs) should be aggressively implemented.

136. **Noise.** There will be a small amount of added ongoing noise with the new pump stations, but the noise generated is of such a small scale and in general its impact is negligible.

E. Risk Assessment of the Environmental Sensitive Receptors

137. Sensitive environmental and social receptors have been identified based on their proximity to the proposed subproject infrastructures as well as importance of the site in terms of water resources. Site specific environmental and safety risk assessment for the eight identified sensitive receptors include proposed mitigation measures for the anticipated impacts for the site-specific areas. The identified sensitive receptors include (i) Vanimo Hospital and Vanimo School, (ii) Reservoir 2, (iii) Reservoir 3, (iv) Damili School, (v) Transmitter Field, (vi) Spring Outfall 1-5, (vii) Wara Boil, and (viii) Stoney Cave.

138. **Risk assessment methodology**. The likelihood and consequence of each identified risk are provided in Table 18 and Table 19, respectively. To quantify the overall level of risk, a numerical value is assigned to both the likelihood and the consequence. These values are then multiplied together to produce a risk score, as provided in Table 20. The risk score provides a standardized way to assess and compare the severity of different risks, enabling more informed decision-making and prioritization of risk mitigation efforts.

Table 18: Likelihood of Risk

Likelihood of Risk	Description	Score
Certain	Will occur more than once a week	4
Likely	Likely to occur more than once or twice during the construction phase	3
Unlikely	May occur once or twice during the construction phase	2
Rare	Unlikely to occur during the construction phase	1

Table 19: Consequence of Risks

Consequence of Risk	Description	Score
Catastrophic	Unprecedented damage or impacts involving the environment or surrounding communities: (i) Extreme loss of soil, water resources, and water quality because of storm-water runoff.	4

Consequence of Risk	Description	Score
	(ii) Extreme pollution of soil and water resources, including major contamination from hazardous materials. (iii) Widespread effects on ecosystems, with deaths of fauna/flora. (iv) Widespread community impacts resulting in inconvenience, illness or injury. (v) Loss or destruction of archaeological or historical sites. The occurrence of any of the above will almost certainly result in the work being halted and in a significant fine.	
Major	A Major damage to the environment or the surrounding communities. For example: (i) Major loss of soil, water resources, and water quality because of stormwater runoff. (ii) Major pollution of soil and water resources, including contamination from hazardous materials. (iii) Significant effects on ecosystems, with isolated deaths of non-vulnerable flora and fauna. (iv) Significant annoyance or nuisance to communities. (v) Major damage to, or forced displacement of, archaeological or historical sites. The occurrence of any of the above may result in work being halted and in a fine.	3
Moderate	Limited adverse impacts on the environment or on the surrounding communities. For example: (i) Localized, short-term noticeable changes in stormwater quality. (ii) Short-term minor changes in ecosystems. (iii) Some annoyance or nuisance to communities. (iv) Isolated or partial damage to archaeological or historical sites. The occurrence of any of the above is unlikely to result in work being halted or in a fine.	2
Minor	No or minimal adverse environmental or social impacts. For example: (i) No measurable or noticeable changes in stormwater quality and water quality remains within tolerable limits. (ii) Little noticeable effect on ecosystems. (iii) No community complaints or only an isolated few. (iv) No minimal damage to archaeological or historical sites. After the occurrence of any of the above, there would be no likelihood of work being halted or a fine.	1

Table 20: Risk Assessment Matrix

		Consequence			
		Catastrophic (4)	Major (3)	Moderate (2)	Minor (1)
Likelihood	Certain (4)	16	12	8	4
	Likely (3)	12	9	6	3
	Unlikely (2)	8	6	4	2
	Rare (1)	4	3	2	1

Quantifying Risk: Risk = Consequence x Likelihood
(i) High Risk: Score 10–16
(ii) Medium Risk: Score 5–9
(iii) Low Risk: Score <5

Note: Scores greater than 6 determine the need for environmental management measures and requires action.

139. **Environmental risk assessment**. The initial environmental risk assessment (ERA) affecting the identified sensitive receptors are presented in the following sections. It is important to note that this assessment reflects conditions prior to the implementation of any environmental management measures. At this stage, the potential impacts identified with high risk levels include dust generation, noise and vibration, waste management challenges, and accidental spills that may affect soil and groundwater quality.

140. These environmental risks are site-specific, temporary in nature, and can be effectively mitigation through the application of well-designed management strategies. Within the implementation of these measures, the initial risks are expected to be reduced to acceptable residual levels, ensuring minimal long-term environmental impact.

1. Sensitive Receptor Site 1 – Vanimo Hospital and High School

141. Situated along the coastline and opposite to the Vanimo School is the Vanimo Hospital. The hospital's water supply is extracted from a spring outfall at the back of the hospital. The hospitals liquid effluents are piped out and disposed in the sea. The Vanimo School is adjacent to the Vanimo Hospital. The school accesses its drinking water from a well within the school. Latrines and sanitation facilities are not hygienic due to the lack of consistent supply of water.

142. Effects of climate change have already been observed along the coastlines with the sea level rise and permanent inundation causing the sandy beaches to recede.

Figure 13: Sensitive Receptor 1 – Vanimo Hospital and Vanimo School

Table 21: Environmental Risk Assessment – Vanimo Hospital and Vanimo School

Critical Sections	Construction Activity	Risks (hazards to consider)	Likelihood (If that site or sensitive receptors will be affected)	Consequence (If the site or sensitive receptors affected)	Risk Score (consequence x likelihood)	Environmental Management Measures
Vanimo Hospital and School	• Installation of Reservoir and Pumping station 2 • Slope Excavations/ Site Clearance	Degrades Natural Habitat	3	2	6	- Less likely to happen as this site has already been occupied by human settlement. - Should there be any excavations disturbing site of importance, it will be reported to the authorities.
		Slope Erosion	3	3	9	- Gently batter unstable slopes in order to prevent loose soil to enter the waterway during rainy periods. - Regular monitoring shall be conducted.
		Surface water pollution is due to increased sedimentation during excavation works.	3	3	9	- Sediment ponds shall be dug on the adjacent end of the excavation works in order to capture sediments, whilst allowing clean water to flow. - Regular monitoring shall be conducted.
		Slope Collapse from Excavation	3	3	9	- Gently batter the slope face to stabilize the slopes - Regular Monitoring to be conducted.
		Disturbing the stability of Nearby House /Adjourning structures.	2	4	8	- Pay compensation for the damaged structures if required.
		Pollution of ground water from hydrocarbon leakages	3	3	9	- Fuel and oil change shall be conducted only at designated workshops away from the work sites. - Conduct in situ water quality checks weekly to monitor water quality.
		Dust/Exhaust Fumes	2	4	8	- Using new equipment and machinery. - Maintaining and servicing machinery. - Conduct air quality monitoring regularly
		Noise pollution from machineries	3	4	12	- Using new equipment and machinery. - Maintaining and servicing machinery. - Conduct Noise level checks regularly
		Solid waste/ Excavated waste management.	4	3	12	- Identify stable sites for spoils disposal. - All solid waste shall be disposed of at authorized sites. - Burning of solid waste on site shall be

Critical Sections	Construction Activity	Risks (hazards to consider)	Likelihood (If that site or sensitive receptors will be affected)	Consequence (If the site or sensitive receptors affected)	Risk Score (consequence x likelihood)	Environmental Management Measures
						prohibited.
		Accidental spills	2	4	8	- All fuel and oil change shall be conducted at the designated workshops. - Immediately clean up accidental spills of oil and fuel
		Protected /Endangered Species	2	3	6	- Prevent poaching animals/ birds during work - All new species identified during work shall be reported to the relevant authority
		Worksite accidents	3	3	9	- Practice safe workplace practice - Provide all workers with job specific PPEs. E.g. Vests, shoes and masks to all workers. - Provide emergency contact details for all local health clinics in the area. - Provide first aid kit onsite with first aid training to selected workers in those worksites to apply first aid to any injuries onsite.
		Worksite threats	1	2	2	- Provide contact details for law enforcement authorities and councilors in the area. - PRO/CRO present onsite during work. - Communication devices are present onsite to communicate with the Emergency Response team at the campsite.
		Emergency response cases onsite	1	2	2	- Provide Communication device onsite - Provide a 24-hour journey onsite - Induct workers on emergency protocol or evacuation techniques when facing an emergency onsite.
		Occupational Health Issues	2	2	4	- Provide First Aid Kit onsite - Provide proper PPE for the work - Provide 24-hour vehicle onsite to transport to hospital and communication device.

2. Sensitive Receptor Site 2 – Reservoir 2

143. The proposed Reservoir site 2 is located approximately 200m north and upslope from Vanimo Hospital and reaching an altitude of 20masl. The site is surrounded by residential homes with a forested area on the slope face. There is a narrow access road leading to this site.

Figure 14*:* Sensitive Receptor 2 – Reservoir 2

Table 22: Environmental Risk Assessment – Reservoir 2

Critical Sections	Construction Activity	Risks (hazards to consider)	Likelihood If that site or sensitive receptors will be affected	Consequence If the site or sensitive receptors affected	Risk Score (consequence x likelihood)	Environmental Management Measures
Reservoir 2 and Booster Pump.	• Installation of Reservoir 2 and Pumping station (High level Booster Pump) • Slope Excavations/ Site Clearance • Clearance of access road	Degrades Natural Habitat	3	2	6	- Less likely to happen as this site has already been occupied by human settlement. - Should there be any excavations disturbing site of importance, it will be reported to the authorities.
		Slope Erosion	3	3	9	- Gently batter unstable slopes in order to prevent loose soil to enter the waterway during rainy periods. - Regular monitoring shall be conducted.
		Surface water pollution due to increased sedimentation during excavation works.	3	3	9	- Sediment ponds shall be dug on the adjacent end of the excavation works in order to capture sediments, whilst allowing clean water to flow. - Regular monitoring shall be conducted.
		Slope Collapse from Excavation	2	3	6	- Gently batter the slope face to stabilize the slopes. - Regular Monitoring to be conducted.
		Disturbing the stability of Nearby House/ Adjourning structures.	3	3	9	- Pay compensation for the damaged structures if required.
		Pollution of ground water from hydrocarbon leakages	3	4	12	- Fuel and oil change shall be conducted only at designated workshops away from the work sites. - Conduct in situ water quality checks weekly to monitor water quality.
		Dust/Exhaust Fumes	3	4	12	- Using new equipment and machinery. - Maintaining and servicing machinery. - Conduct air quality monitoring regularly
		Noise pollution from machineries	3	4	12	- Using new equipment and machinery. - Maintaining and servicing machinery. - Conduct Noise level checks regularly

Critical Sections	Construction Activity	Risks (hazards to consider)	Likelihood If that site or sensitive receptors will be affected	Consequence If the site or sensitive receptors affected	Risk Score (consequence x likelihood)	Environmental Management Measures
		Solid waste/Excavated waste management.	3	2	6	- Identify stable sites for spoils disposal. - All solid waste shall be disposed of at authorized sites. - Burning of solid waste on site shall be prohibited.
		Accidental spills	3	4	12	- All fuel and oil change shall be conducted at the designated workshops. - Immediately clean up accidental spills of oil and fuel
		Protected/Endangered Species	3	3	9	- Prevent poaching animals/ birds during work. - All new species identified during work shall be reported to the relevant authority
		Worksite accidents	3	3	9	- Practice safe workplace practice. - Provide all workers with job specific PPEs e.g., Vests, shoes and masks for all workers. - Provide emergency contact details for all local health clinics in the area. - Provide first aid kit onsite with first aid training to selected workers in those worksites to apply first aid to any injuries onsite.
		Worksite threats	1	2	2	- Provide contact details for law enforcement authorities and councilors in the area. - PRO/CRO present onsite during work. - Communication devices are present onsite to communicate with Emergency Response team at the campsite.
		Emergency response cases onsite	1	2	2	- Provide Communication device onsite - Provide 24-hour vehicle onsite. - Induct workers on emergency protocol or evacuation techniques when facing an emergency onsite.

Critical Sections	**Construction Activity**	**Risks (hazards to consider)**	**Likelihood** If that site or sensitive receptors will be affected	**Consequence** If the site or sensitive receptors affected	**Risk Score** (consequence x likelihood)	**Environmental Management Measures**
		Occupational Health Issues	2	2	4	- Provide First Aid Kit onsite. - Provide proper PPE for the work. - Provide 24-hour vehicle onsite to transport to hospital and communication device.

3. Sensitive Receptor Site 3 – Reservoir 3 (high level)

144. The proposed site is located at Vanimo Hill overlooking the Town. This is the highest point within the project site reaching up to 60m asl.

145. The proposed site houses two telecommunication towers and Vanimo hill park, surrounding the proposed high level reservoir site are residential homes. Further downslope on the south face of the hill are several spring outlets; there is also the main spring source on the downslope north side of the slope.

Figure 15: Sensitive Receptor 3 – Reservoir 3

Table 23: Environmental Risk Assessment – Reservoir 3

Critical Sections	Construction Activity	Risks (hazards to consider)	Likelihood If that site or sensitive receptors will be affected	Consequence If the site or sensitive receptors affected	Risk Score (consequence x likelihood)	Environmental Management Measures
Reservoir 1 and Booster Pump.	• Installation of Reservoir 1 and Pumping station (High level Booster Pump) • Slope Excavations/ Site Clearance	Degrades Natural Habitat	3	2	6	- Less likely to happen as this site has already been occupied by human settlement. - Should there be any excavations disturbing site of importance, it will be reported to the authorities.
		Slope Erosion	3	3	9	- Gently batter unstable slopes in order to prevent loose soil to enter the waterway during rainy periods. - Regular monitoring shall be conducted.
		Surface water pollution due to increased sedimentation during excavation works.	3	3	9	- Sediment ponds shall be dug on the adjacent end of the excavation works in order to capture sediments, whilst allowing clean water to flow. - Regular monitoring shall be conducted.
		Slope Collapse from Excavation	3	3	9	- Gently batter the slope face to stabilize the slopes - Regular Monitoring to be conducted.
		Disturbing the stability of Nearby House /Adjourning structures.	3	3	9	- Pay compensation for the damaged structures if required.
		Pollution of ground water from hydrocarbon leakages	3	4	12	- Fuel and oil change shall be conducted only at designated workshops away from the work sites. - Conduct in situ water quality checks weekly to monitor water quality.
		Dust/Exhaust Fumes	3	4	12	- Using new equipment and machinery. - Maintaining and servicing machinery. - Conduct air quality monitoring regularly

Critical Sections	Construction Activity	Risks (hazards to consider)	Likelihood If that site or sensitive receptors will be affected	Consequence If the site or sensitive receptors affected	Risk Score (consequence x likelihood)	Environmental Management Measures
		Noise pollution from machineries	3	4	12	- Using new equipment and machinery. - Regularly maintaining and servicing machinery. - Conduct Noise level checks regularly
		Solid waste/ Excavated waste management.	3	3	9	- Identify stable sites for spoils disposal. - All solid waste shall be disposed of at authorized sites. - Burning of solid waste on site shall be prohibited.
		Accidental spills	3	4	12	- All fuel and oil change shall be conducted at the designated workshops. - Immediately clean up accidental spills of oil and fuel
		Protected /Endangered Species	3	3	9	- Prevent poaching animals/ birds during work - All new species identified during work shall be reported to the relevant authority
		Worksite accidents	3	3	9	- Practice safe workplace practice - Provide all workers with job specific PPEs. E.g. Vests, shoes and masks to all workers. - -Provide emergency contact details for all local health clinics in the area. - Provide first aid kits on site with first aid training to selected workers in those worksites to apply first aid to any injuries onsite.
		Worksite threats	1	2	2	- Provide contact details for law enforcement authorities and councilors in the area. - PRO/CRO present onsite during work. - Communication devices are present onsite to communicate with

Critical Sections	Construction Activity	Risks (hazards to consider)	Likelihood If that site or sensitive receptors will be affected	Consequence If the site or sensitive receptors affected	Risk Score (consequence x likelihood)	Environmental Management Measures
						the Emergency Response team at the campsite.
		Emergency response cases onsite	1	2	2	- Provide Communication device onsite - Provide 24-hour vehicle onsite - Induct workers on emergency protocol or evacuation techniques when facing an emergency onsite.
		Occupational Health Issues	2	2	4	- Provide First Aid Kit onsite - Provide proper PPE for the work - Provide 24-hour vehicle onsite to transport to hospital and communication device.

4. Sensitive Receptor Site 4 – Damili School

146. The Damili Primary School is situated within the proposed well bore site 2 and is approximately 300m south of the Vanimo main market. Drinking water is accessed through water wells within the school. The surrounding communities also access drinking water through water wells, the Damili Creek flows nearby, however it is not accessible for drinking. Health and sanitation are a major concern in the school as there is no sufficient supply of water.

Figure 16: Sensitive Receptor 4 – Damili School

Table 24: Environmental Risk Assessment – Damili School

Critical Sections	Construction Activity	Risks (hazards to consider)	Likelihood If that site or sensitive receptors will be affected	Consequence If the site or sensitive receptors affected	Risk Score (consequence x likelihood)	Environmental Management Measures
Damili School	• Well drilling and well pump installation • Site Clearance • Clearance of access road	Degrades Natural Habitat	3	2	9	- Less likely to happen as this site has already been occupied by human settlement. - Should there be any excavations disturbing site of importance, it will be reported to the authorities.
		Impact on local wildlife and local ecosystem	3	3	9	- Developing proper well designs - Spreading out the water pumping sites. - regulatory oversight to ensure compliance with environmental laws and permit requirements.
		Soil erosion and sedimentation	3	3	9	- Gently batter unstable slopes in order to prevent loose soil to enter the waterway during rainy periods. - Regular monitoring shall be conducted.
		Surface water pollution due to increased sedimentation during excavation works.	3	3	9	- Sediment ponds shall be dug on the adjacent end of the excavation works in order to capture sediments, whilst allowing clean water to flow. - Regular monitoring shall be conducted.
		Land disturbance	3	3	9	- Regulatory compliance. - Pay compensation for the damaged structures if required.
		Water table fluctuation	3	3	9	- Proper well designs
		Potential for aquifer depletion	3	4	12	- Developing proper well designs. - Spreading out the water pumping sites. - regulatory oversight to ensure compliance with environmental laws and permit requirements.
		Disturbing the stability of Nearby House /Adjourning structures.	3	3	9	- Pay compensation for the damaged structures if required.

Critical Sections	Construction Activity	Risks (hazards to consider)	Likelihood If that site or sensitive receptors will be affected	Consequence If the site or sensitive receptors affected	Risk Score (consequence x likelihood)	Environmental Management Measures
		Pollution of ground water from hydrocarbon leakages	3	4	12	- Fuel and oil change shall be conducted only at designated workshops away from the work sites. - Conduct in situ water quality checks weekly to monitor water quality.
		Dust/Exhaust Fumes	3	4	12	- Using new equipment and machinery. - Maintaining and servicing machinery. - Conduct air quality monitoring regularly
		Noise pollution from machineries	3	4	12	- Using new equipment and machinery. - Maintaining and servicing machinery. - Conduct Noise level checks regularly
		Solid waste/ Excavated waste management.	3	3	9	- Identify stable sites for spoils disposal. - All solid waste shall be disposed of at authorized sites. - Burning of solid waste on site shall be prohibited.
		Accidental spills	3	4	12	- All fuel and oil change shall be conducted at the designated workshops. - Immediately clean up accidental spills of oil and fuel
		Protected /Endangered Species	3	3	9	- Prevent poaching animals/ birds during work - All new species identified during work shall be reported to the relevant authority
		Worksite accidents	3	3	9	- Practice safe workplace practice. - Provide all workers with job specific PPEs. e.g., vests, shoes and masks to all workers. - Provide emergency contact details for all local health clinics in the area. - Provide first aid kit onsite with first aid training to selected workers in those worksites to apply first aid to any injuries onsite.

Critical Sections	Construction Activity	Risks (hazards to consider)	Likelihood If that site or sensitive receptors will be affected	Consequence If the site or sensitive receptors affected	Risk Score (consequence x likelihood)	Environmental Management Measures
		Worksite threats	1	2	2	- Provide contact details for law enforcement authorities and councilors in the area. - PRO/CRO present onsite during work. - Communication devices are present onsite to communicate with Emergency Response team at the campsite.
		Emergency response cases onsite	1	2	2	- Provide Communication device onsite. - Provide 24-hour vehicle onsite. - Induct workers on emergency protocol or evacuation techniques when facing an emergency onsite.
		Occupational Health Issues	2	2	4	- Provide First Aid Kit onsite - Provide proper PPE for the work - Provide 24-hour vehicle onsite to transport to hospital and communication device.

5. Sensitive Receptor Site 5 – Transmitter Field

147. The proposed well field 2 is situated in the Damili area (Wara Kongkong). The proposed site covers the Damili School, the NBC station and the Wara Kongkong settlement, which is inhabited by the settlers from Green River and Nuku.

Figure 17: Sensitive Receptor 5 – Transmitter Field

Figure 18: Sensitive Receptor 5 – Transmitter Field

Table 25: Environmental Risk Assessment – Transmitter Field

Critical Sections	Construction Activity	Risks (hazards to consider)	Likelihood If that site or sensitive receptors will be affected	Consequence If the site or sensitive receptors affected	Risk Score (consequence x likelihood)	Environmental Management Measures
Proposed Location for Groundwater Bore Site 2.	• Well drilling and well pump installation • Site Clearance • Clearance of access road	Degrades Natural Habitat	3	2	6	- Less likely to happen as this site has already been occupied by human settlement. - Should there be any excavations disturbing site of importance, it will be reported to the authorities.
		Impact on local wildlife and local ecosystem	3	3	9	- Developing proper well designs - Spreading out the water pumping sites. - regulatory oversight to ensure compliance with environmental laws and permit requirements.
		Soil erosion and sedimentation	3	3	9	- Gently batter unstable slopes in order to prevent loose soil to enter the waterway during rainy periods. - Regular monitoring shall be conducted.
		Surface water pollution due to increased sedimentation during excavation works.	3	3	9	- Sediment ponds shall be dug on the adjacent end of the excavation works in order to capture sediments, whilst allowing clean water to flow. - Regular monitoring shall be conducted.
		Land disturbance	3	3	6	- Regulatory compliance - Pay compensation for the damaged structures if required.
		Water table fluctuation	3	3	9	- Proper well designs
		Potential for aquifer depletion	3	4	12	- Developing proper well designs - Spreading out the water pumping sites. - regulatory oversight to ensure compliance with environmental laws and permit requirements.
		Disturbing the stability of Nearby House /Adjourning structures.	3	3	9	- Pay compensation for the damaged structures if required.
		Pollution of ground water from hydrocarbon leakages	3	4	12	- Fuel and oil change shall be conducted only at designated workshops away from the work sites. - Conduct in situ water quality checks weekly to monitor water quality.

Critical Sections	Construction Activity	Risks (hazards to consider)	Likelihood If that site or sensitive receptors will be affected	Consequence If the site or sensitive receptors affected	Risk Score (consequence x likelihood)	Environmental Management Measures
		Dust/Exhaust Fumes	3	4	12	- Using new equipment and machinery. - Maintaining and servicing machinery. - Conduct air quality monitoring regularly
		Noise pollution from machineries	3	4	12	- Using new equipment and machinery. - Maintaining and servicing machinery. - Conduct Noise level checks regularly
		Solid waste/ Excavated waste management.	3	3	9	- Identify stable sites for spoils disposal. All solid waste shall be disposed of at authorized sites. - Burning of solid waste on site shall be prohibited.
		Accidental spills	3	4	12	- All fuel and oil change shall be conducted at the designated workshops. - Immediately clean up accidental spills of oil and fuel
		Protected /Endangered Species	3	3	9	- Prevent poaching animals/ birds during work - All new species identified during work shall be reported to the relevant authority
		Worksite accidents	3	3	9	- Practice safe workplace practice - Provide all workers with job specific PPEs. E.g. Vests, shoes and masks to all workers. - Provide emergency contact details for all local health clinics in the area. - Provide first aid kit onsite with first aid training to selected workers in those worksites to apply first aid to any injuries onsite.
		Worksite threats	1	2	2	- Provide contact details for law enforcement authorities and councilors in the area. - PRO/CRO present onsite during work. - Communication devices are present onsite to communicate with Emergency Response team at the campsite.

Critical Sections	Construction Activity	Risks (hazards to consider)	**Likelihood** If that site or sensitive receptors will be affected	**Consequence** If the site or sensitive receptors affected	**Risk Score** (consequence x likelihood)	Environmental Management Measures
		Emergency response cases onsite	1	2	2	- Provide Communication device onsite - Provide 24-hour vehicle onsite - Induct workers on emergency protocol or evacuation techniques when facing an emergency onsite.
		Occupational Health Issues	2	2	4	- Provide First Aid Kit onsite - Provide proper PPE for the work - Provide 24-hour vehicle onsite to transport to hospital and communication device.

6. Sensitive Receptor Site 6 – Spring Outfall 1–5

148. All five spring outfall areas are situated at the foot of Vanimo hill facing the town area and area a few meters apart. The springs have a continuous flow even in the dry months of the year and serves the residents in the area. The area is occupied by residential homes.

Figure 19: Sensitive Receptor 6 – Spring Outfall 1

Figure 20: Sensitive Receptor 6 – Spring Outfall 2

Figure 21: Sensitive Receptor 6 – Spring Outfall 3

Figure 22: Sensitive Receptor 6 – Spring Outfall 4

Figure 23: Sensitive Receptor 6 – Spring Outfall 5

Table 26: Environmental Risk Assessment – Spring Outfall 1-5

Critical Sections	Construction Activity	Risks (hazards to consider)	Likelihood If that site or sensitive receptors will be affected	Consequence If the site or sensitive receptors affected	Risk Score (consequence x likelihood)	Environmental Management Measures
Spring Outfall 1- 5	• Pump installation • Site Clearance • Clearance of access road	Degrades Natural Habitat	3	2	6	- Less likely to happen as this site has already been occupied by human settlement. - Should there be any excavations disturbing site of importance, it will be reported to the authorities.
		Impact on local wildlife and local ecosystem	3	3	9	- Developing proper well designs - Spreading out the water pumping sites. - regulatory oversight to ensure compliance with environmental laws and permit requirements.
		Soil erosion and sedimentation	3	3	9	- Gently batter unstable slopes in order to prevent loose soil to enter the waterway during rainy periods. - Regular monitoring shall be conducted.
		Surface water pollution due to increased sedimentation during excavation works.	3	3	9	- Sediment ponds shall be dug on the adjacent end of the excavation works in order to capture sediments, whilst allowing clean water to flow. - Regular monitoring shall be conducted.
		Land disturbance	3	3	9	- Regulatory compliance - Pay compensation for the damaged structures if required.
		Water table fluctuation	3	3	9	- Proper well designs
		Potential for aquifer depletion	3	4	12	- Developing proper well designs - Spreading out the water pumping sites. - regulatory oversight to ensure compliance with environmental laws and permit requirements.
		Disturbing the stability of Nearby House /Adjourning structures.	3	3	9	- Pay compensation for the damaged structures if required.
		Pollution of ground water from hydrocarbon leakages	3	4	12	- Fuel and oil change shall be conducted only at designated workshops away from the work sites. - Conduct in situ water quality checks weekly to monitor water quality.

Critical Sections	Construction Activity	Risks (hazards to consider)	Likelihood If that site or sensitive receptors will be affected	Consequence If the site or sensitive receptors affected	Risk Score (consequence x likelihood)	Environmental Management Measures
		Dust/Exhaust Fumes	3	4	12	- Using new equipment and machinery. - Maintaining and servicing machinery. - Conduct air quality monitoring regularly
		Noise pollution from machineries	3	4	12	- Using new equipment and machinery. - Maintaining and servicing machinery. - Conduct Noise level checks regularly
		Solid waste/ Excavated waste management.	3	3	6	- Identify stable sites for spoils disposal. - All solid waste shall be disposed of at authorized sites. - Burning of solid waste on site shall be prohibited.
		Accidental spills	3	4	12	- All fuel and oil change shall be conducted at the designated workshops. - Immediately clean up accidental spills of oil and fuel
		Protected /Endangered Species	3	3	6	- Prevent poaching animals/ birds during works. - All new species identified during works shall be reported to the relevant authority
		Worksite accidents	3	3	6	- Practice safe workplace practice - Provide all workers with job specific PPEs. E.g. Vests, shoes and masks to all workers. - Provide emergency contact details for all local health clinics in the area. - Provide first aid kit onsite with first aid training to selected workers in those worksites to apply first aid to any injuries onsite.
		Worksite threats	1	2	2	- Provide contact details for law enforcement authorities and councilors in the area. - PRO/CRO present onsite during work. - Communication devices are present onsite to communicate with Emergency Response team at the campsite.

Critical Sections	Construction Activity	Risks (hazards to consider)	Likelihood If that site or sensitive receptors will be affected	Consequence If the site or sensitive receptors affected	Risk Score (consequence x likelihood)	Environmental Management Measures
		Emergency response cases onsite	1	2	2	- Provide Communication device onsite - Provide 24-hour vehicle onsite - Induct workers on emergency protocol or evacuation techniques when facing an emergency onsite.
		Occupational Health Issues	2	2	4	- Provide First Aid Kit onsite - Provide proper PPE for the work - Provide 24-hour vehicle onsite to transport to hospital and communication device.

7. Sensitive Receptor Site 7 – Wara Boil

149. Wara boil is a spring situated 300m south of the main Sepik Highway and approximately 200m from the timber yard. The spring is available all year-round and is used by the community living along the area.

Figure 24: Sensitive Receptor 7 – Wara Boil

Critical Sections	Construction Activity	Risks (Hazards to consider)	Likelihood If that site or sensitive receptors will be affected	Consequence If the site or sensitive receptors affected	Risk Score (consequence x likelihood)	Environmental Management Measures
Wara Boil	• Well drilling and well pump installation • Site Clearance • Clearance of access road	Degrades Natural Habitat	3	2	6	- Less likely to happen as this site has already been occupied by human settlement. - Should there be any excavations disturbing site of importance, it will be reported to the authorities.
		Impact on local wildlife and local ecosystem	3	3	9	- Developing proper well designs - Spreading out the water pumping sites. - regulatory oversight to ensure compliance with environmental laws and permit requirements.
		Soil erosion and sedimentation	3	3	9	- Gently batter unstable slopes in order to prevent loose soil to enter the waterway during rainy periods. - Regular monitoring shall be conducted.
		Surface water pollution due to increased sedimentation during excavation works.	3	3	9	- Sediment ponds shall be dug on the adjacent end of the excavation works in order to capture sediments, whilst allowing clean water to flow. - Regular monitoring shall be conducted.
		Land disturbance	3	3	9	- Regulatory compliance. - Pay compensation for the damaged structures if required.
		Water table fluctuation	3	3	9	- Proper well designs
		Potential for aquifer depletion	3	4	12	- Developing proper well designs. - Spreading out the water pumping sites. - regulatory oversight to ensure compliance with environmental laws and permit requirements.
		Disturbing the stability of Nearby House /Adjourning structures.	3	3	9	- Pay compensation for the damaged structures if required.

Critical Sections	Construction Activity	Risks (Hazards to consider)	Likelihood If that site or sensitive receptors will be affected	Consequence If the site or sensitive receptors affected	Risk Score (consequence x likelihood)	Environmental Management Measures
		Pollution of ground water from hydrocarbon leakages	3	4	12	- Fuel and oil change shall be conducted only at designated workshops away from the work sites. - Conduct in situ water quality checks weekly to monitor water quality.
		Dust/Exhaust Fumes	3	4	12	- Using new equipment and machinery. - Maintaining and servicing machinery. - Conduct air quality monitoring regularly
		Noise pollution from machineries	3	4	12	- Using new equipment and machinery. - Maintaining and servicing machinery. - Conduct Noise level checks regularly
		Solid waste/ Excavated waste management.	3	3	9	- Identify stable sites for spoils disposal. - All solid waste shall be disposed of at authorized sites. - Burning of solid waste on site shall be prohibited.
		Accidental spills	3	4	12	- All fuel and oil change shall be conducted at the designated workshops. - Immediately clean up accidental spills of oil and fuel.
		Protected /Endangered Species	3	3	9	- Prevent poaching animals/ birds during works. - All new species identified during works shall be reported to the relevant authority
		Worksite accidents	3	3	9	- Practice safe workplace practice. - Provide all workers with job specific PPEs. e.g., vests, shoes and masks to all workers. - Provide emergency contact details for all local health clinics in the area. - Provide first aid kit onsite with first aid training to selected workers in those worksites to apply first aid to any injuries onsite.
		Worksite threats	1	2	2	- Provide contact details for law enforcement authorities and councilors in the area. - PRO/CRO present onsite during works. - Communication devices are present

Critical Sections	Construction Activity	Risks (Hazards to consider)	Likelihood If that site or sensitive receptors will be affected	Consequence If the site or sensitive receptors affected	Risk Score (consequence x likelihood)	Environmental Management Measures
						onsite to communicate with Emergency Response team at the campsite.
		Emergency response cases onsite	1	2	2	- Provide Communication device onsite. - Provide a 24-hour vehicle onsite. - Induct workers on emergency protocol or evacuation techniques when facing an emergency onsite.
		Occupational Health Issues	2	2	4	- Provide First Aid Kit onsite - Provide proper PPE for the work - Provide 24-hour vehicle onsite to transport to hospital and communication device.

8. Sensitive Receptor Site 8 – Stoney Cave

150. Stoney Cave is a natural spring which flows all year round. The spring is situated within the proposed well field 1. The spring serves the communities within the area as well as communities living along the coast during dry periods.

Figure 25: Sensitive Receptor 8 – Stoney Cave

Table 27: Environmental Risk Assessment – Stoney Cave

Critical Sections	Construction Activity	Risks (Hazards to consider)	Likelihood If that site or sensitive receptors will be affected	Consequence If the site or sensitive receptors affected	Risk Score (consequence x likelihood)	Environmental Management Measures
Stoney Cave	• Well drilling and well pump installation • Site Clearance • Clearance of access road	Degrades Natural Habitat	3	2	6	- Less likely to happen as this site has already been occupied by human settlement. - Should there be any excavations disturbing site of importance, it will be reported to the authorities.
		Impact on local wildlife and local ecosystem	3	3	9	- Developing proper well designs - Spreading out the water pumping sites. - regulatory oversight to ensure compliance with environmental laws and permit requirements.
		Soil erosion and sedimentation	3	3	9	- Gently batter unstable slopes in order to prevent loose soil to enter the waterway during rainy periods. - Regular monitoring shall be conducted.
		Surface water pollution due to increased sedimentation during excavation works.	3	3	9	- Sediment ponds shall be dug on the adjacent end of the excavation works in order to capture sediments, whilst allowing clean water to flow. - Regular monitoring shall be conducted.
		Land disturbance	3	3	9	- Regulatory compliance. - Pay compensation for the damaged structures if required.
		Water table fluctuation	3	3	9	- Proper well designs
		Potential for aquifer depletion	3	4	12	- Developing proper well designs. - Spreading out the water pumping sites. - regulatory oversight to ensure compliance with environmental laws and permit requirements.
		Disturbing the stability of Nearby House /Adjourning structures.	3	3	9	- Pay compensation for the damaged structures if required.
		Pollution of ground water from hydrocarbon leakages	3	4	12	- Fuel and oil change shall be conducted only at designated workshops away from the work sites. - Conduct in situ water quality checks weekly to monitor water quality.

Critical Sections	Construction Activity	Risks (Hazards to consider)	Likelihood If that site or sensitive receptors will be affected	Consequence If the site or sensitive receptors affected	Risk Score (consequence x likelihood)	Environmental Management Measures
		Dust/Exhaust Fumes	3	4	12	- Using new equipment and machinery. - Maintaining and servicing machinery. - Conduct air quality monitoring regularly
		Noise pollution from machineries	3	4	12	- Using new equipment and machinery. - Maintaining and servicing machinery. - Conduct Noise level checks regularly
		Solid waste/ Excavated waste management.	3	3	9	- Identify stable sites for spoils disposal. - All solid waste shall be disposed of at authorized sites. - Burning of solid waste on site shall be prohibited.
		Accidental spills	3	4	12	- All fuel and oil change shall be conducted at the designated workshops. - Immediately clean up accidental spills of oil and fuel
		Protected /Endangered Species	3	3	9	- Prevent poaching animals/ birds during works - All new species identified during works shall be reported to the relevant authority
		Worksite accidents	3	3	9	- Practice safe workplace practice. - Provide all workers with job specific PPEs. e.g., vests, shoes and masks to all workers. - Provide emergency contact details for all local health clinics in the area. - Provide first aid kit onsite with first aid training to selected workers in those worksites to apply first aid to any injuries onsite.
		Worksite threats	1	2	2	- Provide contact details for law enforcement authorities and councilors in the area. - PRO/CRO present onsite during works. - Communication devices are present onsite to communicate with Emergency Response team at the campsite.

Critical Sections	Construction Activity	Risks (Hazards to consider)	Likelihood If that site or sensitive receptors will be affected	Consequence If the site or sensitive receptors affected	Risk Score (consequence x likelihood)	Environmental Management Measures
		Emergency response cases onsite	1	2	2	- Provide Communication device onsite. - Provide a 24-hour vehicle onsite. - Induct workers on emergency protocol or evacuation techniques when facing an emergency onsite.
		Occupational Health Issues	2	2	4	- Provide First Aid Kit onsite - Provide proper PPE for the work - Provide 24-hour vehicle onsite to transport to hospital and communication device.

VI. ANALYSIS OF ALTERNATIVES

151. Analysis of alternatives has been carried out including the “no project” alternative, and alternative locations. These are discussed below.

152. **“No project” alternative**. An analysis of the “no project” alternative indicates that residents of Vanimo town would continue to face limited access to clean and safe drinking water. This ongoing deficiency in water supply constrains both social infrastructure and economic development. Without intervention, the town’s potential as a major growth hub in Papua New Guinea—recognized but never fully realized—will remain hindered, largely due to the absence of essential urban services. In contrast, implementing the proposed subproject is expected to deliver substantial economic, social, and environmental benefits, helping to unlock Vanimo’s development potential and improve the quality of life for its residents.

153. **Alternative locations**. Multiple locations were evaluated for the siting of the wellfield, abstraction points, and reservoir infrastructure. In selecting these sites, priority was given to government-owned land to minimize the risk of involuntary resettlement. In cases where privately-owned land or customary owned was deemed the most suitable, formal lease agreements will be established with landowners to secure legal easements. To address any potential impacts related to land acquisition or displacement, a Resettlement Plan was prepared. This plan provides a framework for managing resettlement processes and ensuring that affected parties are adequately compensated in accordance with applicable safeguards.

154. **Hydrogeological study**. A comprehensive hydrogeological study will be undertaken to evaluate the suitability of the proposed wellfields and to explore alternative water sources, including potential spring water sites. This study will assess key factors such as aquifer capacity, recharge rates, water quality, and vulnerability to climate-related risks such as saline intrusion and reduced recharge due to rising temperature and sea level rise. The findings will be critical in determining the viability of the selected water sources and will directly inform the resilient design and long-term operational strategy of the subproject in Vanimo. Additionally, the study will support sustainable water resource management by identifying potential risks and recommending mitigation measures to ensure a reliable and safe water supply for Vanimo town.

155. **Summary and impact on resources.** The option for water supply will not significantly impact on the topography or geology of the area, it is noted that the physical resources relate mostly to existing road corridors and already developed areas. The do-nothing option will have no impact on the physical resources but there will be continued reliance on unsafe water supply, particularly in times of drought. It does not provide for future climate change impacts such as an increased frequency of dry periods. Ecologically, the preferred option is likely to have only minor impacts on ecological resources. This is because areas to be developed for all options are heavily modified. The construction works may temporarily disturb local wildlife in areas with adjacent tree habitat; however, these impacts are considered minor. For socio-economic resources, the do-nothing option will not improve current health issues with lack of access to water and continued contamination of existing supplies.

VII. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

A. Legislative Framework for Public Consultation

156. Public participation and consultation in the evaluation of project design, planning and implementation is an important part of environmental assessment as it directly reflects the public's perceptions on environmental quality in the project's area of influence. Relevant national and state regulations in PNG require public consultation, public disclosure, provision for submission of written comments, design review and approval. ADB's environmental guidelines also have detailed and strict requirements on public participation and consultation. The completed public consultation processes for this project have adhered to both PNG requirements and the ADB's Access to Information Policy, 2018.

B. Public Consultation Activities

157. The consultation process for the Vanimo Water Supply and Sanitation Subproject has been guided by the principles of ADB's SPS (2009), ensuring meaningful consultation, participation, and social inclusion throughout the project cycle. Engagements with local communities and authorities in Vanimo were conducted to disclose relevant project information, explain objectives, and address concerns related to water supply and sanitation improvements. In line with SPS requirement for inclusive consultation, focused discussions were held with vulnerable and marginalized groups, including women and persons with disabilities, to ensure their views and needs were considered and integrated into project design. Specific consultations, including interviews, were also conducted as part of the WASH Socioeconomic Baseline Survey in Vanimo Town, with particular attention to the gender dimensions of water access and management. Women, as primary household water managers, were given the opportunity to express their concerns and contribute to the planning process.

158. The consultations were carried out over a 12-month period between June 2024 and June 2025. However, stakeholder engagement for Vanimo Water Supply and Sanitation Subproject commenced as early as 2018, during the conceptualization phase. Initial consultations involved key stakeholders such as the Department of Lands and Physical Planning (DLPP), the Water and Sanitation Program Asia (WSPA), and landowner communities associated with the identified water sources. In June 2025, a multidisciplinary consultation team visited Vanimo to further engage the stakeholders and support project planning. The team included safeguards specialists, social and gender experts, project design and supervision consultants, WSPA focal representatives, Vanimo District Lands Officers, Water PNG Project Management Unit (PMU), senior lands and survey officers from DLPP, and senior project and safeguards officers from ADB's PNG Resident Mission. This coordinated and participatory approach ensured that technical, social, and environmental considerations were fully integrated into the subproject's design and implementation.

159. The list of stakeholders consulted is presented below, while a summary of the consultation outcomes is provided in the following section and detailed further in Appendix 1.

(i) National Level: Department of National Planning and Monitoring (DNPM), Kumul Consolidated Holdings (KCH), Department of Lands and Physical Planning (DLPP), and National Broadcasting Commission (NBC);
(ii) Provincial Level: West Sepik Provincial Government / Administration, West Sepik Provincial Lands Office, and Vanimo-Green Urban District Administration;
(iii) Local Government: Vanimo Urban Local Level Government, Ward Councilors, and Krisa Villagers (impacted communities).

(iv) Schools: Don Bosco Technical Collage, Vanimo Secondary School, St. Paul Primary School, and Vanimo Primary School;
(v) Hospitals and Clinics: Vanimo General Hospital and Catholic Diocese Clinics
(vi) Business Establishment: Vanimo Forest Products Limited and Vanimo local small and medium enterprises;
(vii) Law Enforcement Agencies: West Sepik Province Correctional Institution Services (CIS), PNG Defense Force (DF) based in Vanimo, and Royal PNG Constable (RPNGC) based in Vanimo;
(viii) Non-Government Organizations (NGOs): Wara Boil and Stoney Cave Community Groups;
(ix) Vulnerable Groups (e.g., people living with disabilities); and
(x) Informal Settlements in Vanimo Town: West Deco, Palai, and Transmitter.

160. It is noted that as the project progresses into implementation, continued stakeholder engagement will be undertaken to provide updates on construction schedules, anticipated impacts, and proposed mitigation measures. This iterative process of consultation aims to foster transparency, build stakeholder trust, and ensure that community feedback is continuously integrated into project implementation.

1. Consultation summary with affected people and community

161. Representatives of affected persons and community members residing near the water source areas, specifically in the Ware boil and Stoney Cave village settlements, as well as the communities of Wes Deco, Palai, and Transmitter settlements, were actively engaged during stakeholder consultation and community consultative meetings. These sessions were conducted onsite by the social and gender assessment and survey teams (**Error! Reference source not found.**).

Figure 26: Consultation Proceedings at Stoney Cave Settlement

162. In June 2024, more than 413 households, each comprising approximately 6 to 8 members, participated in the WASH Household Survey conducted as part of preparation of the Vanimo Water Supply and Sanitation Subproject. In addition to the survey, further consultations were held with over 200 individuals, including men, women, children, and community leaders from the settlement areas. These consultations aimed to inform stakeholders about the scope of the project and its anticipated impacts, particularly on land and physical assets such as food and tree crops, as well as small-scale businesses located along road easements where water reticulation pipelines will be installed.

163. The project teams provided detailed information on the implementation process and potential disruptions, ensuring that APs and communities were aware of the implications and had the opportunity to raise concerns. In Wara Boil and Stoney Cave, the proposed acquisition of customary land for spring sources and access roads raised concerns among landowners, particularly regarding compensation for affected tree crops, livelihoods, and access to water during construction. Despite these concerns, communities expressed strong support for the project, recognizing the urgent need for reliable water access, especially during dry seasons.

164. In Wes Deco, Palai, and Transmitter Field, the planned installation of reticulation pipelines was noted to potentially affect existing structures and improvements. Community members, however, welcomed the project and emphasized the importance of inclusive engagement, regular consultations, and transparent communication. Across all settlements, there was a consistent call for the project to create opportunities for local youth and unemployed individuals, and to ensure that mitigation measures are in place to address any disruptions or losses. The feedback gathered reflects a shared optimism about the project's benefits, alongside a desire for continued dialogue and fair treatment of affected persons.

165. At the community level, mechanisms such as outreach on the Grievance Redress Mechanism (GRM) and feedback collection ensured continuous dissemination of project information and integration or stakeholder views.

2. Other Stakeholder Groups

166. **Government Stakeholders**. Regular updates were shared between ADB and key government stakeholders, including WPNG, KCH, and DNPM. High-level meetings facilitated timely communication on design revisions, priorities, and implementation challenges. In June 2025, a joint consultation team, comprising technical and safeguards officers from WPNG, DLPP and ADB, conducted provincial-level consultations in Vanimo (**Error! Reference source not found.**). These focused on confirming the status of state leases and customary land for key infrastructure sites and presenting the updated scope of works.

167. **Vanimo Forest Products (VFP)** expressed strong support, noting that approximately 7 hectares of their land may be used for the installation of tube wells, a raw water holding tank, and a pump station. However, their final decision is contingent on confirming groundwater availability through technical assessments.

168. **National Broadcasting Corporation** (NBC) also showed general support but has not yet committed to land use, pending formal engagement and finalization of the detailed design.

169. **West Sepik Provincial Administration** has actively supported the project, confirming that key infrastructure such as reservoirs and pump stations will be located on vacant state land. They recommended land subdivision and lease issuance to WPNG and advised expediting negotiations with private and customary landowners where necessary.

170. **Other Institutions**, including schools, health centers, correctional services, and businesses welcomed the project as a long-overdue development. Many currently rely on boreholes that become saline during dry seasons, making the new water supply system a critical intervention for safe and reliable access. These stakeholders emphasized the importance of the project in improving public health and service delivery across Vanimo.

Figure 27: Provincial Consultative Meeting with Stakeholders in Vanimo (June 2025)

C. Information Disclosure

171. In accordance with the requirements under the SPS, ADB shall post on its website the following documents submitted by WPNG: (i) the final IEE, upon receipt by ADB; (ii) a new or updated environmental assessment document, and a corrective action plan, if any, prepared during project implementation, upon receipt by ADB. A copy of the IEE and EMP will be provided to the key stakeholders and community as part of information disclosure and the objective is to promote stakeholder trust, commitment to transparency, accountability, and participation by stakeholders. It also recognizes the right of people to seek, receive and impart information about the project.

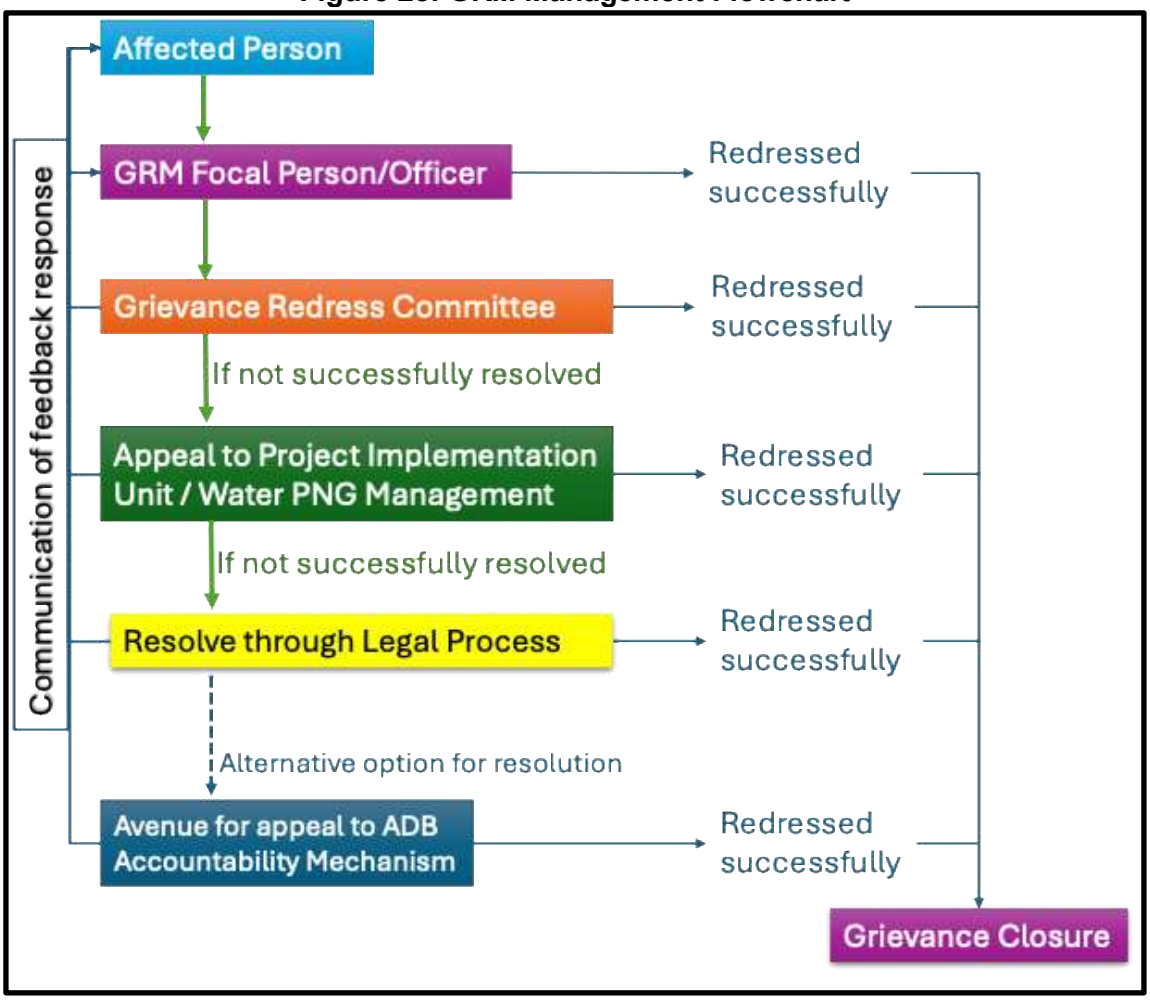
172. This IEE will be updated based on detailed design, results of the geological surveys and hydrological studies. WPNG will make it accessible to the public in accordance with ADB Access to Information Policy 2018. During implementation of the project, all environmental monitoring reports and corrective action submitted by WPNG will also be made available on the ADB website.

VIII. GRIEVANCE REDRESS MECHANISM

173. The Grievance Redress Mechanism (GRM) is a system established at early implementation of the project for managing complaints/grievances and serves as a response mechanism to and from project affected persons and stakeholders on the project's social and environmental performance. The GRM will address both verbal and written complaints throughout project implementation by receiving, assessing, responding to, and resolving them. It will be accessible (considering literacy levels), predictable (known procedures), timely (within a set timeframe), and transparent to address all environmental and social community grievances during pre-construction, construction and operational phases of the project. All concerns will need to be addressed quickly and transparently, and without retribution to the AP. The GRM in this context has been prepared based on existing frameworks. It is important to note in this context that at a project level, both environment and social grievance procedures will be

administered through the same WPNG and Provincial administrative framework with identified focal points with the exception, when grievances get escalated to the national regulatory framework. For environmental concerns, the GRM process outlined in **Error! Reference source not found.** will be followed. The process begins with an attempt to resolve the issue directly at subproject level.

Figure 28: GRM Management Flowchart



A. Roles and responsibilities

174. **GRM Focal Point in Vanimo.** To enhance accessibility and responsiveness, the PMU will coordinate with the West Sepik Provincial Administration (WSPA) and appoint an officer from the WSPA to be the focal for the Project's GRM in Vanimo until such time when WPNG establishes an office in Vanimo. The role of the focal person is to ensure the project related grievances are received, recorded in a grievance registry and inform the PMU and Grievance Redress Committee (GRC) when necessary. The focal person will ensure complaints received from affected people (AP), through verbal communication, social media or from written complaints via email or letters, are recorded and effectively communicated with the GRC and PMU. The focal point will assess the information provided in the complaint and either respond directly to the complainant with a proposed resolution or, if necessary, refer the grievance to the Project Grievance Redress Committee for further consideration and resolution. The focal point will collaborate with the Contractors and the PMU to identify practical solutions for minor and low-risk grievances. For more complex and high-risk grievances, the focal point will engage the GRC, as described below. Additionally, the focal will work closely with the affected communities and the Contractors on site on a daily basis doing awareness, consultations and listening to the stakeholders and APs, in return communicate any findings, issues or concerns to GRC and PMU. It is noted that once the PMU is established, the role of the GRM focal point will be passed to the safeguard's specialist in the PMU.

175. **Subproject Grievance Redress Committee.** A gender inclusive GRC will be established by the Project at the district/provincial level in Vanimo-Green District which will oversee all sensitive and high-risk grievances that are external in nature or requires government intervention at the district or provincial level. This GRC is composed of 5-6 members from the WSPA, including representatives from planning, environment, community development, lands & survey divisions, Vanimo Green District representative and Local Ward Councillors. A Community Women's Group or a Non-Government Organization (NGO) women's representative will be added to the committee to represent women. The GRC's primary role is to oversee the handling of environment and social risks, impacts, and complaints from communities affected by project in Vanimo and collaboratively identify mitigation measures.

176. **WPNG/Project Management Unit**. The PMU supported by the DSC will be based in Port Moresby and travels to Vanimo for periodic project site visits during project implementation phase. PMU is responsible for providing project related information and coordinate with the focal on daily basis in planning and coordination of activities in Vanimo and provides timely response to complaints. PMU may receive complaints from the focal or directly from the affected people and stakeholders and will ensure timely responses are provided. The Project's environmental and social safeguards and gender officer will ensure GRM is monitored, and records are updated on regular basis and guides the implementation to ensure all complaints are redressed and responded to in accordance with the ADB Accountability Mechanism (AM) requirements.

177. **Record and track keeping.** A Register of Complaints will be kept at the PMU office in POM. This registry will contain the following: dates received, names and gender of complainants, action/s taken, and personnel involved and remarks. All complaints received and resolutions will be properly documented and reported during quarterly and semi-annual reporting for public consumption and inform the management.

B. GRM Process.

178. The GRM will be established to receive and response to grievances coming from APs and stakeholder communities. The stakeholders and APs shall be informed about the focal person, GRC and the GRM process at early stages of the project implementation. Issues including clan differences, landowner disputes over water sources or other safeguards issues will be handled by the focal and the GRC and responses provided within 24 hours and 7 days. Other project-related grievances such as compensation, environmental impacts or technical project related matters shall be submitted to PMU and Water PNG Management for deliberation and responses provided within 14 days to 21 days. Grievance received and responses must be documented and reported in monthly/quarterly progressive reports. Affected person has the liberty to appeal to the local courts systems if their concerns are not fully resolved at provincial and project management and WPNG level.

179. **Steps of grievance redress process.** Once a grievance from a complainant has been lodged to the contractor's site office or the focal, the following steps will be followed for redressing the grievance:

Step 1 – Upon receipt of complaint(s), the focal will log the details in a grievance register recording the date, name of affected household, contact address and/or phone number, if available. The focal point will then share the details of the grievance with the PIU and issue an acknowledgment to the complainant within the day of receiving the grievance.

Step 2 – The focal point assesses the grievance and determines it validity and whether it is low-risk and can be easily and promptly resolved or whether it is high risk and requires the engagement of the GRC. If low risk, the focal point investigates the alleged complaint and provides a response to the complainant with a resolution. If the complainant is satisfied with the resolution, such resolution is recorded in the grievance registry and the grievance is closed. If grievance is unresolved at the project site level, or is a high-level risk, the focal will bring it to the attention of WSP Administration to resolve. If still unresolved, the GRC chairperson will call a meeting with the GRC members and organize a hearing session at the district level within 5-7 days for resolution process. The verdicts will be conveyed by the focal to the concerned affected person or stakeholder within 7 days' time. If the grievance is resolved to the satisfaction of the complainant, the resolution is recorded in the grievance registry and the grievance is closed.

Step 3 – If grievances are not resolved at the GRC level, then the focal will escalate the grievance to Water PNG Management, where resolution will be attempted within 14 and 21 days.

Step 4 – If grievance cannot be resolved at the WPNG Management level after 21 days then the affected person or stakeholder has the liberty to take their case to the appropriate regulatory authority and judicial process if necessary.

Step 5 – Only when issues cannot be resolved at this level, then the grievance moves to the resolution process as outlined in Section 87 of the Environment Act 2000. This procedure is for addressing environmental issues only. For social safeguards dealing with land and compensation issues, at a regulatory level they are to be directed at the Department of Lands who have established procedures for dealing with these issues.

180. **CEPA.** Should the complainant not be satisfied with the decision of the GRC and WPNG , the complainant may take the complaint to Secretary-CEPA and continue the grievance in accordance with Section 87 of the Environment Act 2000 i.e., procedure for dealing with compensation claims for environmental impacts. The procedure is set out as follows:

(i) A copy of the alleged impact is submitted to CEPA requesting CEPA to carry out a verification investigation.
(ii) If CEPA confirms that the impact has occurred, he/she will advise the EP holder and complainant to negotiate a settlement within 90 days.
(iii) If a negotiated settlement is not reached, the EP holder or complainant can request CEPA to formulate a determination. Once this request is made, SEC- CEPA will have 90 days to reach a determination.
(iv) If either party is dissatisfied with the determination, they can appeal to the National Court. Should the complainant not be satisfied with the ruling of the CEPA, the AP may at their discretion take the grievance to the PNG judicial system. This will be at the AP's cost but if the court shows that the CEPA or the administration have been negligent in making their determination the AP will be able to seek costs.

181. All of the foregoing steps will be recorded in an inventory/register and included in the contractor's monthly reports, project quarterly progress reports (QPRs) submitted to WPNG and ADB and semi-annual safeguards monitoring reports (SMRs).

182. **During operation.** The same procedure and the same conditions apply, i.e. there are no fees attached to the AP for making a complaint, the complainant is free to make the complaint which will be treated in a transparent manner and the AP will not be subject to retribution for making the complaint.

C. Other Measures Available

183. ADB's Accountability Mechanism also applies to the project. However, while the project level GRM is the responsibility of the DCCNR PMU, the Accountability Mechanism is the responsibility of ADB. The accountability mechanism provides opportunities for people (2 or more complainants) that are adversely affected by ADB-financed projects to express their grievances, seek solutions, and report alleged violations of ADB's operational policies and procedures, including safeguard policies. ADB's accountability mechanism comprises (i) consultation led by ADB's special project facilitator to assist people adversely affected by ADB assisted projects in finding solutions to their concerns and (ii) providing a process through which those affected by projects can file requests for compliance review by ADB's Compliance Review Panel. Details of the Accountability Mechanism can be found at: https://www.adb.org/documents/accountability-mechanism-policy-2012

D. Sexual Exploitation, Abuse and Harassment

184. Moving into the next stage of project implementation, and for the duration of the project, a specific SEAH procedure will be developed and implemented for integration into the GRM process. Development of SEAH standard operating procedures will require consultation with IA, the contractor and key project stakeholders to identify reporting mechanisms (including confidentiality) and capacity requirements.

IX. ENVIRONMENTAL MANAGEMENT PLAN

A. Objectives

185. This section outlines mitigation and management measures to avoid, minimize, mitigate, or offset adverse environmental impacts that have already been identified in the previous sections. The EMP serves as a management tool for managing these identified issues in accordance with the sequence of activities related to the pre-construction, construction and operational phases of the project. It also provides guidance on institutional arrangements and responsibilities to ensure mitigation, monitoring and reporting takes place meeting the requirements of ADB's SPS and the CSS. It is noted that as part of the contract, the EMP will be binding on all contractors and subcontractors. In summary it includes the following information:

(i) Implementation arrangements including institutional roles and responsibilities for EMP implementation throughout all phases of the project.
(ii) Environmental management matrices including:
    a. potential environmental impacts at each stage of the project;
    b. proposed mitigation measures to address each potential impact;
    c. costs associated with implementation of the mitigation measure;
    d. institutional responsibility for implementing proposed mitigation measures; and
    e. schedule of implementation of mitigation measures.

186. In line with the best international practices, the outlined EMP will be revised based on detailed design, and subsequently, the contractors will develop the CEMPs, describing their methodologies. These plans should undergo approval by the PMU/DSC, CEPA, and the ADB before implementation. The roles and responsibilities regarding various environmental management tasks, as well as the overall institutional framework, are discussed further below. The EMP provided aims to be generic across all subprojects to enable the consistent implementation of controls and allow for efficiency of implementation and reporting where applicable. In summary, the environmental assessment of the subproject indicates minor and site-specific impacts on the local environment and proposed environmental mitigation measures aim to prevent or minimize these impacts to acceptable levels

B. Institutional Arrangements and Responsibilities

187. Kumul Consolidated Holdings (KCH) will have the overall responsibility for the project as the Executing Agency (EA). WPNG as the key implementing agency (IA) is the agency responsible for implementation of the project, and subsequent operation and maintenance of the proposed infrastructure. The PMU under the WPNG supported by the DSC will support project implementation and conduct training and capacity building for KCH and WPNG and will be responsible for implementing the IEE and EMP. Table 28 summarizes the organizational responsibilities for the Vanimo Subproject.

Table 28: Organizational Environmental Responsibilities

Project Implementation Organization	Management Roles and Responsibilities
Asian Development Bank (ADB)	ADB will provide guidance as to the submission of periodic monitoring reports from WPNG that would meet ADB's standards and guidelines before these are uploaded onto ADB website for public viewing. ADB in this context is responsible for: • Review and approve IEEs/EMPs, and any updated EMPs • Review bidding documents

Project Implementation Organization	Management Roles and Responsibilities
	• Review EA's and IA's submissions for procurement of goods, equipment, works and services • Conducts project review missions, midterm review mission and project completion review mission to assess project implementation progress of all outputs, compliance of project to covenants including safeguards requirements • Review of quarterly progress and semi-annual safeguards monitoring reports (SMRs) • If required, provide advice to WPNG in carrying out its responsibilities to implement the EMP for the Project
Kumul Consolidated Holdings (KCH)	• Guide and monitor overall project execution. • Financial oversight • Ensure flow of funds to the implementing agency and the timely availability of counterpart funding
Water Papua New Guinea (WPNG)	Responsible for overall project implementation and monitoring at the implementing agency level. For environmental safeguards WPNG is responsible for: • Ensuring that Project, complies with the provisions of the EMP and SPS • Ensuring that Project implementation complies with Government environmental policies and regulations. • Providing and retaining sufficient resources to support EMP-related implementation issues. • Ensuring that the PMU commit environment and safety staff • Providing sufficient resources to PMU to enable proper and timely staffing, monitoring and reporting EMP/CEMP requirements • Submit quarterly progress and semi-annual monitoring reports to ADB • Assist in resolving complaints brought through the grievance redress mechanism (GRM) that have not been resolved at lower levels
Project Design Supervision Consultant (DSC)	The Consulting firm recruited to support PMU in overseeing project implementation, including international environmental consultant to support PMU with updating the IEE/EMP, and providing regular (monthly) on-site supervision during the construction period. In addition, they will be responsible for: • Responsible for oversight and providing guidance and strategic direction to WPNG PMU with respect to project implementation and environmental compliance • Establish systems and tools to monitor implementation of the approved CEMP and provide technical on-the-job training and support to partners, implementing agencies including contractor, local community, and government to ensure successful CEMP implementation, including mitigation • Ensure that the PMU is supplemented with the necessary resources to effectively carry out its duties and responsibilities
WPNG Project Management Unit (PMU)	The recruited PMU will be responsible for overall project management, implementation, and monitoring for compliance. Their environmental duties will constitute the following: • Review and coordinate evaluation of bids for works, goods, and consultant services • Responsible for WPNG's application for approvals

Project Implementation Organization	Management Roles and Responsibilities
	• Update the IEEs and EMPs based on the detailed design and submit to ADB for clearance. • Ensure environmental safeguard concerns are incorporated in the detailed engineering design • Disclose safeguard documents, as appropriate • Submit monthly, quarterly, semi-annual, and annual monitoring report to WPNG management • Review and clear the CEMP of contractors • Review contractor's monthly reports • Implement the GRM and maintain records of complaints/grievances • Ensure the contractor observes the GRM requirements • Ensure contractor compliance with required resources for mitigation measures as reflected in the CEMP • Submitting semi-annual environmental monitoring report to ADB • In case unpredicted environmental impacts occur during the project implementation stage, preparing and implementing (as necessary) a corrective action plan in consultation with ADB, CEPA and any other relevant government agencies.
PMU Environment Officer	The officer will work with the WPNG Safeguards team to oversee all environmental safeguard aspects of the project. The officer will be responsible for: ensuring that all environmental safeguard requirements of ADB and government are complied with, monitoring implementation of subprojects CEMPs; and preparing compliance reports for PMU. Duties will comprise the following: • Ensure IEEs/EMPs are updated based on the final detailed designs, if required, and their disclosure in locations and form accessible to the public • Coordinate with the preparation of bid documents for the inclusion of IEEs/EMPs and CEMP frameworks in the bidding documents and civil works contracts • Ensure required government permits and clearances are obtained by WPNG prior to actual construction activities • Ensure that contractor(s) obtained the environmental permit(s) and licenses specific to their scope of work prior to actual construction activities • Establish system for monitoring environmental safeguards of the Project as described in the IEEs/EMPs • Review, monitor, and evaluate the effectiveness of implemented mitigation measures and recommend corrective actions whenever necessary • Prepare monthly environmental monitoring reports for consolidation to the semi-annual monitoring reports for WPNG and ADB • Ensure GRM is activated prior to the start of construction • During construction, conduct site visits and coordinate with the project engineers to ensure that required environmental mitigation measures are implemented at the construction sites • Coordinate with the contractors' environment health and safety officers (EHSO) to ensure that environmental awareness trainings for workers are done.

Project Implementation Organization	Management Roles and Responsibilities
Contractor(s) / Subcontractor(s)	The principal contractor for each sub project location is responsible for: • Providing sufficient funding and human resources for proper and timely implementation of required mitigation measures in the EMP and CEMP • Prepares and submit prior to construction the CEMP for review by PMU's Environment Specialist for approval by PMU • Understand the EMP requirements and allocate necessary resources for implementation • Recruits qualified Environmental Health and Safety Officer (EHSO) to ensure that the contractor complies with all requirements concerning environmental, health and safety, and labor regulations during construction • Obtain statutory permits/clearances for establishment and operation of contractor(s) facilities • Implement construction activities with the required mitigation measures • Conduct environmental monitoring as required by EMP and as stipulated in the CEMP • Act promptly on complaints and grievances concerning the construction activities in accordance with the project's GRM • Submit monthly progress reports on CEMP/EMP implementation to PMU
PNG Conservation and Environment Protection Authority (CEPA)	CEPA is responsible for enforcement of the Environment Act 2000 and its regulations. They will be responsible for the following: • Responsible for processing approvals for WPNG and issuing notice to proceed/EP requirements for each subproject. • Monitors construction progress for compliance with the terms of the issued approvals • Monitors implementation of the mitigation measures and the CEMP in general

C. Mitigation Measures

188. Most of the pre-construction phase environmental mitigation measures are already established within best engineering design practices. The pre-construction work concludes with the integration of the EMP conditions into the bid and contract documents and the evaluation and selection of the contractor. Environmental impacts identified during construction are limited in size, site specific, and temporary in nature. The activities would normally be recognized as Best Construction Practices. While the scale of the construction works are relatively minor, sub-projects may still require the normal range of contractor's facilities such as site offices, workshops, storage areas, construction camp and temporary ablutions. For excavations, contractors must also consider existing utilities, liaising with provincial government utilities to avoid contact or damage of utility infrastructure such as telecommunication and electricity lines. Some operational environmental impacts are anticipated, including waste, wastewater, noise, fugitive dust, community and occupational health, and safety. These environmental impacts are anticipated to be minor and will be addressed through conventional operation and maintenance practices, health and safety codes and measures included in the operational aspects of the EMPs.

189. Implementation of the EMP and mitigation measures will ensure compliance with obligations under the CSS on environmental and social safeguards. The EMP will also ensure ADB's

safeguard standards are met. To ensure mitigation measures contained in the EMP are successfully implemented:

(i) The EMP will be updated after detailed design and after the geological survey and hydrological studies are completed;
(ii) The EMP will be included in tender documentation;
(iii) The contractor(s) shall prepare a CEMP describing the project and site-specific measures that will be implemented to comply with the EMP;
(iv) The contractor(s) will submit its CEMP to WPNG PMU for approval prior to the commencement of construction; and
(v) WPNG PMU will ensure that there are sufficient resources to oversee the implementation of the EMP at the project site.

D. Monitoring and Reporting

190. Environmental monitoring will be undertaken based on the project level of risk and the specific activities. It is noted that environmental monitoring will be required across all phases of project implementation. The objectives of environmental monitoring are to ensure:

(i) Mitigation measures are effective in reducing/managing impacts and identifying corrective actions as required
(ii) Safeguard requirements are being complied with by the contractor and the implementing agency (on behalf of the government).

191. The WPNG PMU will have overall responsibility for the management, monitoring and reporting of project implementation. The PMU will be supported by the DSC to deliver the monitoring and reporting requirements and will be responsible for liaising with the contractor and providing training, advice, and assistance in the preparation of the CEMP and its implementation as well as assisting in any baseline and follow-up monitoring required as well as conducting inspections and reporting on implementation of the CEMP for compliance. The monitoring timeframe will require daily inspections by the contractor/engineer/site supervisor, and monthly inspections by the PMU/DSC during the construction phase, particularly during critical activities related to site clearance, preparation, and earthworks.

192. The EMP (including monitoring requirements) is presented in Table 29. The EMP is prepared in a matrix form and describes the potential impacts, proposed mitigation measures, roles and responsibilities. This project, and all project activities to be financed by ADB and government, will be subject to ADB's SPS and PNG's CSS.

Table 29: Environmental Management and Monitoring Plan Matrix

Project Activity		Mitigation Measures			Monitoring	
Project Activity	Environment Impact	Proposed Mitigation Measures	Implementing Responsibility	Mitigation Cost	Frequency and Means of Monitoring	Monitoring Responsibility
Pre-Construction Phase						
Review EMP and integrate construction section of EMP in BCD / Preparation of Construction EMP submitted and approved	Environmentally responsible procurement	• BCD section "Special Conditions of Contract" will include the updated EMP and provisions from EMP section of IEE under Section 6 - Employer's Requirements and also within in Part 1 the Price; • Schedule 4 - BOQ, provisional sums included for the preparation and implementation of the CEMP and all subplans and procedures and for monitoring. • Inclusion of SPS Appendix 5 - Prohibited Investment Activities List in the BCD for compliance by contractor of subproject. • Specify in the tender document that the contractor shall engage appropriately qualified and experienced staff to take responsibility for the environmental management and safety issues at the working level and to monitor the effectiveness and review mitigation measures as the project proceeds. • Works Contractor to submit construction environmental management plan (CEMP) based on contractual EMP for approval by CSC (i.e., site clearance, waste and materials management, traffic, noise, and dust management etc.).	WPNG PMU / DSC Contractor	Project cost Part of the contractors' bid cost	Verified bid documents during bid preparation stage CEMPS approved after detailed design and before start of civil works	WPNG / ADB WPNG PMU / DSC
Environment and Other Permits	Compliance with CSS	• Obtain Environmental Compliance Certificated (ECC) or Environment Permit (EP) from CEPA	Contractor	Part of the contractors' bid cost	Relevant Environmental Permits (EP) secured before	WPNG PMU / DSC / CEPA

Project Activity		Mitigation Measures			Monitoring	
Project Activity	Environment Impact	Proposed Mitigation Measures	Implementing Responsibility	Mitigation Cost	Frequency and Means of Monitoring	Monitoring Responsibility
					commencement of civil works and as required	
Survey and Land acquisition	Land access	• Memorandum of Agreement (MOAs) / Lease Agreement with Landowners documented in updated RP. No physical or economic displacement to take place until compensation is complete	WPNG / Provincial Government / Land Department	As per RP	Monitoring of Resettlement Plan (RP) implementation. Stakeholder engagement with APs	WPNG PMU / DSC / DLPP
Climate change vulnerability and adaptation	Flooding affects investment infrastructure and drought incidences affecting catchment area, ground water recharge rates and saline intrusion into water lens.	• Conduct hydrological studies to identify areas with lower flood risk. Ensure that the infrastructures are built at a higher elevation than historical flood levels to minimize the risk of inundation. • Incorporate flood-resistant materials and construction techniques in the design of boreholes and treatment plants. This includes using waterproofing methods and elevated structures. • Hydrological study should also inform responsive design to droughts, potential sea level rise and implications for water catchment recharge and saline intrusion into the ground water lens. • Design systems that can be easily modified or upgraded in response to changing climate conditions or new flood data. • Create detailed emergency response plans that outline actions to take during flooding events, including evacuation procedures for	Detailed Design Consultant	Included in project cost as part of detailed design	Engineering drawings and specifications prepared once at the design verification stage	WPNG PMU / DSC / Provincial Government

Project Activity		Mitigation Measures			Monitoring	
Project Activity	Environment Impact	Proposed Mitigation Measures	Implementing Responsibility	Mitigation Cost	Frequency and Means of Monitoring	Monitoring Responsibility
		personnel and protection measures for equipment. • Engage local communities, government agencies, and other stakeholders in planning processes to ensure that adaptation measures are contextually relevant and supported by those affected. • Educate the community about flood risks associated with climate change and promote sustainable water usage practices that enhance resilience at the local level.				
Induction of contractor to site	Maintenance of environmental values by ensuring that contractor understands and addresses the CEMP conditions	• Contractor will undergo training and prepare and submit the CEMP. • Contractor together their environment officer responsible for supervising and monitoring the CEMP and all the staff concerned of the contractor will meet on- site where the CEMP requirements will be confirmed by the contractor. • Contractors will be informed of the grievance redress mechanism (GRM) recording and resolution requirements and protocols for addressing complaints, issues and concerns raised by the stakeholders during the construction. • Contractors will also be advised of the responsibility of securing environmental permits. All employees of the contractor will be made aware of the safeguards requirements and their obligations as stipulated in the CEMP.	Contractor	Included in project cost	Once, verify that induction has been carried out and contractor is competent to implement CEMP	WPNG PMU / DSC

Project Activity		Mitigation Measures			Monitoring	
Project Activity	Environment Impact	Proposed Mitigation Measures	Implementing Responsibility	Mitigation Cost	Frequency and Means of Monitoring	Monitoring Responsibility
Mobilization of the contractor, and presence of construction workers (influx of labor)	The presence of construction workers affects the community. Community protocols ignored and potential for conflict and unrest. Access to materials sites and any new operations not permitted or agreed creating conflicts and environmental impacts	• Community protocols will be discussed with workers as part of awareness and mobilization training. • Implementation of awareness and prevention program – workers. • Implementation of STI and HIV/AIDS awareness and prevention program – both for workers and community. • A Code of conduct (community protocols) agreed, and workers' awareness provided. • Contractor to ensure workers' actions comply with the code. • Signage and security at work site(s) and office compound – i.e. prohibition on unauthorized people (especially children) entering work site(s) etc. and workers' accommodation. • Maximization of local labor with as many local workers as possible will be hired and trained from the community. • Provide adequate housing for all workers who are not from the local area with hygienic living and cooking areas. • Worksites will have potable water for drinking, with sufficient water supply, worker canteen/rest areas and first aid facilities will be provided. Separate toilets shall be provided for male and female workers;	Contractor Approved service providers	Part of the contractors' bid cost	• Periodic audits of site offices, work sites and workers living accommodation throughout construction phase. • Reported number of worker incidents in the community. • STI/HIV/AIDS prevalence. • Number of awareness trainings prevention completed	WPNG PMU / DSC
GRM establishment	Community complaints due to project	• The PMU and the contractors will: • Establish the approved project level GRM • Publicize the existence of the project's GRM through campaigns, websites, billboards etc.	Contractor	Included in project cost	• Number of both verbal and written GRM complaints registered.	WPNG PMU / DSC

Project Activity		Mitigation Measures			Monitoring	
Project Activity	Environment Impact	Proposed Mitigation Measures	Implementing Responsibility	Mitigation Cost	Frequency and Means of Monitoring	Monitoring Responsibility
	related impacts	• Ensure that the contact details are visible on noticeboards and/or website.			• Once in early project implementation and ongoing throughout project implementation with verification of the number of valid complaints registered	
Extraction of local construction materials	Impact on local habitats	• The contractor will provide sufficient information about the source of construction materials to be used in the project. Sources such as quarries and borrow pits should be licensed and covered by required government permits.	Contractor	Part of contractor's bid cost	Periodic visual inspection of sources and verification of Government permits	WPNG PMU / DSC
Site mobilization and import of materials and equipment.	Introduction of Invasive Alien Species	• All construction equipment will be sourced locally. In case there is equipment and materials to be imported, these materials, including the vessels that import them will be subjected to clearance procedures under PNG's National Biosecurity • Legislation may require issuance of phytosanitary certificates from PNG Biosecurity Department.	Contractor and Biosecurity PNG	Part of contractor's bid cost	• Secure phytosanitary certificates and clearances • Verification of certificates	WPNG PMU / DSC
Site clearance and site preparation	Potential impacts on physical cultural resources	• Chance finds procedures included in CEMP. • Consultations as required with relevant authorities • Cease activities immediately. • Inform Provincial Authority. • Recommence works upon official instruction	Contractor and Provincial Authority	Part of contractor's bid cost	• Approved CEMP (including chance find procedures) • Visual inspection prior to and during site clearance and	WPNG PMU / DSC

Project Activity		Mitigation Measures			Monitoring	
Project Activity	Environment Impact	Proposed Mitigation Measures	Implementing Responsibility	Mitigation Cost	Frequency and Means of Monitoring	Monitoring Responsibility
					earthworks activities	
Construction Phase						
Construction work in general	Impacts on the sensitive receptors (community, churches, schools, hospitals, etc.)	• Use of the right construction methodology results in lesser disruption to the public, especially identified sensitive receptors.	Contractor	Included in contract cost	• Verification of construction methodology • Immediate verification of complaints received from communities.	WPNG PMU / DSC
Earth works and excavation	Soil erosion and sedimentation	Measures to divert surface runoffs away from the exposed areas and to prevent sediments from moving offsite may include: • small interceptor dikes, pipe slope drains, grass bale barriers, silt fence, sediment traps, and temporary sediment basins; • replanting disturbed areas The contractor will be required to prepare an erosion and sediment control plan as part of their CEMP.	Contractor	Included in contract cost	• Visual inspection of sites • Verification of plans • Daily during rainy periods	WPNG PMU / DSC
Spoil disposal	Impacts on rivers/streams, soil stability, community/agri. land through incorrect spoil disposal	• Spoil will be reused as far as possible for bulk filling. • Spoil will not be disposed of in rivers and streams or other natural drainage path. • Under no circumstances will spoil be dumped into any other watercourses (rivers, streams, drainage, irrigation canals, etc.). • Spoil disposal shall not cause sedimentation and obstruction of flow of watercourses, damage to agricultural land and densely vegetated areas.	Contractor	Included in contract cost	• Disposal of spoil to authorized site or permit granted • Inspection of disposal site • After submission of disposal plan	WPNG PMU / DSC

Project Activity		Mitigation Measures			Monitoring	
Project Activity	Environment Impact	Proposed Mitigation Measures	Implementing Responsibility	Mitigation Cost	Frequency and Means of Monitoring	Monitoring Responsibility
		• Surplus spoil will be used where practicable for local repair works to fill eroded gullies and depression areas and degraded land in consultation with local community. • Spoils shall only be disposed of in areas where the landowner has signed an agreement with the contractor following an evaluation of its environmental and social suitability approved by local authority and landowner. • The spoil disposal site shall be located at least 50m from surface water courses and shall be protected from erosion by avoiding formation of steep slopes and grassing. • Spoil disposal area slopes will be rehabilitated and re-vegetated when completed.				
Construction waste storage and disposal	Nuisance, health and safety impacts, land and/or water contaminatio n form improper storage and disposal	• Prepare and implement a Waste Management Plan (WMP) as part of CEMP before construction to cover all aspects of waste management, storage and disposal and accidental spills. • Burning of wastes associated with the project or the supporting activities is NOT allowed anywhere. • Segregation of wastes shall be observed. Cleared foliage, shrubs and grasses may be given to local farmers for fodder and fuel. Organic (biodegradables) shall be collected and disposed of on-site by composting (burning waste is not allowed anywhere within the sub-project site footprint). • Recyclables shall be recovered and sold to recyclers.	Contractor-	Included in contract cost	• Implementation of WMP provisions • Disposal of solid waste to authorized sites or permits granted. • Visual inspection of storage area on a daily basis and as necessary • Verification of records	WPNG PMU / DSC

Project Activity		Mitigation Measures			Monitoring	
Project Activity	Environment Impact	Proposed Mitigation Measures	Implementing Responsibility	Mitigation Cost	Frequency and Means of Monitoring	Monitoring Responsibility
		• Solid waste from the camps will be properly collected and disposed only at the approved disposal sites. • The contractor will maximize the recycling of used materials to minimize generation of waste. • Used wood and timber shall be reused for formwork and other appropriate works. • Recovery of materials will be encouraged, however if these cannot be recovered for scrap value these materials are to be taken to an approved landfill sites for final disposition. • Spillage, if any, will be immediately cleared with utmost caution to leave no traces. • The contractor will be required to display safety information in all work areas and to train workers in the safe use of these materials, including the provision of protective equipment for handling these substances.				
Use of Oil and hazardous materials and hazardous waste disposal	Accidental leak or spillage to surrounding environment	• Prepare and implement a Hazardous Material Management Plan as part of CEMP before construction to cover all aspects of management, storage, disposal and accidental spills. • Implement measures for clean-up and handling of contaminated materials. • Conduct training on how to handle fuel/hazardous substances and how to contain spills. • Provide spill cleanup materials such as absorbent pads.	Contractor	Included in contract cost	• Records of accidental releases • Training records of personnel for hazardous materials • Visual inspection of storage area • Daily and as necessary	WPNG PMU / DSC

Project Activity		Mitigation Measures			Monitoring	
Project Activity	Environment Impact	Proposed Mitigation Measures	Implementing Responsibility	Mitigation Cost	Frequency and Means of Monitoring	Monitoring Responsibility
		• Immediate clean-up of spills. • Collect and dispose of oil-stained waste and used oil through authorized waste handlers and waste facilities. • Restore temporary work sites will include removal, treatment, and proper disposal of oil contaminated soils.				
Vegetation removal, tree clearing;	Impacts on flora and fauna;	• Trees that need to be cut will be included in an inventory by the contractor in the pre-construction stage and trees that must be removed will be agreed with relevant stakeholders prior to cutting. • Vegetation clearing should be kept to a minimum and occur only within the designated construction limits. Trees shall not be indiscriminately cut but instead given root protection for replanting elsewhere if at all possible. • Vegetation clearance during surveying and demarcation activities will be minimized. • The contractor will be responsible for providing adequate knowledge to construction workers in relation to existing laws and regulations regarding illegal logging. • Cut timber shall not be used for fuel by the contractor but shall be removed from the roadside and returned to the owner. • Construction workers will be informed about general environmental protection and the need to avoid unnecessary felling of trees.	Contractor	Included in contract cost	• Tree/vegetation removal as per approved plan / only marked trees removed • Validate tree cutting permit • Training to workers • Implement re-vegetation plan	WPNG PMU / DSC

Project Activity		Mitigation Measures			Monitoring	
Project Activity	Environment Impact	Proposed Mitigation Measures	Implementing Responsibility	Mitigation Cost	Frequency and Means of Monitoring	Monitoring Responsibility
		• The contractor will be responsible for providing information to workers with respect to fauna. • Contract documents and technical specifications will include clauses expressly prohibiting the poaching of fauna by construction workers and the contractor will be responsible for imposing sanctions on any workers who are caught trapping, killing, poaching, or having poached fauna.				
Access and traffic safety	Disruption to users of the road/Public access affected and traffic disruption	• The contractor will prepare and submit a traffic management plan (TMP) detailing diversions and management measures as part of the CEMP. • Signs and other appropriate safety features such as use of flag men will be used to indicate that construction works are being undertaken. • Contract clause specifying that care must be taken during the construction period to ensure that disruptions to access and traffic are minimized and that access to villages is maintained at all times. • Construction vehicles will use local access roads or negotiate access with landowners. • The road will keep free of debris, spoil, and any other material at all times. • Provision of adequate protection to the general public in the vicinity of the work site, including advance notice of commencement of works, installing safety barriers if required by villagers, and signage or marking of the work areas.	Contractor	Included in contract cost	Assess the implementation of TMP provisions on a weekly or as required	WPNG PMU / DSC

Project Activity		Mitigation Measures			Monitoring	
Project Activity	Environment Impact	Proposed Mitigation Measures	Implementing Responsibility	Mitigation Cost	Frequency and Means of Monitoring	Monitoring Responsibility
		• Provision of safe access across the works site to people whose villages and access are temporarily affected.				
Disruption with and/or damage to existing infrastructure and utilities services	Services disrupted	• Inform affected communities well in advance of works that would disrupt the normal traffic or other activities. • Reconfirm power, telecommunications and irrigation systems are likely to be interrupted by the works and any additional trees to be cut near utilities. • Contact all relevant local authorities for utilities and local village groups to plan re-provisioning of power, water supply, telecommunications and irrigation systems. • Relocate and reconnect utilities well ahead of commencement of construction works and coordinate with the relevant utility company at the district and district levels for relocation and reconnection well before works commence and include for compensatory planting for trees. • If utilities are accidentally damaged during construction, it shall be reported and utility authority and repairs arranged immediately at the contractor's expense. • Village-based community awareness tp provide prior notification to affected households and establishments	Contractor	Included in contract cost and as per any agreements	• Monitoring of services relocated as per agreed plans • Monitor repair of damaged and rehabilitated utilities • Notification of affected households and establishments • Verification of coordination meetings and notifications • After completion of meetings and notifications	Contractor /- WPNG PMU / DSC Utility providers GRM
Construction dust and on-site air pollution	Climate change/greenhouse gas emissions	Implement measures to prevent dust generation: • Regular water spraying of roads, work areas and other construction-related facilities to minimize dust generation.	Contractor	Included in contract cost	Periodic monitoring of the implementation of relevant dust and	WPNG PMU / DSC

Project Activity		Mitigation Measures			Monitoring	
Project Activity	Environment Impact	Proposed Mitigation Measures	Implementing Responsibility	Mitigation Cost	Frequency and Means of Monitoring	Monitoring Responsibility
		• Provide cover in storage area of construction materials, stockpiles, and spoils to prevent fine materials from being blown. • Prohibit use of equipment and vehicles that emit dark sooty emissions. • Provide tight tarpaulin cover on delivery trucks to avoid spills and dust emission. • Prohibit the burning of all types of waste generated.			emission measures as per the CEMP	
Construction noise and vibration	Increase levels of noise emissions	Implement measures to minimize construction noise and vibration: • Limit construction hours; use noise barriers where feasible. • Regularly maintain equipment and machinery. • Prior notification to the community on schedule of construction activities especially nighttime activities. • Provide noise reduction covers on noisy equipment. • Position stationary noisy equipment (genset, compressors, batching, and rock crushing plant, etc.) away from houses and other sensitive receptors. • If possible, avoid working during nighttime (19:00-06:00). • Conduct regular noise level monitoring (the limits near residential area are 55 and 45 dB(A) during daytime and nighttime, respectively) if required.	Contractor	Included in contract price	Noise monitoring using the meter on a daily basis or as necessary	WPNG PMU / DSC

Project Activity		Mitigation Measures			Monitoring	
Project Activity	Environment Impact	Proposed Mitigation Measures	Implementing Responsibility	Mitigation Cost	Frequency and Means of Monitoring	Monitoring Responsibility
Public Safety	Community health and safety risks	Implement measures for community health and safety: • Engage local communities, government agencies, and other stakeholders in planning processes to ensure that adaptation measures are contextually relevant and supported by those affected. • Educate the community about flood risks associated with climate change and promote practices that enhance safety at the local level. • Use barriers and install safety signage. • Provide security personnel in hazardous areas to restrict public access. • Where nighttime works is required, operate construction night light at the vicinity of construction sites. • Provide adequate safe passageways for the public crossing the construction sites. • Advise local community of site health and safety site plans and seek feedback on appropriate mitigation measures via Community Advisory Committee meetings.	Contractor	Included in contract cost	• Inspection of safety control such as signages, lighting, and barriers • Review health and safety records (near miss, first aide, lost time accident) • Verification of construction safety policy and health and safety records • Daily visual site inspection	WPNG PMU / DSC
Construction site safety	Occupational health and safety at work sites	Measures include: • Implement a health and safety plan (HSP) as part of their CEMP. • Ensure that a first aid station is always available. • Provide appropriate personal protective equipment (PPE). • Provide emergency response equipment such as fire-fighting equipment, fire extinguishers, etc.	Contractor	Included in contract price	• Inspect first aid station, PPE, emergency response equipment • Verification of health and safety plan sanitation facilities	WPNG PMU / DSC

Project Activity		Mitigation Measures			Monitoring	
Project Activity	Environment Impact	Proposed Mitigation Measures	Implementing Responsibility	Mitigation Cost	Frequency and Means of Monitoring	Monitoring Responsibility
		• Provide potable water and adequate sanitation facilities. • Where labor accommodation is required, provide adequate and well-ventilated camps, clean eating areas, and separate sleeping quarters for male and female workers			• Review of health and safety records (near miss, first aide, lost time accident) • Daily visual site inspection	
Excavation and pipelaying activities	Potential damage to hidden archaeological and cultural assets.	Tender documents and construction contract will require the following: • Chance finds procedure to be added in the CEMP • Immediate stoppage upon discovery of archaeological and cultural assets • Inform the local authorities about the presence of physical cultural resources.	Contractor	Included in contract cost	• Assess whether the chance fine procedure is in place • Monthly checks of implementation.	WPNG PMU / DSC
Construction completion	Improper closure of construction sites after subproject completion.	• Site restoration and removal of all temporary facilities, excess materials, equipment, plant, and excavated materials on site; all dumping shall be to approved locations	Contractor	Included in contract price	• Visual site inspection of disturbed sites, staging areas, and worker sites • Review and “clear” site remediation through issuance of completion certificate • Once when all site work is complete	WPNG PMU / DSC
Operational Phase						

Project Activity		Mitigation Measures			Monitoring	
Project Activity	Environment Impact	Proposed Mitigation Measures	Implementing Responsibility	Mitigation Cost	Frequency and Means of Monitoring	Monitoring Responsibility
Infrastructure maintenance	Health and safety risks during operation and maintenance	• Identification of potential causes • Provision of written management procedures • Provision of written standard operating procedures (SOPs)	WPNG operations department	WPNG operational cost	• Verification of management procedures, SOPs, and records • Routine maintenance records. • Visual inspections	WPNG
Water quality	Health hazard due to unplanned delivery of poor water quality	Implementation of Water Supply Plan to: • prevent contamination of the water sources, • treat the water to meet the water quality targets, and • prevent re-contamination during storage, distribution, and handling of drinking water	WPNG operations department	WPNG operational cost	• Verification of WSP implementation • Water sampling and laboratory test as per standards	WPNG

X. MONITORING AND REPORTING

193. Environmental monitoring is an integral component of environmental assessment to (i) combat uncertainties pertaining to unanticipated impacts; (ii) ensure mitigation measures are working; and (iii) reassure the public on the progress of the development. Progressive monitoring must accompany various stages of the sub-project activities (preconstruction, construction, and operational phase). The monitoring program will be conducted on two levels (i) baseline monitoring and (ii) compliance monitoring, to determine the extent of variations and changes in the levels of pollutants in the environment and other parameters and indicators considering the implementation or operation of the subproject. Environmental monitoring meets two objectives to ensure: (i) that mitigation measures are effective in reducing/managing impacts, and identify corrective actions as required; and (ii) that safeguard requirements are being complied with by the contractor and the implementing agency (on behalf of government).

194. **Preconstruction monitoring**. During the pre-construction phase, any gaps in the baseline will be filled. It is in the pre-construction phase where requirements for environmental monitoring in the construction phase can be legally required by placing specific provisions on environmental monitoring in the: (i) subproject specifications, (ii) bidding documents, and (iii) construction contracts. Relevant aspects of each subproject's EMP shall be incorporated in these documents.

195. **Construction Monitoring**. Contractors are expected to implement the relevant aspects of each subproject's EMP as per their approved CEMP during execution of the construction activities as stipulated in their contracts. The contractor's CEMP will detail the monitoring plan (based on the EMP) with details on staff, resources, implementation schedules, and monitoring procedures (parameters, frequency etc.). Compliance with the approved CEMP will be the basis for inspections and audits by WPNG PMU and ADB. The Bidding Documents will include provisions requiring the contractor to submit their CEMP which will include a section on monitoring which should be linked to allocation of budget and staff resources for implementation.

196. **Reporting**. The quarterly progress report (QPR) of the WPNG PMU will summarize the contractor's monthly reports with respect to safeguards as well as any grievances lodged. The semi-annual safeguards monitoring reports (SMR) prepared by the WPNG PMU (supported as required by the DSC) will be submitted to ADB and will incorporate the monthly and quarterly reporting. Reporting will adhere to the following schedule:

(i) A monthly report prepared during construction by the contractor reporting on the progress of CEMP activities, issues, and corrective actions;
(ii) A quarterly progress report (QPR) prepared by WPNG PMU will include a section on environmental safeguards and CEMP compliance for each subproject and will summarize the monthly reports submitted by the contractor and any actions or citations made by the Project Engineer;
(iii) A semi-annual safeguard monitoring report (every 6 months) prepared by the WPNG PMU will be submitted to ADB for review and disclosure. An outline of the SMR is provided in Appendix 3; and
(iv) The project completion report (PCR) will include a section on safeguards implementation and make recommendations as required for modifications to the EMP procedures based on the review undertaken at the end of the project. The safeguards section will be prepared by the WPNG PMU three months prior to the end of the project.

XI. CONCLUSIONS

197. The proposed Subproject 1A presents a significant opportunity to improve public health and water security through enhanced infrastructure in its objective to deliver a sustainable and climate-resilient water supply system to approximately 80% of the households in Vainimo. These households rely on rainwater harvesting and shallow wells, which is becoming increasingly unreliable due to rising water demand and climate variability. A key component of the subproject involves developing a new wellfield in a coastal aquifer. This introduces potential long-term risks of saline intrusion, particularly during the operational phase. These risks are exacerbated by climate change impacts such as reduced recharge rates and sea level rise. Currently, there is insufficient data on the aquifer's hydrogeological properties to fully assess these risks. A detailed hydrogeological investigation will be conducted to inform the resilient design and operation of the wellfield. This IEE report will be updated once this study is completed.

198. The overall finding of the IEE is that the proposed works will not cause any significant adverse environmental impacts, provided that adequate mitigation measures are implemented. The proposed mitigation measures are prescribed in the EMP and the EMP will guide development of the contractor's CEMP in the construction phase once detailed design has been confirmed. The CEMP will incorporate erosion and sediment control measures, a waste management plan and traffic control measures. Supervision of the EMP will be by the PMU and DSC safeguard specialists reporting to WPNG, who will act on behalf of the Government and will report regularly to the ADB.

199. This environmental assessment and the EMP are considered sufficient to meet the ADB SPS requirements and PNG's CSS. The proposed classification of Category B for environmental impact is confirmed and the IEE will be made publicly available in project areas and disclosed via the ADB and WPNG websites. Stakeholder consultation will continue throughout project implementation to ensure inclusive participation and transparency and the project's GRM contains measures for resolving any complaint or issues raised throughout the implementation of the subproject,

COMMUNITY CONSULTATIONS

Table 30: Initial Engagement with Provincial Authorities

Date	Participants	Key Topics Discussed	Outcomes & Commitments
May 20, 2024	Acting Provincial Administrator, Conrad Tilau	Support for project surveys; need for formal support	Mr. Tilau acknowledged email; to draft formal support letter to Water PNG CEO
July 24, 2024	Acting Deputy Provincial Administrator, Dickson Dale	Project progress update; land support; community needs	Personal support expressed; appointed Johnson Siren to assist field activities; support for water supply urgency
July 25, 2024	Acting Director of Community Development Services, Diane Tumku	Community development programs; gender and social safeguards	Highlighted rights-based approach; emphasized gender issues and community empowerment needs
July 29, 2024	Acting Provincial Lands Advisor & Surveyor, Sylvester Nakia	Land site assessments; land status of infrastructure sites	Confirmed sites are on state land; risk of encroachment at Tank 2 site; need for land compliance procedures

Table 31: Community Engagement Sessions

Date	Participants	Key Topics Discussed	Outcome
31 July 2024	Local residents, women's groups, disability advocates	Water and sanitation needs, gender and disability inclusion, safety concerns	Collected community input; prioritized infrastructure needs; identified gaps in accessibility and safety

Table 32: Interviews and Surveys

Type of Meeting	Date	Participants	Key Points & Findings	Follow-up Actions
WaSH Household Survey	July 26 – August 2, 2024	413 households	Heavy reliance on rainwater (67%), limited access (27%), gendered water collection responsibilities, willingness to pay for piped water (~K65/month), sanitation safety issues	Data to inform infrastructure, gender-sensitive planning, and community education initiatives
Focus Group Discussions	July 30, 2024	Community representatives, women, persons with disabilities	Infrastructure gaps, risks faced by vulnerable groups, water access challenges, sanitation issues, health and safety concerns	Design inclusive infrastructure and implement community capacity-building programs
Community Hubs & Institutional Interviews	Various	Hospitals, schools, hotels, military bases	Water quality, maintenance issues, resource constraints, gender and social inclusion efforts	Recommendations for resource allocation, improved maintenance, and institutional collaboration

Type of Meeting	Date	Participants	Key Points & Findings	Follow-up Actions
Key Informant Interviews	July 26, 2024	Hardware shops, water service providers	Demand peaks during dry season, plumbing supply challenges, lack of regulation, need for standard practices	Develop plumbing standards, strengthen local ser

Table 33: Results of Consultation Activities with Affected Communities

Settlements	Communities are informed about Project Activities and Impacts	Vies from Affected Communities and Landowners
Wara boil	Spring source is located within customary land and is owned by landowners from the Krisa Village. If the hydrogeological assessment and bore development validates that surface water is one of the sources because of inadequate ground water availability, then the landmass that is planned to be acquired is 900m^2 (30m x 30m). Tree crops and improvements will be affected by land acquisition.	Communities generally support and welcome the Water Supply Project in Vanimo Urban, as many families—including women, girls, the elderly, and those who are unwell—face significant challenges accessing clean water during the dry season. The Wara Boil water source is widely used by local residents who raised important questions regarding the availability of alternative water supplies for affected persons (APs) during construction, as well as whether compensation will be provided for any loss of livelihood or economic trees.
Stoney Cave	The Stoney Cave Spring source is located within customary land and is owned by landowners of the Krisa Village. If the hydrogeological assessment and bore development validates that surface water is one of the sources because of inadequate ground water availability, then the landmass that is planned to be acquired is 900m^2 (30m x 30m). In addition, an access road with land area 10 m x 200 m (2,000m^2) will be required for accessibility to the spring water.	Communities generally support and welcome the Water Supply Project in Vanimo Urban, as many families—including women, girls, the elderly, and those who are unwell—face significant challenges accessing clean water during the dry seasons. The Wara Boil water source is used by many households in the area. During construction, access to this source will be restricted, raising concerns about the availability of alternative water supplies for affected persons APs. Women and girls, in particular, may face difficulties fetching water from distant or elevated locations due to the challenging terrain. It is important to clarify whether alternative water supply arrangements will be provided during the construction period. Additionally, questions remain regarding whether households will be compensated for the loss of livelihoods, economic trees, and customary land affected by the project.
Wes Deco	The reticulation water pipe system will pass through several communities, potentially impacting existing improvements. These impacts will be assessed by the Project, and appropriate mitigation measures will be developed to address them.	Communities generally support and welcome the Water Supply Project in Vanimo Urban, as many families—including women, girls, the elderly, and those who are unwell—face significant challenges accessing clean water during the dry season. Community members have expressed a strong desire to be engaged and involved in the project, particularly by creating opportunities for local

Settlements	Communities are informed about Project Activities and Impacts	Vies from Affected Communities and Landowners
		youth and unemployed people. They have also emphasized the importance of ongoing consultation throughout the implementation phase to ensure their views and needs are adequately considered.
Palai	The reticulation water pipe system will pass through several communities, where it may affect existing structures and improvements. These potential impacts will be assessed by the Project, and appropriate mitigation measures will be put in place to minimize or address them.	Communities generally support and welcome the Water Supply Project in Vanimo Urban, as many families—including women, girls, the elderly, and those who are unwell—have faced significant challenges accessing clean water during the dry season. Community members have expressed their desire to be actively engaged and involved in the project. They have called on the Project and the WSPA to conduct regular consultations and keep the public well informed about project activities. In particular, they have emphasized the importance of creating opportunities for local youth and unemployed persons and ensuring that communities continue to be consulted throughout the implementation phase.
Transmitter	The reticulation water pipe system will pass through community areas and may affect existing improvements such as fences, gardens, or small structures. These impacts will be assessed by the Project, and appropriate mitigation measures will be developed and implemented to minimize disruption and address any losses.	Communities generally support and welcome the Water Supply Project in Vanimo Urban, as many families—including women, girls, the elderly, and those who are unwell—have experienced ongoing challenges in accessing clean water during the dry season. Community members have expressed a strong interest in being actively engaged and involved in the project. They have called on the Project and the WSPA to ensure regular consultation and transparent communication with the community. In particular, they have emphasized the importance of involving local youth and unemployed individuals in any employment or training opportunities generated by the project.

Table 34: Result of Consultation Activities in Vanimo

Stakeholders	Information dissemination and Project Awareness	Views from Stakeholders Interviewed
Vanimo Forest Product Limited	The Project proposed to install 9 x tube wells station, raw water holding tank (600kL) and pump station. The land area requirement for the installation includes: - 8m x8m x 9BH + (Holding tank) - 40m x 30m + 11m x 11m (TPS)	The management of Vanimo Forest Products Ltd (VFP) has expressed strong support for the Water Supply Project in Vanimo. The company owns approximately 7 hectares of land that may be relevant to the project. However, VFP management emphasized that a final decision on land use cannot be made until the availability and capacity of groundwater at the proposed site

Stakeholders	Information dissemination and Project Awareness	Views from Stakeholders Interviewed
	Land required is 1,897m^2 = 2,000 m^2 and - 250m x 250m = 62,500m2 (considering 50-100m tube wells apart) Land Required is 62,500m2 (6.2ha) **Total land requirement: 6.4 ha**	are confirmed. The company noted that it currently operates a borehole that supplies water to the township during dry seasons. While VFP is open to supporting the development of a permanent water supply system for Vanimo Urban, its support is contingent upon technical confirmation—through water drilling—that the site has sufficient groundwater capacity to meet urban supply needs.
National Broadcasting Commission	The total area of the transmitter field is approximately 7.5 hectares. This site will accommodate key infrastructure components, including the water treatment plant, a pump station, an operator's duplex residence, Reservoir 1A, and nine bore wells. The bore wells will be spaced approximately 50 to 100 meters apart. Based on this configuration, the estimated total area of **land required for acquisition is approximately** (measuring 275 meters by 250 meters – 68,750) or **6.9 ha**.	The management of the National Broadcasting Corporation (NBC) has not yet made a formal commitment regarding the use of its land for the Project. NBC has advised that WPNGL should formally engage with NBC management to discuss the specific land requirements. While NBC has expressed general support for the Project, the exact area of land to be allocated will only be confirmed once the detailed design is finalized.
West Sepik Provincial Administration	Water Reservoir 2, located at Makepa, and the elevated Reservoir 3 at Tower Hill are both situated on vacant state land. The proposed transfer pump station will be installed to the northwest of Lots 10, Section 13. Additionally, the installation of the water supply reticulation pipes will require a 2–3-meter-wide corridor along existing road easements.	The WSPA and the Vanimo District have expressed strong support for the Project and actively participated in consultation events. The Provincial Lands Office was consulted and has provided cadastral survey plans. They recommended the subdivision of vacant state land and the issuance of a lease to Water PNG Limited (WPNG) for the installation of project facilities. In addition, WPNG and WSPA will initiate negotiations with the land title holder of Lot 10, Section 13 for the portion of land required to construct the transfer pump station.
Education, Health and Correctional Service Institutions, NAC and Businesses houses	The proposed water reticulation system will pass through the front porch areas of some properties.	Public and private institutions in Vanimo township have welcomed the Water Supply Project, recognizing it as a long-overdue development for the province after 50 years of independence. Nurses, teachers, and Correctional Institution Service (CIS) officers noted that they currently rely on boreholes for water, which often become saline during dry periods, rendering the water unsafe for use. The Vanimo Water Supply Project is therefore seen as a critical intervention to address the township's ongoing need for safe and reliable water.

Table 35: Stakeholder Consultations

Stakeholder	Number of Person Consulted	Date and Time Consulted	Consultation Notes	Picture
WSP Provincial Administration (joint meeting in Conference Room)	1. Albert Mutumap (Acting Deputy Provincial Administrator) 2. Benjamin Yalehen (Acting Director - WB) 3. Daniel Waranduo (Acing Director Lands, Provincial Lands Division) 4. Paul Jimmy (Acting Director, National Functions) 5. Johnson Siren (Senior Planner) 6. Martin Arket (Senior Business Development Officer/ Commerce)	Date: 12 June 2025 Time: 8am to 11am	• Project information shared with the WSPA. • WSP has a project steering committee which acts as GRC. • Appointing Senior provincial planner as focal for the Project • WSPA supports the project • Town is growing and the need for water is increasing. • Vanimo Ports and the Coastal Highway developments will bring in services thus need for water is there. • Provincial lands with coordination with the national lands office for sub-division of land required for the Project. • WSPA will submit a letter to WPNG informing the Project about the Focal and GRC.	
WSP Lands Division (Meet at Medallion Hotel)	1. Daniel Waranduo (Acing Director, Provincial Lands) 2. Paul Jimmy (Acting Director, National Functions)	Date: 11 June 2025 Time: 9am - 10am	• Project information shared with the WSP Lands Division. • Introducing the provincial lands team • Information shared about the NBC and VFP land requirements. • DLPP - coordination between provincial and national lands officers on assigned tasks and responsibilities. • Specific requirements on acquisition of land for water project at NBC.	

Stakeholder	Number of Person Consulted	Date and Time Consulted	Consultation Notes	Picture
Vanimo CIS	2 (1 CIS Director and 1 Project Officer/Senior Planner.	11 June 2025 3pm to 3:30pm	• Project information shared with the WSP CIS Director and Senior Project Planner. • CIS has over 200 inmates and more than 50 staff members and families that uses ground water and rainwater catchments as water sources. • CIS use electric water pump and costs a lot to maintain the pump. • The capacity of prison camp is 100 inmates but there is 100% increase over the last 5-10 years and the camp is overcrowded. • CIS Director is pleased to hear that WPNG will construct and install water supply and they are happy to be consulted on this important project.	
Vanimo Hospital	3 (two nurses attended the consultation workshop and 1 executive management)	12 June 10am-10:30am	• Vanimo Hospital Senior Executive Office Manager was informed about the proposed water supply project for Vanimo township. • The water pipes will pass through the road easement along the Hospital roadside park. • The Hospital receives over 100 to 150 patients daily. • Vanimo Hospital is a level 5 General Hospital. • The hospital received funding support from the government for infrastructure improvement, including new maternity ward, upgrade electricity, water supply systems (using bore water) and sewage systems and family support center. • The hospital staff are happy to note that WPNG is proposing to	

Stakeholder	Number of Person Consulted	Date and Time Consulted	Consultation Notes	Picture
			construct the water supply systems for Vanimo.	
Vanimo Forest Product (VFP)	2 people (CEO and Admin Manager)	12 June 2:00am to 3:00am	• VFP operates in Vanimo • Logging and export of round logs in Vanimo • Vanimo supports the township with water carts to distribute water during dry seasons. • It has bore water holes that sustains the water supply for VFP company and the workers as well as the township.	
Vanimo Primary School	2 (Head Teacher and Deputy Head Teacher)	12 June 3:15pm to 4pm	• School head teacher and deputy headteacher were consulted. • Information about the project was shared with the teachers. • School uses water tanks and bore water wells. Sometimes the water wells turns salty because of the close proximity of the school to the ocean/beach. • The school has a population of 700-800 students and teachers. • The head teachers were pleased to hear about the water supply project and welcome the WPNG and the project team	
Main Consultation Meeting with Stakeholders of Vanimo	List shall be provided by WPNG	13 June 2025 10am to 12:00am	WPNG will provide the update	

Stakeholder	Number of Person Consulted	Date and Time Consulted	Consultation Notes	Picture
Consultation Meeting with Stoney Cave Community	Approximate 30 females and 27 males (including children) attended the community consultation meeting at Stoney Cave	13 June 2025 2:00 PM – 3:00PM.	• Stoney Cave Communities were already informed about the water project through their representatives/leaders. • The Landowner of Stoney cave was made ware of the land area and the access road area that will be impacted by the project. • Communities were informed on the impacts on the land and improvements and the process of assessing impacts, valuation and compensation following the project and land acquisition requirements. • Community members and the landowner at Stoney cave are will to support the project and will work with the project to ensure all due process of acquisition is complete and LOs are consulted and informed/signed agreements with fare compensation before any works begins. • The mothers raised concerns on difficulty of climbing up the mountains to fetch water from the nearest water brook thus request the project to construct water pipes to supply water community during construction. • Community also request if the project could consider supplying each household at Stoney Cave with water after completion.	 

Stakeholder	Number of Person Consulted	Date and Time Consulted	Consultation Notes	Picture
			• Communities wants to benefit from any project work in terms of labor support and spin-off activities that they can support.	

GRIEVANCE INTAKE/REPORTING FORM

Project: PNG Urban Water Supply and Sanitation Security and Resilience Improvement Project (UWSSSRIP) – Subproject 1 A: Vanimo Water Supply

The UWSSSRIP Subproject in Vanimo, PNG welcomes complaints, suggestions, comments, and queries regarding project implementation and its stakeholders. We encourage persons with grievances to provide their name and contact information to enable us to get in touch for clarification and feedback. Should you choose to include your personal details but want that information to remain confidential, please inform us by writing/typing "(CONFIDENTIAL)" above your name.

Contact Information			
Name		Gender	□ Male □ Female
Home Address		Age	
		Phone No.	
City/Province		Email	

Complaint/Suggestion/Comment/Question Please provide the details (who, what, where, and how) of your grievance below:

How do you want us to reach you for feedback or update on your comment/grievance?

Portion to be filled by the staff:

Date received:	
Received through:	___ In person ___mail ___email ___fax ___phone ___SMS
Name of staff who received comment/ complaint	
Position of staff:	
Type of grievance:	
Remarks	
Signature of staff	

Update on the case:

Date:	Update

OUTLINE OF SAFEGUARD MONITORING REPORT (SMR)

<table>
<tr><th>Heading/Section</th><th>Contents</th></tr>
<tr><td>Abbreviations</td><td>List of abbreviations used in the SMR</td></tr>
<tr><td>Executive Summary</td><td>Concise overview of the entire document</td></tr>
<tr><td>1. Introduction</td><td>• Brief background on the project (including safeguards categories) and subproject
• Report purpose / objectives
• Institutional arrangements for project management and environmental management
• When the monitoring was undertaken and what period it covers</td></tr>
<tr><td>2. Project Status</td><td>• Project progress and status
• Safeguards implementation arrangements
• Status of approvals and clearances etc. under the country system (summarize in table)</td></tr>
<tr><td>3. Environmental Safeguard Monitoring</td><td>• Who participated in the monitoring
• Methodology for monitoring (whether checklists prepared etc.)
• Summary of other monitoring undertaken in the period (i.e., from contractor’s monthly reports and if any survey/sample monitoring undertaken). Include a summary of key management measures implemented at the project site. It may include measures related to air quality, water quality, noise and vibration, pollution prevention, biodiversity and natural resources, health and safety, and labor standards.
• Main activities – observations/inspections, consultations, interviews with contractor staff etc.
• Details of the works/activities being undertaken (with photographs)</td></tr>
<tr><td>4. Social Safeguard Monitoring</td><td>• Who participated in the monitoring
• Methodology for monitoring (whether checklists prepared etc.)
• Summary of other monitoring undertaken in the period (i.e., from contractor’s monthly reports and if any survey/sample monitoring undertaken)
• Main activities – observations/inspections, consultations, interviews with contractor staff etc.
• Details of the works/activities being undertaken (with photographs)</td></tr>
<tr><td>5. Compliance with Safeguards Monitoring</td><td><u>ENVIRONMENT</u>
• Status of preparation, review and clearance of CEMP
• Status of permits and consents required to be obtained by the contractor
• Sample table:
<table>
<tr><th>Project / Subproject</th><th>Contract status (awarded or not)</th><th>Environmental safeguard documents (e.g., IEE, EIA or CESMP) and Status (approve or not approved by ADB)</th><th>Status of regulatory permits (including date and validity)</th><th>Remarks</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
</table>
• Whether works and measures comply with the approved EMP/CEMP
• It should follow the sequence of items identified in EMP/CEMP and</td></tr>
</table>

<table>
<tr><th>Heading/Section</th><th>Contents</th></tr>
<tr><td></td><td>
verify that all mitigations measures noted are being implemented

Sample table:

<table>
<tr><th>Observations / Non-Compliances</th><th>Corrective action required</th><th>Responsibility</th><th>Timeframe and Status</th><th>Evidence of resolution</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
</table>
<u>SOCIAL</u>

Status of actions and measures to ensure compliance with the approved RP.
Sample table:

<table>
<tr><th>Project / Subproject</th><th>Contract status (awarded or not)</th><th>Social safeguard documents (e.g., RP, Land Acquisition Completion Report) and Status (approve or not approved by ADB)</th><th>Status of land acquisition; MOUs (including dates)</th><th>Remarks</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
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</table>

It hould follow the sequence of items/actions identified in RP and verify that all actions are being implemented
Progress on RP validation report and if there is 3rd party monitoring etc.

</td></tr>
<tr><td>6. Public Consultation, Information Disclosure, Capacity Building</td><td>

Details of consultations and information disclosure (attach photos, minutes of meetings, attendance sheet)
Include whether any training/awareness has been provided to PMU, contractor staff etc. in the period (what, by whom etc.)
Sample table:

<table>
<tr><th>Completed public consultation and disclosure activities</th><th>Objectives</th><th>Date, Time and Venue</th><th>Issues raised</th><th>IA / PMU Feedback or Action on issues raised</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>7. Grievance Redress Mechanism</td><td>

Summary of GRM, including table of grievances/issues during the period and status.
Sample table:

<table>
<tr><th>Details of grievance</th><th>Action required</th><th>Timeframe and responsibility of resolution</th><th>Status (Open / Closed)</th><th>Evidence of resolution</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>8. Summary and Conclusions</td><td>

Summary of main findings
Main issues identified and corrective actions noted
Summary of the next steps (for main items described in preceding SMR sections)
Can include a summary table which can be updated each period to track completion of actions required

</td></tr>
</table>

Heading/Section	Contents
9. Recommendations for Implementation & Corrective Actions	• Corrective actions cited (summarized in table noting date to be resolved, action, person responsible on contractor team and verification by IA/PMU)
Attachments	• Monitoring checklist (based on items identified in the EMP/CEMP and RP checklists) • Additional photographs / photo-documentation of identified non-compliances / observations Minutes of meetings, photo-documentation of consultation activities, and attendance sheet • Matrix tracking compliance with project covenants / grant agreement • Necessary permits (e.g., earthmoving permits) • Lease agreements • Additional information as required