Initial Environmental Examination

PUBLIC

July 2025

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

Port Moresby Water Supply and Sanitation System (Outputs 1 and 2)

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

CURRENCY EQUIVALENTS

(as of 11 July 2025)

Currency Unit	–	Kina (K)
$1.00	=	K4.12
K1.00	=	$0.24

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
EHS	–	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

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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 scopes of activities:
>
> Output 1A – Vanimo water supply systems improvement

[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 1B – Port Moresby water source and treatment system optimization and resilience building.
Output 1C – Port Moresby 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 – Vanimo 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: (i) Output 1, Subprojects 1B and 1C, which involves the optimization of water sources and treatment system, as well as the augmentation and expansion of storage and distribution systems in POM; and (ii) Output 2 Subproject 2B, which involves the rehabilitation of the Waigani sanitation system. These activities will entail small-scale construction works that may result in temporary and potentially irreversible adverse environmental impacts. As such, it is expected that CEPA will classify the subprojects 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 POM subprojects are 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.

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

Environmental due diligence. This IEE presents the environmental assessment conducted for the POM subprojects and identifies potential environmental impacts that may result from the pre-construction, construction and operational 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. A key environmental consideration for the POM subprojects is the potential exacerbation of pollution at source anticipated during project implementation. Foremost is the discharge of aluminum sulfate from water supply optimization works and secondly is wastewater effluent from rehabilitation of the sanitation system. Both are expected to contribute substantially to environmental pollution during the construction phase, highlighting the need for more robust management strategies to mitigate their potential impacts. 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. It is noted that with POM infrastructure investments comprising both water supply and sanitation systems, two EMPs have been prepared to mitigate all potential impacts that may arise from the scope of activities. The EMPs identify, avoid, minimize, and mitigate any potential adverse impacts that may arise, inclusive of 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 implementation of the EMPs. The EMPs also outline 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 EMPs during detailed design and will oversee the subprojects environmental management system, including inspection, monitoring, reporting, and initiating corrective actions when necessary. The EMPs will form part of the construction contract documents and the winning contractors will be required to prepare construction environmental management plans (CEMPs) based on the project EMPs. The contractors are obligated under the CEMPs 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 EMPs, the CEMPs are 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 contractors will submit the CEMPs to the PMU and ADB for review and comment and then approval prior to commencement of any works.

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,

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

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. Stakeholders in POM expressed strong support for the subproject and welcomed anticipated benefits. 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 DMC 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 contractors with the CEMPs 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 CEMPs and to monitor the contractor's implementation of the approved CEMPs. The costs of mitigation and monitoring as well as the preparation and implementation of the CEMPs 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 POM subprojects, arising from their design, construction, and operation, will not result in significant adverse impacts on biodiversity, natural habitats, or communities within the subproject's area of influence. The primary adverse impacts are anticipated during the construction phase and include pollution risks, sludge handling risks, odor emissions, waste generation, and localized disturbances such as erosion and sedimentation. The effective implementation of the EMPs, through erosion control, wastewater and effluent management, waste management, traffic measures, and a sludge management plan, will ensure that all assessed impacts are mitigated to acceptable levels. The classification of Category B for environmental impact, in accordance with 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 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. **Port Moresby water supply challenges.** POM's water supply system is under significant stress due to dilapidated assets and limited capital investment in expanding services that cannot meet growing demand. The city's main water treatment plant (WTP) at Mount Eriama is operating at its full design capacity of 184 megaliters per day (MLD), while average daily demand is 180 MLD, and peak demand is 190 MLD. Approximately 90% of the bulk water comes from the Laloki River (regulated by the Sirinumu Dam), which also supports hydroelectric power production, creating competing demands for water resources. The current situation poses functional and redundancy risks that are further exacerbated by increasing rainfall variability and rising temperatures, which impact water availability. Non-revenue water (NRW) levels are also high, estimated at 56%, which is comprised of physical losses (25%), unbilled authorized consumption (20%), and unauthorized consumption and meter inaccuracies (11%).[7] It is estimated that about 45 MLD is lost in the system and needs to be accounted for to improve revenue earnings.

4. **Port Moresby sanitation system challenges.** POM has four wastewater networks: (i) three inland networks—Gerehu, Morata, and Waigani— covering 85% of the area and discharging to waste stabilization ponds; and (ii) one coastal network—Joyce Bay—covering the remaining 15% and discharging to an activated sludge treatment plant with an ocean outfall. The existing ponds are heavily filled with sludge, offering minimal treatment and resulting in the discharge of large volumes of partially treated wastewater. Poor maintenance further exacerbates

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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.

[7] Hunter H2O.2019. Port Moresby 20-Year Water Supply Master Plan.

the issue, with stormwater infiltrating the wastewater network during the wet season. Overall, POM's sewerage infrastructure is limited and in urgent need of rehabilitation and upgrades. The Waigani sewerage system (network and sewage ponds) serves about 70% of the total area of the NCD, with its performance undermined by the absence of any desludging of the anaerobic ponds and regular removal of excessive algal growth on the facultative ponds.

5. **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.

6. **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

7. 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 POM and Vanimo; but also, significantly expand customer base and revenue.

8. **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).[8] 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:

[8] 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 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 of the existing raw water mains will be carried out to improve the resilience of the 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

9. **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.

10. **Scope of the IEE.** The scope of the IEE covers all the components of the water supply (Output 1B and 1C) and sanitation (Output 2B) subprojects in the NCD including optimization of water source and treatment system, augmentation and expansion of storage and distribution systems, and rehabilitation of the sanitation system. In accordance with ADB's SPS, the overall POM subprojects are assessed as Category B for environment based on its most environmentally sensitive impacts, requiring an IEE and two EMPs 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 Outputs 1 and 2, while Output 3 is 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 POM subprojects 1B, 1C and 2B IEE have been prepared and will be implemented in alignment with these environment safeguards requirements.

11. In the case of PNG's CEPA, the proposed water and sanitation subprojects are 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. These requirements will be confirmed based on CEPA's assessment of the submitted application and supporting documentation. 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 two EMPs will be updated after the detailed design has been finalized.

12. **IEE methodology**. 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 being undertaken in June 2024 and again in early 2025. Given that the subproject areas of influence are in an urban and highly modified 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)[9] 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

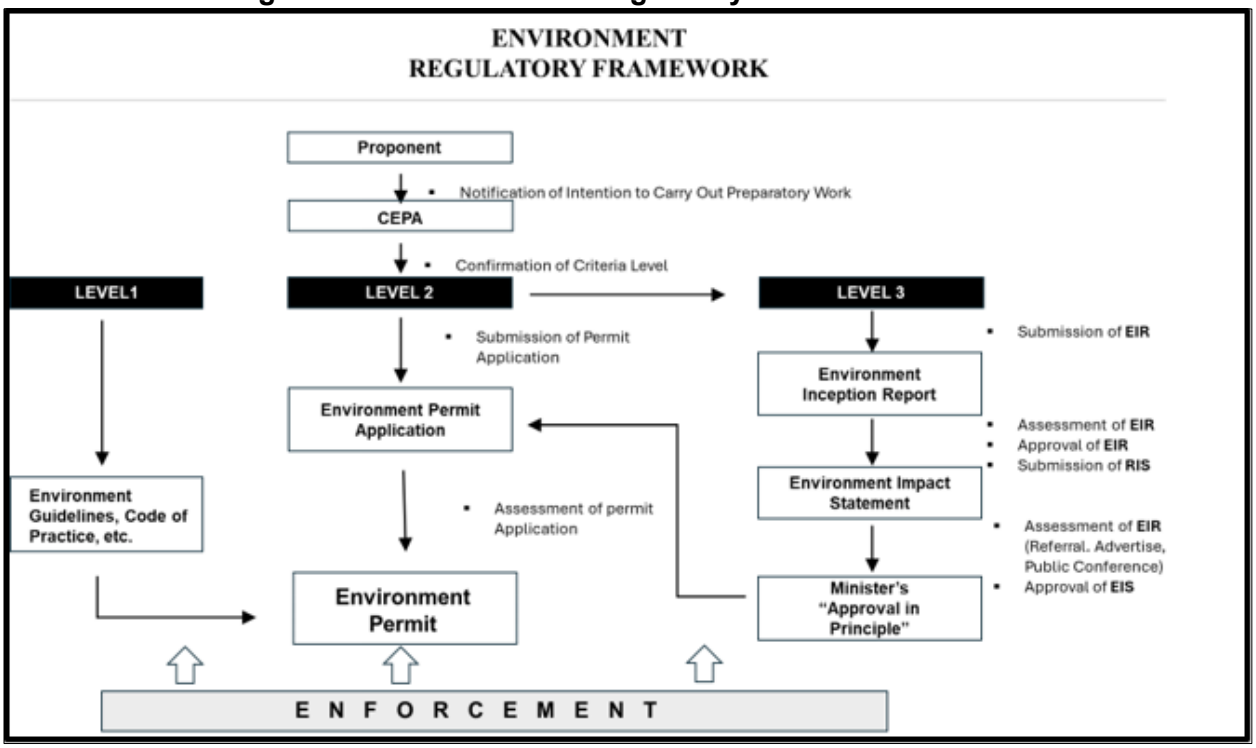
[9] Note: This relates to Environmental Act Classification. This is not the same as ADB project classification.

Corporate Plan (2009-2012). The 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 POM. 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 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 19: Environmental Regulatory Framework in PNG



20. **Relevant legislation**. **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 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	The Conservation Areas Act will be used in the site development phase, 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 resource 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	Should any of the customary, freehold, or state-lease land be required for the project,

Policy and/or legislation	Description	Relevance
	for the Government to acquire land both from voluntary and compulsory land registration	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 Land Groups Incorporation (Amendment) Act 2009	The Act provides a basis for customary groups to hold, manage and deal with land in their customary names through an incorporated land group (ILG). Under the 2009 amendment, ILGs are required to include two female representatives.	Negotiations with customary landowners can be conducted through the relevant ILGs.
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 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	Ensure that stakeholders conform with biosecurity obligations of PNG during procurement of construction materials from overseas, movement of foreign workers, etc.

Policy and/or legislation	Description	Relevance
	unlocking new trade and investment opportunities through international compliance.	
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. 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.	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.
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	These water quality standards are applicable to the water supply project to ensure safe and compliant service delivery.

Policy and/or legislation	Description	Relevance
	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.	

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** 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 Port Moresby 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. Scope of Works

25. The POM Water Supply and Sanitation Subproject is designed to enhance the resilience and adaptive capacity of water supply services in the NCD, ensuring safe and reliable piped water access for the population, including targeted informal settlements. It also aims to improve wastewater treatment to ensure that treated effluent is safely discharged into the environment without posing public health risks. Key infrastructure investment components of the subproject include the optimization of the POM water source and treatment system (Output 1B), expansion of water storage and distribution networks (Output 1C), and rehabilitation of the Waigani sanitation system (Output 2B). This integrated approach in investment is envisaged to strengthen the capacity of WPNG to more effectively deliver water and sanitation services in meeting increasing

demand in the NCD.

B. Subproject Components

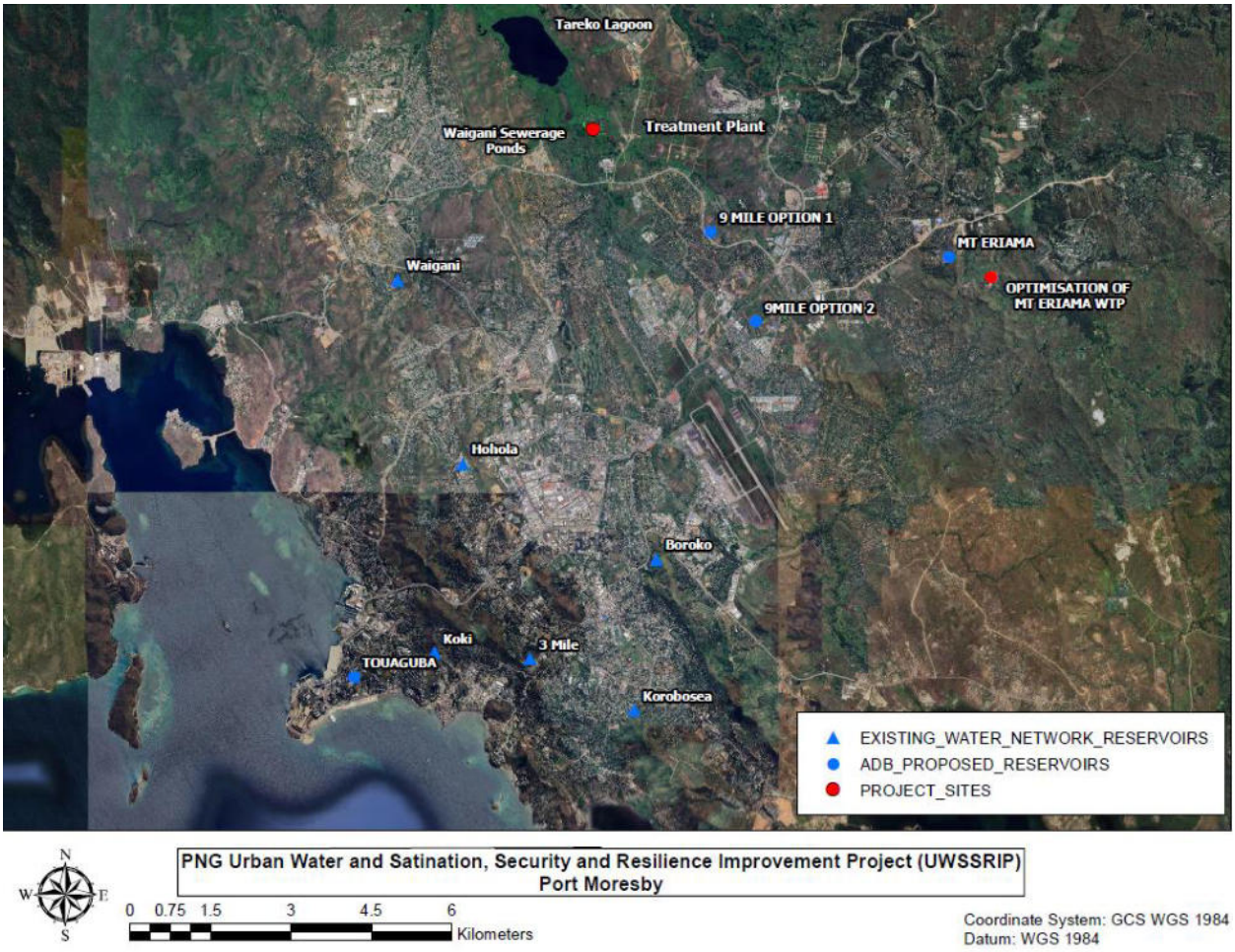
26. POM subproject components are summarized in Table 3, illustrated in Figure 2 and detailed in the succeeding subsections.

Table 3: POM Subproject Components

No.	Scope	Components
Output 1B	Port Moresby Water Source and Treatment System	Optimization of the Mt. Eriama WTP, including equipment replacement, electrical automation and communications, instrumentation upgrades, process improvements, and laboratory supply equipment.
Output 1C	Port Moresby NRW reduction, augmentation, and expansion of storage and distribution systems	NRW reduction and augmentation: Supply and installation of monitoring equipment and provision of leakage detection services. Expansion of storage and augmentation of distribution system: • Construction of three new reservoirs: i. Mt. Eriama Reservoir serving three DMAs – POM 35, POM 14 (including Bushwara and Morobe settlements), and POM 11. ii. 9-Mile Reservoir serving seven DMAs – POM 12 (including 8-Mile settlements), POM 52, POM 57, POM 58, POM 08, POM 09 and POM 61. iii. 8-Mile Reservoir serving three DMAs – POM 36 (including ATS and Saiwara settlements), POM 11 and POM 60. • Rehabilitation of Touaguba Reservoir • Installation and augmentation of branch mains and distribution mains
Output 2B	Waigani sanitation system rehabilitation	The rehabilitation works includes: • Removal of vegetation from Ponds 1 to 5 • Removal and disposal of sludge from Ponds 1 to 4 (disposal site to be confirmed) • Refurbishment of Ponds 1 to 4 • Construction of Pond 6 • Refurbishment of inlet works

Notes: WTP – Water Treatment Plant; POM – Port Moresby; NRW – nonrevenue water; DMA – distribution metering area.

Figure 2: POM Subproject Locations



1. Port Moresby Water Source and Treatment System Optimization (Output 1B)

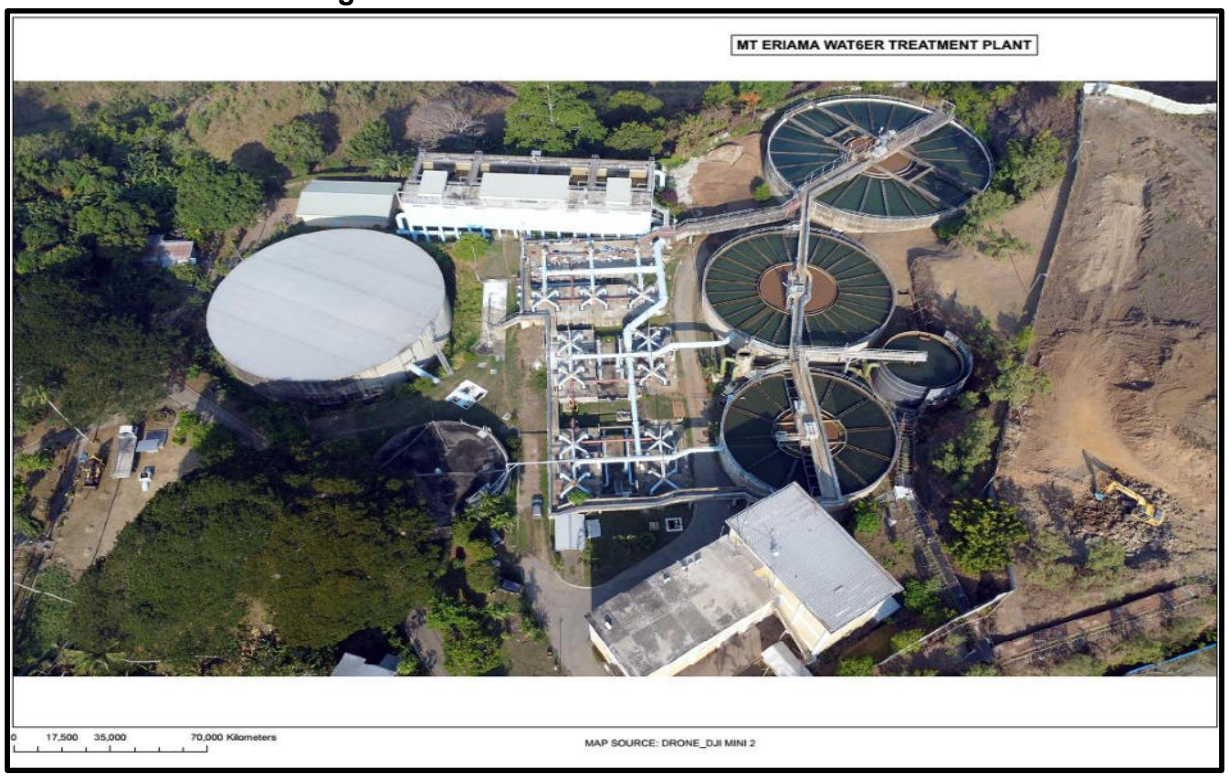
27. **Existing condition**. The Mt. Eriama Water Treatment Plant (WTP) is a critical infrastructure facility located near Bomana, in the NCD (**Error! Reference source not found.** 3**Error! Reference source not found.**). It plays a vital role in supplying safe and clean drinking water to the city by treating water sourced from Laloki River. Water is extracted through a network of channels that direct flow from Rouna Ponds. In these ponds, the raw water undergoes initial sedimentation, allowing larger particles and debris to settle before further treatment.

The treatment process at Mt. Eriama WTP follows a conventional method comprising several key stages that includes raw water delivery and storage, clarification, filtration, chlorine contact, and treated water storage facilities. Each stage is designed to progressively eliminate contaminants and ensure compliance with health and safety standards. The facility is equipped with treated water storage tanks and advanced monitoring systems to maintain continuous regulatory compliance. Routine maintenance and periodic upgrades are essential to sustaining optimal performance and reliability.

28. Originally constructed in 1965 with a capacity of 27 million liters per day (MLD), the Mt.

Eriama WTP underwent several expansions. In 1968, a second clarifier was added, increasing capacity to 68 MLD. A third clarifier unit was installed in 1977, raising the total capacity to 136 MLD. Further enhancements in 2002, including the installation of Lamella tubes in the clarification units, enhanced the plant's performance and raised its capacity to 184 MLD. This remains the current design capacity, and the facility typically operates at or near this maximum on most days. However, due to its location within the saddle of Mt. Eriama, space for future expansions is limited.

Figure 320: Mt. Eriama Water Treatment Plant



29. **Proposed works**. WTP will undergo refurbishment to restore essential functionality and enhance system resilience. Planned upgrades include converting standby filters and a future clarifier into active-duty process units, which will increase treatment throughput capacity by approximately 10 MLD. Additionally, prioritized processes will be automated to improve operational efficiency. To strengthen the raw water transmission system, inspection and critical repairs of the existing raw water mains will also be carried out. These improvements will enable the expansion of water services to currently unserved informal settlements, contributing to broader access to safe drinking water.

30. The existing units operate continuously throughout the week with and currently lack redundancy, posing a risk to operational reliability. To address this, WPNG is currently installing a new clarifier 4 to serve as a backup to clarifier 3, thereby enhancing redundancy within the clarification process and ensuring more reliable and uninterrupted service delivery. It is noted that the construction of clarifier 4 is not part of the ADB financed subprojects.

2. Expansion of Storage and Distribution Systems (Output 1C)

31. The POM subproject also includes the construction of three new storage reservoirs and

rehabilitation of one existing reservoir along high-pressure trunk mains to improve the water supply, reduce losses, and enable efficient redistribution. The distribution network will be expanded downstream of selected distribution metering area (DMA) boundaries to serve approximately 60,000 additional customers. Service delivery will be institutionalized for all citizens, including those in informal settlements, supported by extensive non-revenue (NRW) reduction programs, digitalized billing and customer management systems, and strengthened community engagement.

a. Storage Reservoir

32. The NCD faces serious water supply challenges due to rapid population growth and insufficient infrastructure, resulting in daily water rationing in revenue-generating zones and widespread reliance on illegal connections in informal settlements. To address these issues, the proposed construction of three new reservoirs and refurbishment of one existing reservoir will increase storage capacity, helping to stabilize supply during peak demand periods and improve overall system reliability. These reservoirs will also support more equitable water distribution, particularly in underserved areas, and reduce dependence on illegal connections by formalizing access to clean water. In addition, improved management of stored water resources is expected to enhance public health and support inclusive service delivery across the city.

33. **Mt. Eriama Reservoir (new)**. As illustrated in Figure 4, the proposed reservoir site is located on a hill near the Bomana turnoff roundabout, approximately 100 masl. To the south, at the base of the hill, is a guard dog security base, while a quarry site occupies the opposite end. The Mt. Eriama WTP is situated roughly 900m north of the proposed location. The site itself lies within the operational area of an active quarry managed by an international construction company.

34. Surrounding the proposed site are several houses and food gardens, primarily cultivated by local settlers. These gardens mainly grow peanuts. There is no flora or fauna of concern in the area based on the International Union for Conservation of Nature (IUCN) red list. Human settlement has led to the migration of most wildlife. The local vegetation is dominated by red grass, with scattered rain trees around the Bomana settlement.

35. **9-Mile Reservoir (new)**. The proposed site for the 9-Mile Reservoir is located south of the McGregor Police Barracks and adjacent to the Gerehu–9 Mile Road as illustrated in Figure **522**5. It is situated on a hill that rises approximately 85 masl. Near the site are three telecommunication towers, and an access road connects the hilltop to the existing Gerehu–9 Mile Road.

36. The area features several food gardens along the slope, primarily cultivating peanuts and bananas, with multiple residents in the vicinity. The dominant vegetation consists of red grass (*Themeda triandra*), interspersed with patches of rain trees (*Samanea saman*) and Neem trees. During the assessment, no flora or fauna of concern listed by the IUCN were identified. Bird calls were rarely heard, and no wild animals were observed in the area, aside from domesticated animals.

37. Due to the site's location on a slope, there is a potential risk of landslips and erosion during the construction of the reservoir. Additionally, several houses located downslope of the proposed site may be affected. The access road will also require maintenance and possible upgrades to accommodate construction activities

Figure 421: Proposed Location of Mt. Eriama Reservoir

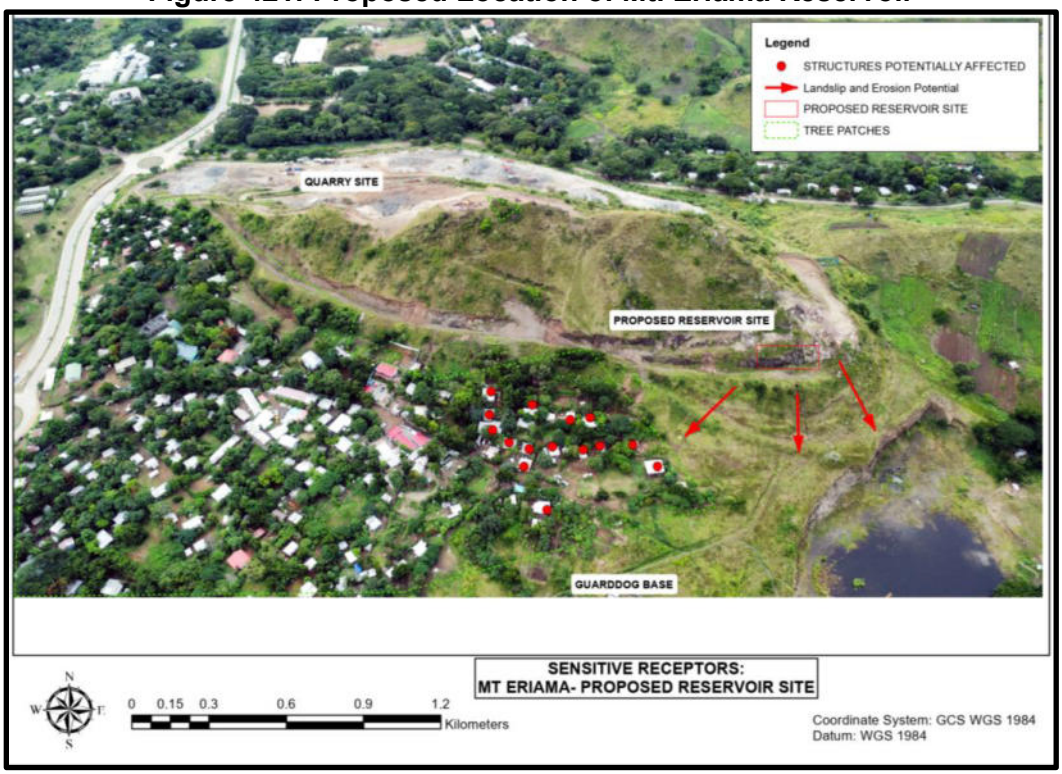
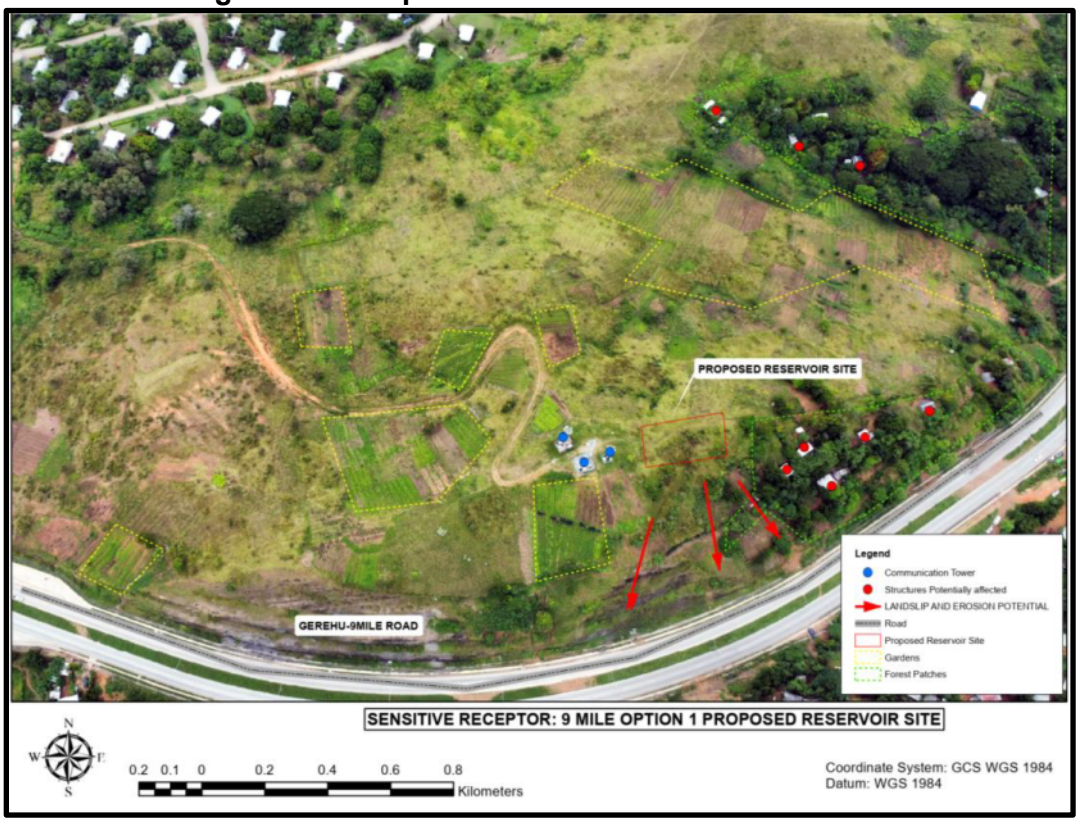


Figure 522: Proposed Location of 9-Mile Reservoir



38. **8-Mile Reservoir (new)**. The proposed 8-Mile Reservoir site is located east of the 8-Mile roundabout along the Hubert Murray Highway, at an elevation of approximately 90 masl (Figure **6**6). To the east of the site are the Carpenter's Logistics Warehouse and Carpenter's Estate. No significant flora or fauna were identified during the site visits and no birds were observed. Ongoing development in the area has contributed to the migration of wildlife. Vegetation is primarily composed of red grass, with several Neem trees and rain trees planted within residential zones for shade.

39. The installation of the reservoir is expected to impact several nearby structures and patches of vegetation. Additionally, there is an increased risk of landslip or slope erosion if the hillside is significantly disturbed during construction

40. **Touaguba Reservoir rehabilitation**. The Touaguba Reservoir, which was previously decommissioned, is now planned for rehabilitation under the subproject, and is located on Touaguba Hill in Downtown Port Moresby (Figure 7) at an elevation of approximately 90 masl. It has a storage capacity of 16,000 cubic meters and is currently non-operational due to disrepair. The surrounding area is primarily composed of residential homes and office buildings. No flora or fauna of concern, as classified by the IUCN, were identified during the site assessment. Wildlife presence was minimal, with only domesticated animals observed in the vicinity. Vegetation includes Neem trees and Rain Trees, which have grown both within and around the site.

Figure 6: Proposed Location of 8-Mile Reservoir

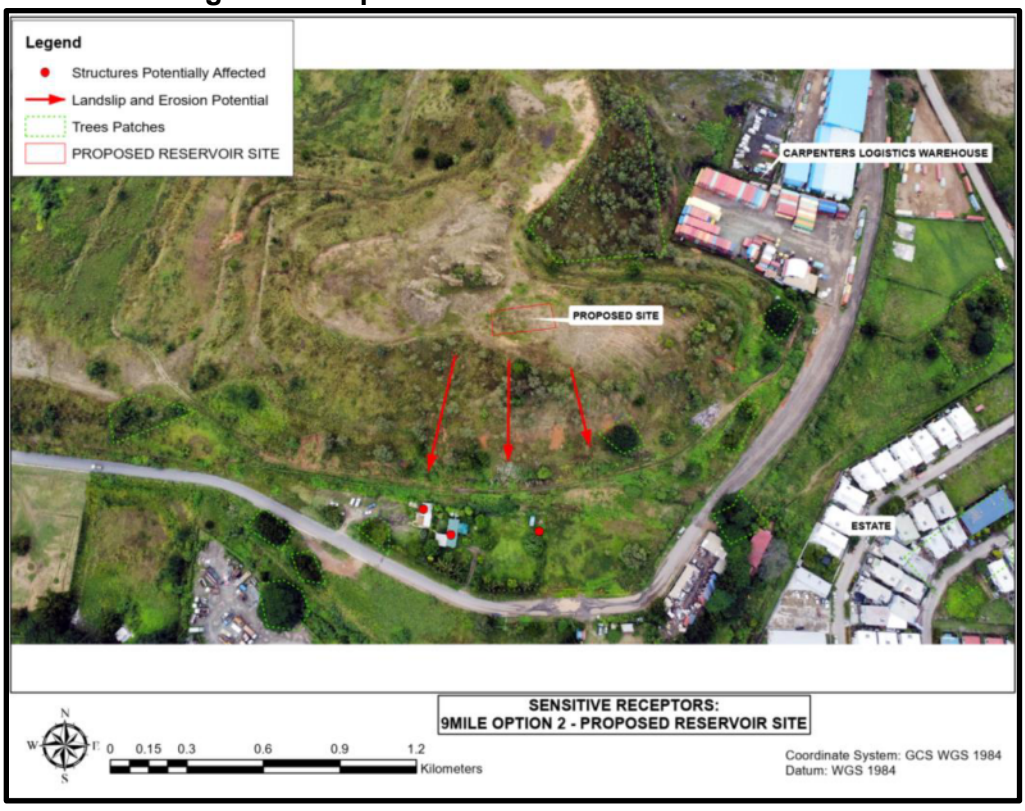
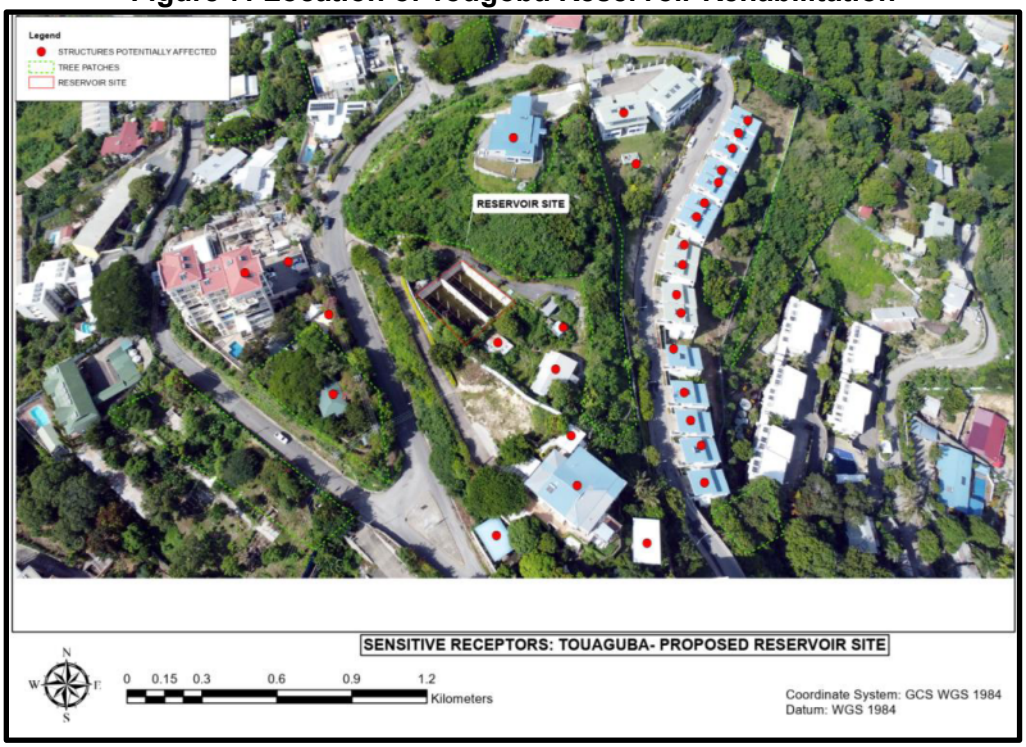


Figure 7: Location of Tougoba Reservoir Rehabilitation



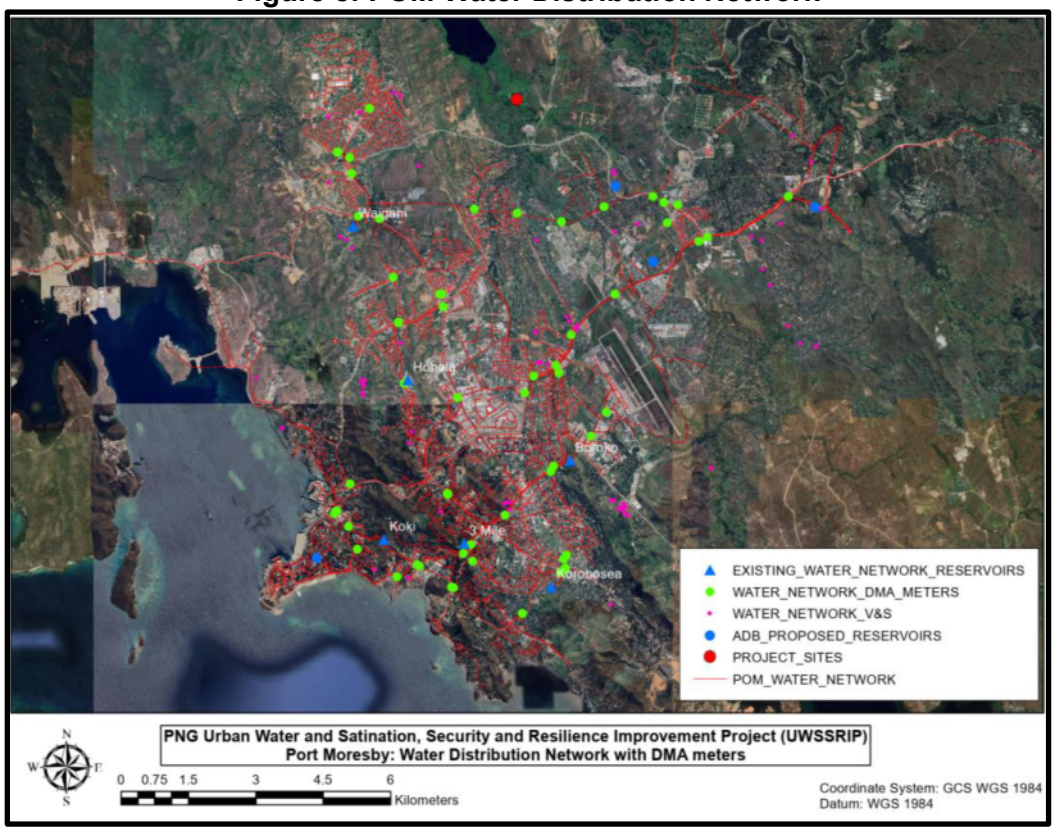
b. Distribution System

41. Treated water from the Clear Water Reservoir (CWR) at Mt. Eriama WTP is distributed via two main trunk lines, which branch off at various points (Figure **88Error! Reference source not found.**). These trunk lines primarily supply six major reservoirs located in the city center. In some segments, multiple pipelines have been installed in parallel, up to five in certain areas, indicating that additional lines were added over time to meet growing demand and enhance supply to specific storage reservoirs.

42. Although the trunk lines were originally designed to serve storage reservoirs, new off-takes have been introduced over time to directly supply areas along the route. Currently, there are approximately 18 direct District Metered Area (DMA) off-takes from the trunk lines, delivering treated water to adjacent regions or command areas that lack dedicated storage reservoirs. The total estimated outflow from these DMA off-takes is around 50 MLD per day.

43. Pressure regulating valves are installed at the DMA inlets and are remotely controlled—activated during the day to supply water and deactivated at night to allow reservoir refilling. Because these off-takes are directly connected to DMAs, the system experiences peak demand on the trunk mains during daytime hours. During the rehabilitation process, careful management is essential to protect sensitive receptors, particularly nearby residential communities that may be exposed to dust, noise, and odor nuisances during construction. However, such impacts are expected to be minimal, as the rehabilitation works will be carefully planned and managed to mitigate these risks.

Figure 8: POM Water Distribution Network



3. Refurbishment of the Waigani Waste Stabilization Ponds (Output 2B)

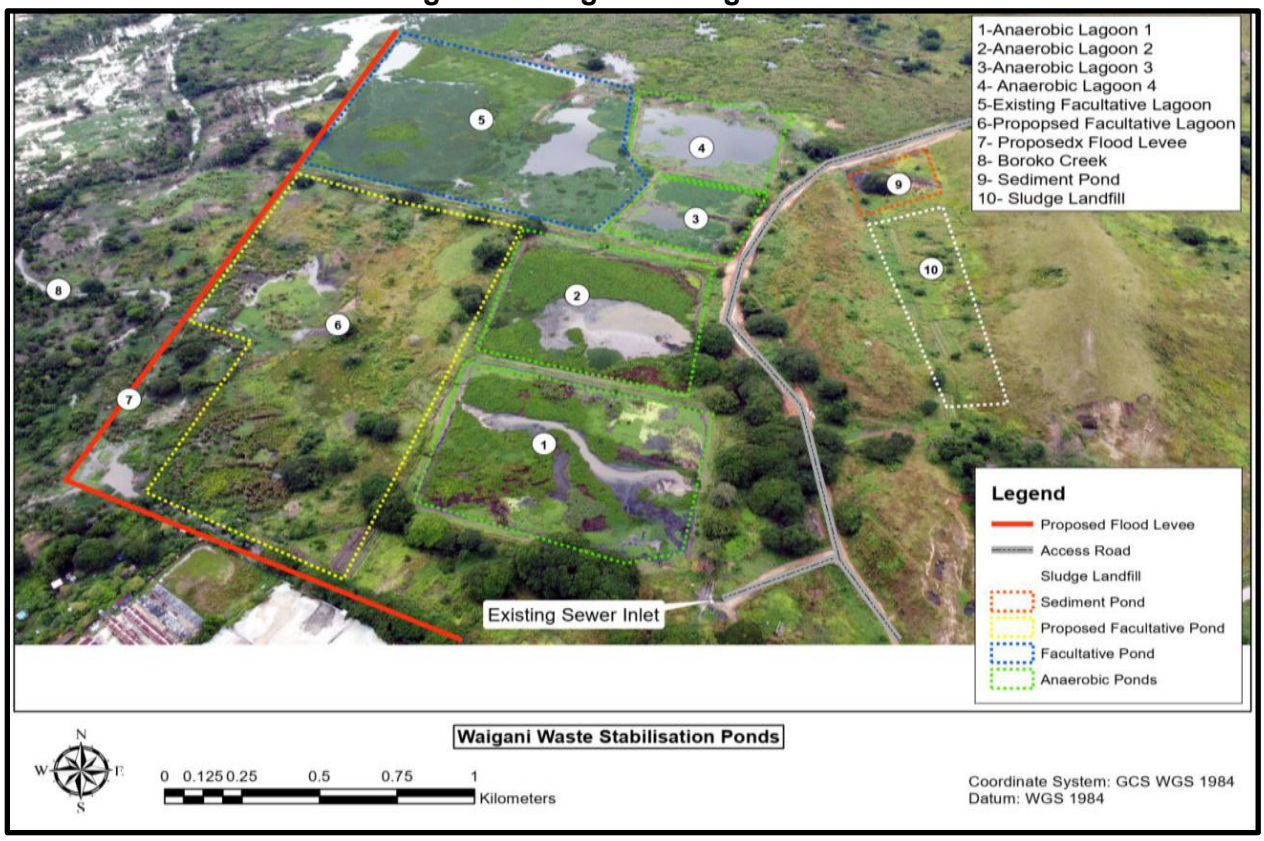
44. **Existing condition**. The Waigani sanitation ponds are a vital component of the NCD's wastewater management infrastructure, designed to treat sewage through natural processes prior to discharge. However, the aging facilities require substantial rehabilitation to address several issues, including diminished treatment efficiency, structural deterioration, and capacity limitations. If left unaddressed, these challenges could lead to environmental pollution and pose significant public health risks.

45. **Proposed works**. The refurbishment of the Waigani sewage ponds as illustrated in Figure 9 is a critical initiative to improve wastewater treatment and environmental protection in the NCD. These ponds are essential for managing sewage and industrial effluents, ensuring treated water meets environmental standards before discharge into surrounding ecosystems, particularly the Tereko Lagoon.

46. The project includes both immediate repairs and long-term upgrades. Urgent actions involve temporary repairs of Ponds 4 and 5 and restoration of the outlet weir from Pond 5. These steps are vital to prevent leakage, contamination, and backflow from Tareko Lagoon, which could compromise water quality and disrupt local ecosystems. Restoring the outlet weir also enables dewatering for effective desludging operations. Following these repairs, the removal of inert sludge from Ponds 3 and 4 will enhance treatment efficiency and operational capacity. During refurbishment, wastewater will be diverted to Ponds 3, 4, and 5 to maintain continuous treatment operations.

47. Upgrades will also be carried out to Ponds 1 and 2 to improve functionality and extend their lifespan. Additionally, a new facultative pond (Pond 6) will be constructed to increase treatment capacity and provide flexibility in managing varying inflow volumes. To safeguard the facility from flooding, a protective levee will also be built around the site. This is essential to prevent overflow during heavy rainfall or storm surges. Furthermore, the inlet works will be upgraded to ensure effective removal of solids and grit before water enters the downstream ponds, protecting the integrity of Ponds 3 through 6.

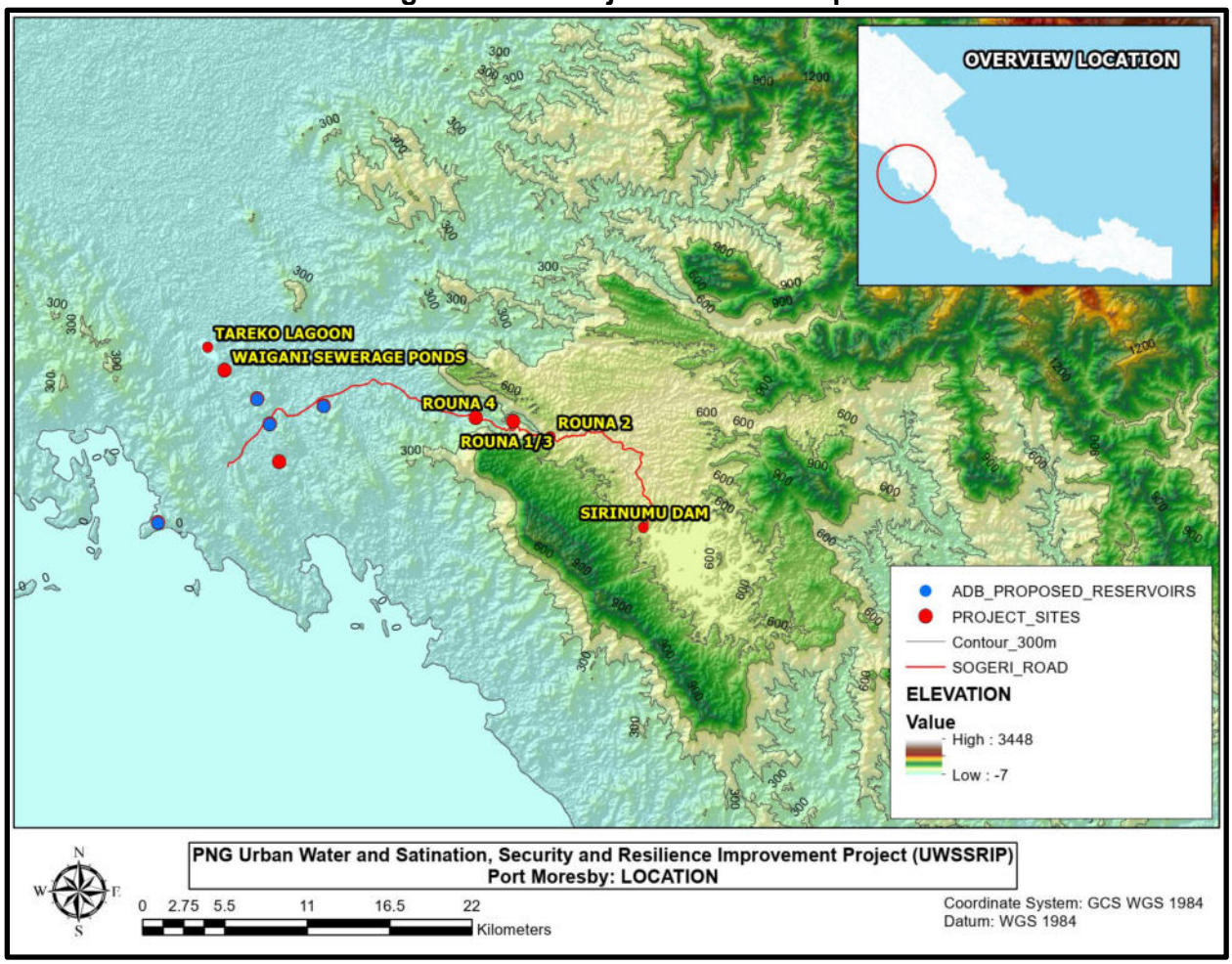
Figure 9: Waigani Sewage Ponds



IV. DESCRIPTION OF THE ENVIRONMENT (BASELINE CONDITIONS)

48. 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. Surveys were conducted to gather information for the socio-economic baseline as well as field and site investigations whereby it is noted that 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 subproject areas are all within POM, the capital and largest city of PNG, with a majority of the areas of influence covered in this IEE in a highly modified urban environment with targeted infrastructure investments comprising (i) POM water resource supply and treatment systems augmentation; (ii) POM NRW storage and distribution systems expansion; and (iii) the rehabilitation of the Waigani sanitation system. These infrastructure investments are presented in the project location map as illustrated in Figure 10 to visually support the environmental overview.

Figure 10 23: Project Location Map



A. Project Area of Influence

49. The general project site, which extends from Rouna 2 to Mt. Eriama and Bomana, is predominantly characterized by tropical dryland savannah, with occasional patches of rainforest

caps on the upper slopes of the Sogeri Gorges. Further inland from the Sogeri Dam, tropical rainforests become more prominent. Due to the higher elevation of the Sogeri Plateau, the area receives significantly more rainfall—up to 2,500 mm annually—compared to POM, which receives approximately 1,500 mm per year.

50. All three proposed new storage reservoir sites, along with the existing reservoir site slated for rehabilitation, have been heavily disturbed by infrastructure development and nearby settlements. Beyond these settlements, the landscape is dominated by dryland savannah, primarily consisting of red grass (*Themeda triandra*), with scattered patches of rain tree (*Samanea saman*), neem tree, and eucalyptus (*Eucalyptus polyanthemos*). All four sites fall within a slope range of 5–10 degrees and are situated at elevations between 80–95 meters above sea level (masl), receiving an average annual rainfall of 1,000–1,500 mm. The Laloki River originates from the Sirinumu Dam and flows southward, converging with the Goldie River. Its upper catchment traverses the Sogeri Plateau, which sits at an elevation of approximately 600 masl. The river then flows through deep gorges between Rouna 1 and Rouna 1/3 before descending into the lowlands and eventually discharging into the sea.

51. Apart from the densely populated urban business and residential areas of the NCD, there are within the peri urban settlement areas, residents who cultivate shade trees such as mango, neem, and rain trees. Food gardens are also commonly found on the outskirts of the city and along the slopes, with peanuts and bananas being the primary crops. Wildlife presence is minimal, limited mostly to domesticated animals. Bird sightings are rare, though migratory species such as the egret (*Ardea alba*), Papuan eagle (*Harpyopsis novaeguineae*), and Papuan crow (*Corvus orru*) are occasionally observed.

B. Physical Environment

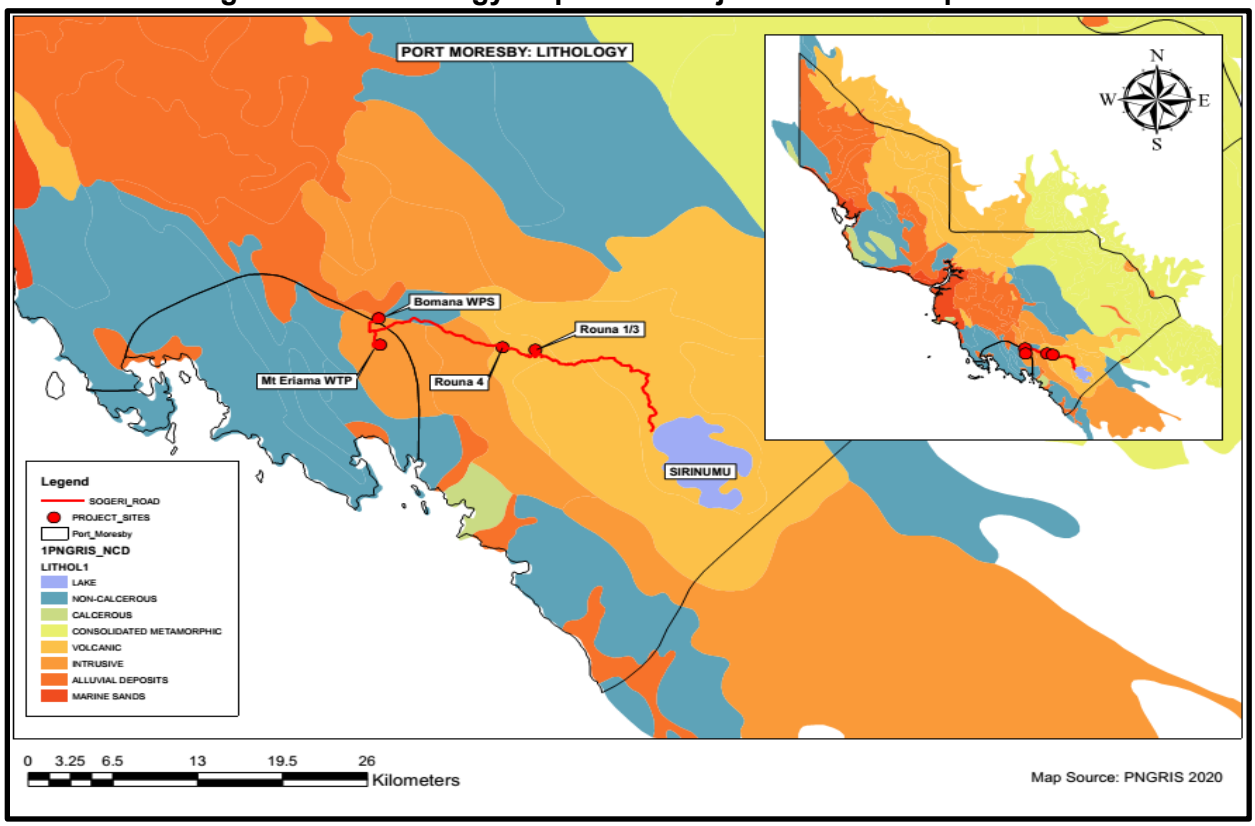
1. Geomorphological, Topographic and Geological Characteristics

52. **Topography**. The island of New Guinea lies along the southwestern edge of the Pacific Ring of Fire, a geologically active zone marked by frequent seismic and volcanic activity. This region represents the boundary between the continental Indo-Australian Plate and the oceanic Pacific Plate. The convergence of these two major tectonic plates is mediated by several micro-plates, including the Bismarck, Solomon, Woodlark, and Caroline Plates. These ongoing and complex geotectonic interactions have resulted in a highly dynamic and geologically diverse regional setting.

53. PNG occupies a unique position between the stable continental landmass of Australia and the deep ocean basin of the Pacific. The country's largest landmass is the eastern half of the island of New Guinea, which is dominated by a massive central cordillera—a system of mountain ranges stretching from Indonesia's Papua (formerly Irian Jaya) to East Cape in PNG. This range includes the Owen Stanley Range and the country's highest peak, Mt. Wilhelm (4,509 meters). A secondary mountain chain runs parallel to the central cordillera along the northern coast. Active and recently active volcanoes are prominent features throughout the landscape. The lowland areas are characterized by extensive swamps and floodplains. POM, the capital city, is surrounded by high mountains, which, in combination with the southeast trade winds, contribute to its distinct dry season.

Geology and Soils. PNG is tectonically active as it lies in the collision zone between the Pacific and the Australian tectonic plates which are associated with earthquakes and volcanic activities. This tectonic relationship ultimately controls the geomorphology of the landscape and therefore the soil characteristics found across the diverse range of locales within PNG. The majority of PNG's rocks underlying the landmass are volcanic and overall, seismic activity in PNG is mostly evidenced by landslides and subsidence. The soils are mainly of weathered volcanic origin which makes them very productive for agriculture [10] The entire Sogeri Plateau is composed predominantly of volcanic agglomerate. The site's lithology is characterized by volcanic rock formations, while the mid and lower sections of the Laloki River are underlain by intrusive igneous rocks. Due to the region's climatic conditions and the chemical variability of the rock types, the geological formations along the gorge are deeply weathered (Figure 11).

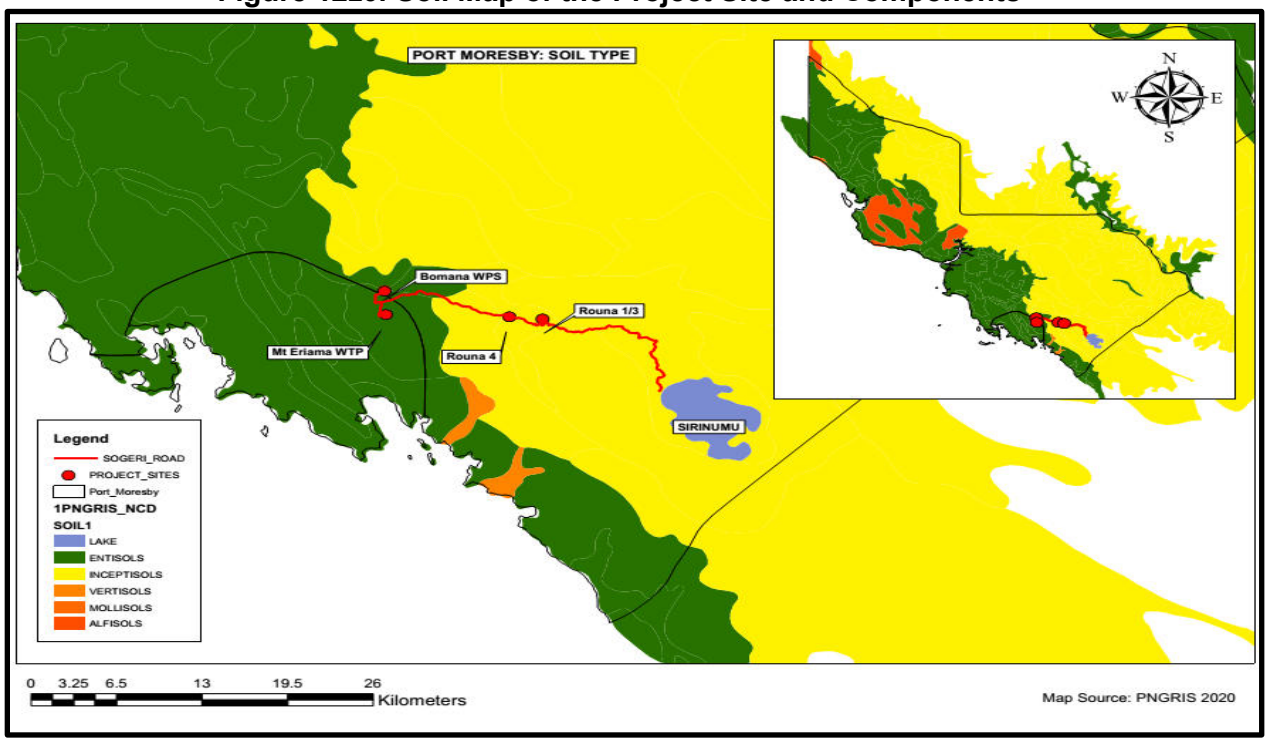
Figure 1124: Lithology Map of the Project and its Components



54. The soils along the Sogeri Plateau and the mid-sections of the Laloki River are predominantly classified as *Inceptisols*—young soils with limited horizon development (**Error! Reference source not found.** 12). Due to their relatively recent formation, these soils are highly susceptible to erosion. In contrast, the lower sections of the Laloki River, including areas covering the NCD, are dominated by *Entisols*, which are minimally developed soils formed through ongoing soil-forming processes. Vegetation across the project area is primarily savannah, interspersed with patches of shrubland. Frequent bushfires are observed in these areas, suggesting that the ecosystem may be classified as a fire climax system, where fire plays a key role in maintaining the ecological balance.

[10] Geological Survey of PNG, 1981.

Figure 1225: Soil Map of the Project Site and Components



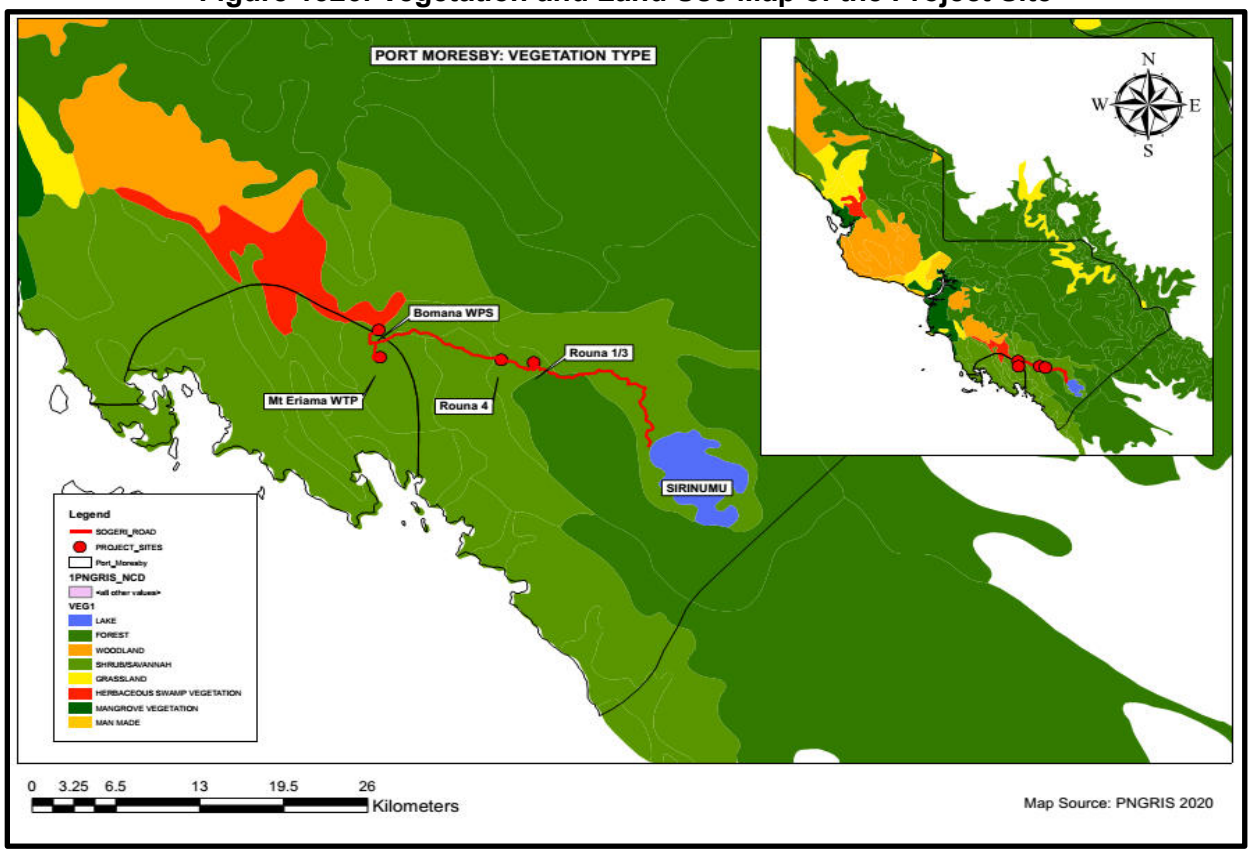
55. **Natural resources**. The country is rich in natural resources such as forestry, agriculture, fisheries, and minerals. It is characterized by rugged terrain, including dense rainforest, swamps, and unstable volcanoes, which continue to pose challenges for the extension of infrastructure and provision of social services.

56. Since forest covers over 70% of PNG's landmass, approximately 70% of the total land area has between low and very low potential for most food or cash crops, while 7% has high to very high potential. PNG is the supplier of 3% of the world's gold, 2% of its copper, 3% of its coffee and 1% of its palm oil.[11]

57. Most of the vegetation across the project site is classified as shrubland and savannah, which are naturally adapted to fire-prone conditions. These vegetation types form part of a fire-regime ecosystem, where periodic burning plays a role in maintaining ecological balance. The upper slopes of the area are characterized by forested zones, indicating a transition in vegetation type with elevation (Figure 13).

[11] World Bank Group Papua New Guinea Economic Update January 2020 Facing Economic Headwinds.

Figure 1326: Vegetation and Land Use Map of the Project Site



2. Hazard (Nature or Induced)

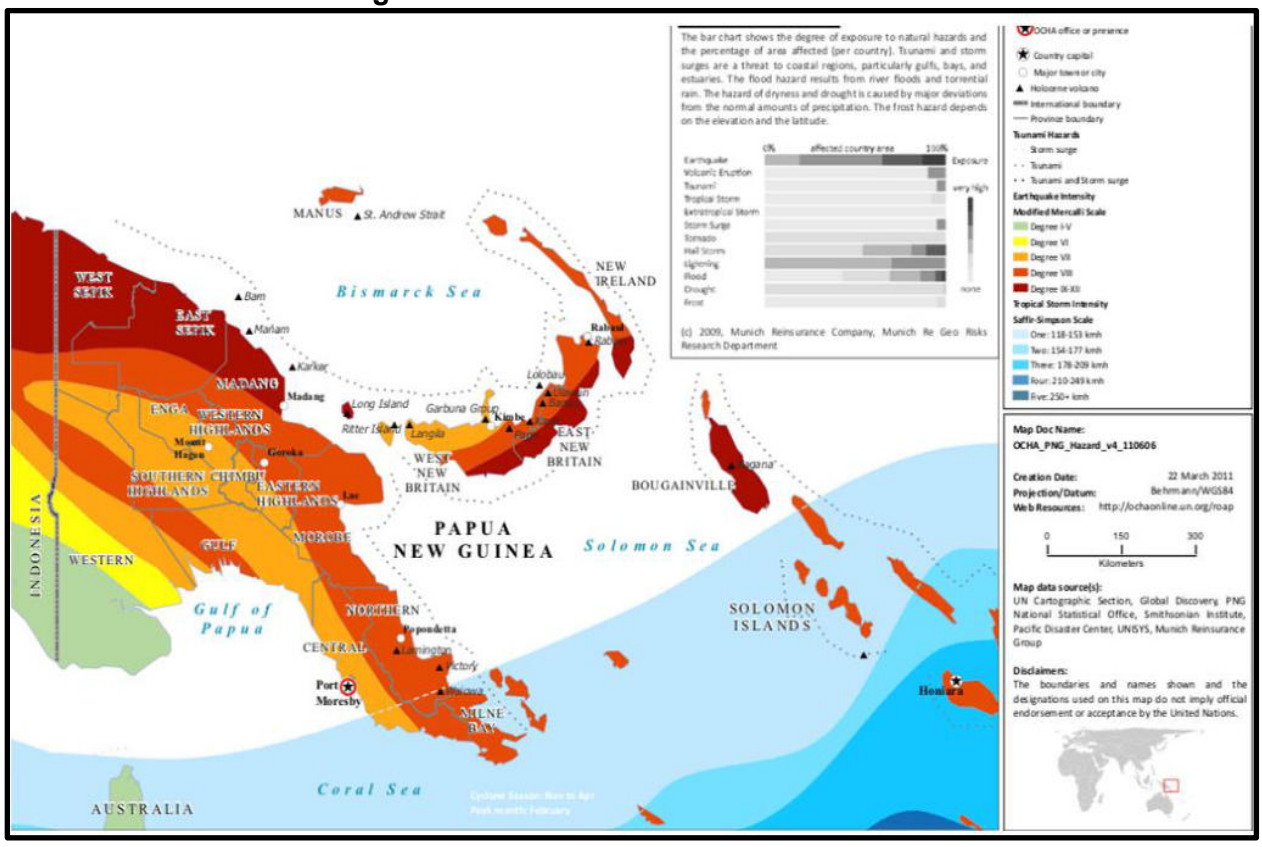
58. PNG is prone to myriad natural hazards, and climate variability and change may increase their incidence. Some of these include landslides, soil erosion, deforestation, loss of biodiversity, as well an increased occurrence of recurrent floods and droughts. The hazard map, sourced from secondary data 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 (Figure 14). PNG is also at risk of tsunamis, with an estimated 40% probability of experiencing a damaging event within the next 50 years. The most devastating tsunami in the country's history occurred in 1998 in the northern region, when the Aitape tsunami claimed thousands of lives and displaced over 10,000 people. Reports indicate that the tsunami was triggered by a submarine landslide, rather than a direct seismic event.

59. There are 16 active volcanoes in PNG; six of which are classified as high risk. A relatively high percentage of the population is exposed to volcanic eruption. The Madang and Morobe provinces are highly vulnerable to volcanic tsunamis and New Britain has the highest concentration of calderas in the Asia-Pacific region. Papua New Guinea has a number of active and extinct volcanoes. Mount Ulawun Volcano, on the island of New Britain, has erupted several times causing airport closures and, in some cases, evacuations. Mount Bagana in Bougainville erupted on 13 August 2019. Manam Island volcano, one of Papua New Guinea's most active, erupted on 25 August 2018 forcing thousands to flee to the mainland. Further activity occurred in December 2018. Kadovar Island volcano erupted in January 2018, leading to an evacuation of the island.

60. POM situated within the NCD province has the following hazard levels obtained from the GFDRR ThinkHazard! Database (Think Hazard, 2024) which are applicable to where the proposed subproject areas are located:

(i) High risk to coastal floods and wildfire;
(ii) Medium risk to tsunami and extreme heat;
(iii) Low risk to urban floods, earthquake, and landslides; and
(iv) River floods, volcanic activity and water scarcity are considered very low risk.

Figure 1427: Hazard Risks Areas in PNG



3. Climatic Regime

61. PNG has a monsoonal climate characterized by high temperatures and humidity throughout the year. Two monsoonal seasons are recognized: the northwest monsoons, which occur from December to March, and the southwest Monsoons, which occur from May to October. PNG has one of the wettest climates of the world and rainfall in many areas of the country exceeds 2500 mm, with the heaviest events occurring in the highlands. Temperatures are relatively steady across the country, and a mean temperature range from 26°C to 28°C.[12] The climate is characterized by high rainfall and humidity and high temperatures which remain generally uniform throughout the year. However, there are significant differences in climatic conditions across the

[12] Office of Climate Change and Environmental Sustainability and World Bank, 2009. Climate Change in Papua New Guinea: Framework for the National Climate Change Strategy and Action Plan.

country. The main component of spatial variation in temperature is the difference which occurs with change of altitude.[13]

62. **Climate change**. Observed climate changes between 1960-1999 indicate increasing vulnerability to climate change in PNG, United Nations Framework Convention on Climate Change (UNFCCC, 2000) state:

(i) The temperature and precipitation trends in PNG follow global and regional trends of high rainfall intensity events and prolonged droughts.
(ii) The mean near-surface temperatures, especially over the last 25 years, were increasing faster than the global mean.
(iii) The increase in mean minimum temperatures has been greater than the increase in mean maximum temperatures since 1970.
(iv) Dry season patterns exhibit weakening La Nina impacts during the dry season, and this weakening is influencing the weak dry conditions, implying longer decadal phases of dry conditions.

63. During the previous 40 years, the mean annual daily temperature for PNG has increased by around 0.5°C, which is consistent with the global and typical Asian trend. Mean temperatures across the South Pacific have increased by 1°C since 1970 (0.3°C per decade), and the number of hot days and hot nights has also increased across the Pacific. The monthly mean historical rainfall trend for PNG follows the global and regional trends of high rainfall intensity events and prolonged droughts.

64. **Rainfall**. PNG is situated at the junction of the equatorial Indo-Malayan and Southwest Pacific regions. To the west lies the large mass of islands of the Indonesian archipelago. To the east are the small, scattered islands and atolls of the Pacific. The whole region is known as a 'maritime continent'. The size of the island of which PNG forms half is the largest, highest, and most massive island in this maritime continent. Its size results in significant local modifications to its climate, which would otherwise be equable equatorial, tropical and oceanic in nature.[14] In PNG, no location is more than 300 km from the sea and most of the island, except for the main central range, is much closer. The highest point is more than 4500 m above sea level and approximately half the island is above 1000 m. Its height above sea level and the alignment of the island's physiography in relation to the main weather systems are the major factors which account for the climatic differences found within the island. Altitude is a major factor. Rainfall varies seasonally in most areas, but the degree of seasonality is not great. This seasonality is most evident in the drier areas, but even here there is no reliable period of nil or near nil monthly rainfall, as found in true 'monsoon' climates. The seasonal variation of rainfall over most of Papua New Guinea can be described best as a change from 'fairly wet' to 'very wet'. Nevertheless, minor droughts can occur from time to time even in moderately wet regions. The national capital Port Moresby lies in the driest part of the country.[15]

65. Port Moresby is thus characterized by a dry sub-humid climate with an average temperature of 22°C to 31°C. There is little temperature variation throughout the year. Variation in temperature can be affected by the sea breeze, suppressing the heat. Humidity typically ranges from 70-80% during the monsoonal season and 40-50% in the dry season. The two areas lie in a

[13] Climatic Research Unit (CRU) of University of East Anglia (UEA).
[14] Ibid.
[15] Ibid.

rain shadow with an average annual rainfall of just over 1000 mm. Most rainfall occurs between December and April with February usually being the wettest month.

4. Ambient Air Quality

66. While the ambient air quality in PNG is generally considered to be good, there is still concern in urban centers with air pollution typically restricted to urban areas such as POM and is caused by vehicle emissions, smoke from grass and refuse burning, some industrial emissions, dust and other aerial particulate matter from construction works and landfill disposal sites. Available data shows that the concentrations are generally below World Health Organization standards. In the absence of data or substantive complaints, the issue of air pollution in PNG is considered to be relatively insignificant (Nicolls, 2004). The United Nations Environment Programme (UNEP) (2022) undertook a global review of national guidelines and reported no identified data for air quality monitoring, air quality management strategies, sustainable agricultural practices, incentives for residential cooking and heating, or controls for sulfur level in diesel in PNG. This regulatory setting or lack thereof indicates that there is the potential for air quality issues to occur in PNG.

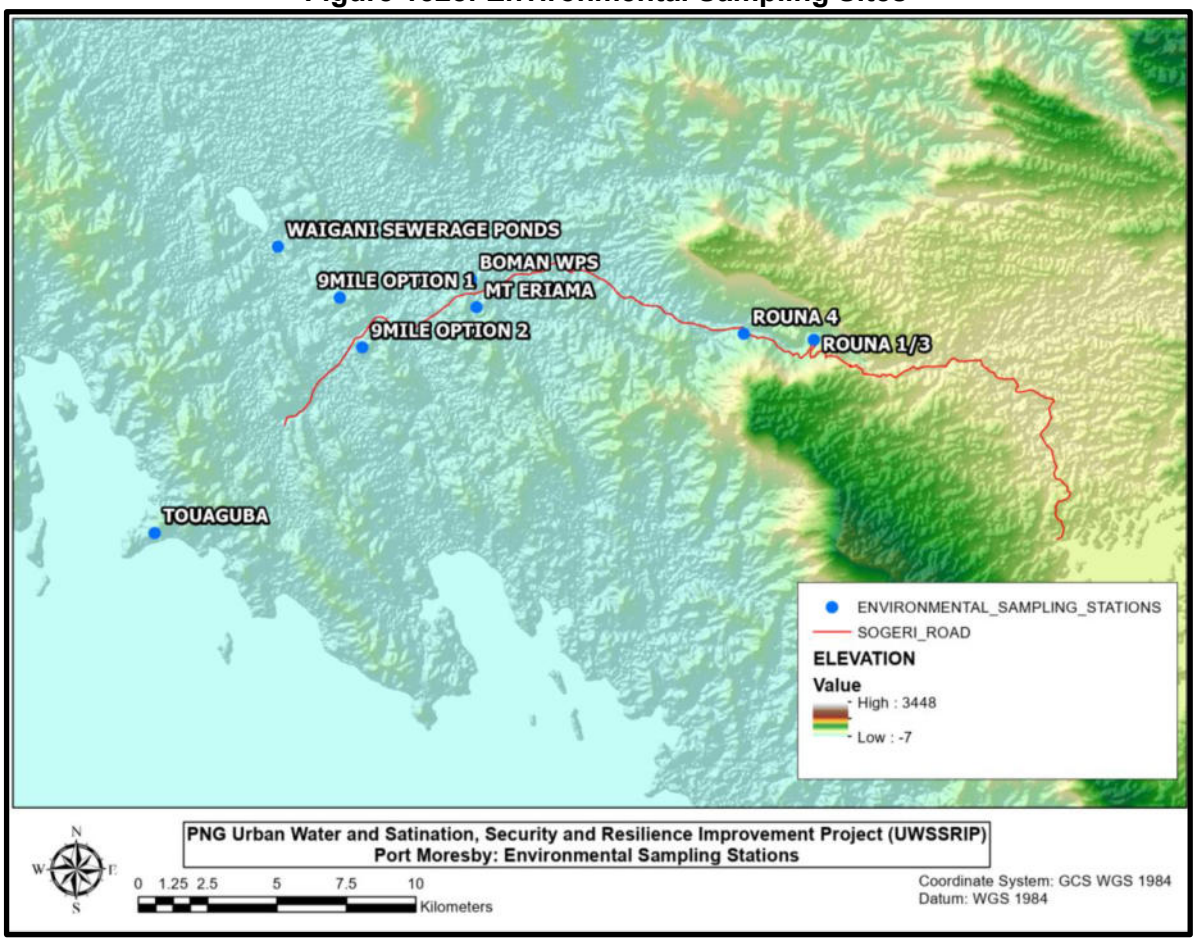
5. Water Resources

67. PNG has a dense river network with heavy rainfall experienced within the country. The landscape also includes a high number of lakes and wetlands. The water quality of water courses in PNG is variable and largely affected by sediment loading in higher areas. The water within tributaries and streams in the mountain ranges is clear water, however, this can vary due to sediment loading. Limestone is widespread in PNG due to the elevated coral terraces causing many streams to be alkaline in nature. Anthropogenic activity is not considered to have a significant impact on the quality of the streams, however, within urban areas, contamination by discharges from households and industry is prevalent. The terrain in the subproject area drains major watercourses topographically into the Coral Sea and in POM although no major rivers run directly through the city, POM lies within the catchment areas of the Vanapa and Brown Rivers. The Loloki River runs along the city's periphery, and smaller watercourses such as Waigani and Boroko Creeks are located within the urban area. Water supply for POM in this context is derived from the Sirinumu Dam located adjacent to the Owen Stanley Range at Sogeri in the Central Province.

6. Baseline Environmental Conditions

68. **Water sampling**. On site water quality sampling and testing was conducted at four selected sites along the project corridor. The water sampling activity used *in-situ* water testing equipment for total dissolved solids (TDS), electrical conductivity (EC), temperature, pH and dissolved oxygen (DO). Locations of the water sampling stations are provided in Figure 15.

Figure 1528: Environmental Sampling Sites



69. The results of the water sampling activity covering the bodies of water along the water project are provided in Table 4. It is noted that three sampling stations fall below the required values for dissolved oxygen which should be greater than >6.5mg/L. All the other parameters fall within the desired guidelines.

Table 44: Results of Water Sampling in Selected Sites Using in-Situ Equipment

	Location		Water quality Parameters					
Sampling location	Latitude	Longitude	Temp	pH	TDS (ppm)	DO	Salinity (%)	EC
Rouna 1/3	-9.41680142°	147.36832311°	25.2	7.96	286	6.7	0.02	88
Rouna 4	-9.41236377°	147.33995200°	26.8	7.9	263	6.1	0.03	76
Mt Eriama water discharge	-9.41187243°	147.26000451°	28.8	7.86	256	6.8	004	67
Bomana WPS	-9.39127118°	147.25958708°	27.8	7.5	302	6.0	0.02	69
Waigani Creek	-9.38589056°	147.19438889°	32.6	7.86	364	6.8	0.04	722
WHO/PNG Guidelines & standards			No alteration greater than 2^0C	6.5-8.5	≤500 mg/L	>6.5 mg/L	<600MG/L	< 400 µS/cm

70. **Air quality**. The parameters measured during 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 micrometer in diameter ($PM_{2.5}$). Particulate matter is of great

importance since it could cause various health issues including heart disease, asthma, low birth weight and premature death. Long term exposure could also cause chronic bronchitis and reduced lung function. The air quality was measured through the use of a particulate matter analyzer which measures dust particles. A summary of baseline measurements is presented in Table 5 and indicates that PM10 and PM2.5 results are within the WHO ambient air quality guidelines.

Table 55: Baseline Air Quality Monitoring Results

Parameter			PM_{10}	$PM_{2.5}$
WHO Ambient Air Quality Guidelines (24-hour)			(50 µm/m^3)	(25 µm/m^3)
Sampling Stations	Latitude	Longitude	Baseline	Baseline
Rouna 1/3	-9.41680142°	147.36832311°	20	23
Rouna 4	-9.41236377°	147.33995200°	3	3
Mt Eriama WTP	-9.41187243°	147.26000451°	11	10
Bomana Water P station	-9.39127118°	147.25958708°	6	6
9-mile Option 1	-9.402843°	147.214164°	4	3
9-mile Option 2	-9.417689°	147.221715°	5	4
Mt Eriama	-9.406950°	147.254097°	6	5
Touaguba	-9.476273°	147.154428°	4	4
Waigani Pond	-9.38589056°	147.19438889°	6	5

71. **Noise Levels**. Noise pollution from excessive noise levels could be hazardous to a person's auditory health. Noise level sampling was conducted for areas which would be sensitive to high noise levels including the reservoir sites, and the other project sites. The baseline for noise level was measured *in-situ*, using handheld noise level equipment. This is illustrated in Table 6, with only one sampling site, the Mt Eriama WTP exceeded the PNG standard of ≤ 50 dB.

Table 6: 6Baseline Noise Monitoring Results

Sampling Stations	Latitude	Longitude	Noise Level (Dba)	PNG standards
Rouna 1/3	-9.41680142°	147.36832311°	44.2	⩽ 50 dB
Rouna 4	-9.41236377°	147.33995200°	42.8	
Mt Eriama WTP	-9.41187243°	147.26000451°	53.9	
Bomana Water P Station	-9.39127118°	147.25958708°	41.2	
9-mile Option 1	-9.402843°	147.214164°	35.6	
9-mile Option 2	-9.417689°	147.221715°	44.5	
Touaguba	-9.476273°	147.154428°	45.6	
Waigani Pond	9.38589056°	147.19438889°	36.5	

7. Pollution Sources

72. Two significant sources of pollution are anticipated during the implementation of the subproject: (i) the discharge of aluminum sulfate from the water treatment plant, and (ii) effluent from the wastewater system. Both are expected to contribute substantially to environmental pollution during the rehabilitation phase, highlighting the need for robust management strategies to mitigate their potential impacts.

a. Water Treatment Process and Aluminum Sulphate

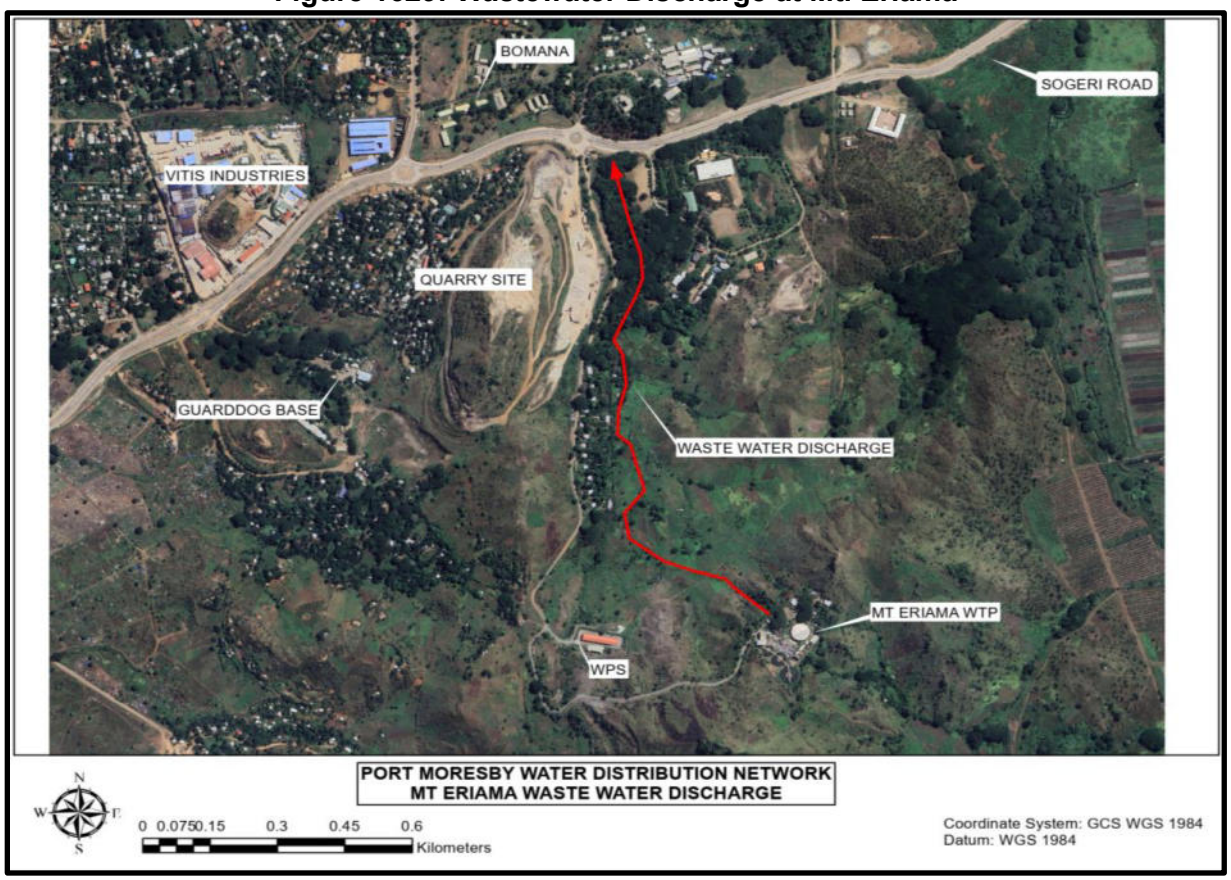
73. **Aluminium Sulphate from Water Treatment Plant.** Aluminum sulfate is widely used as a coagulant in water treatment processes to remove impurities and clarify water. During the coagulation phase, it facilitates the formation of flocs that trap suspended particles and

contaminants, which are then removed through sedimentation and filtration. This process is effective in producing clean drinking water; however, residual aluminum sulfate may remain in the treated effluent discharged from the plant. If not properly managed, the discharge of effluent containing residual aluminum sulfate into nearby water bodies can lead to elevated aluminum concentrations, which may be toxic to aquatic life and disrupt local ecosystems. Additionally, improper handling or accidental spills during transportation or storage pose risks of soil and water contamination.

74. Consultations with treatment plant personnel confirmed that aluminum sulfate is added during the coagulation phase specifically to enhance the removal of suspended solids. While the treatment process is designed to minimize residuals, the presence of aluminum in discharged water remains a concern, necessitating careful monitoring and mitigation measures to prevent environmental harm.

75. **Discharge characteristics**. The discharge from the Mt. Eriama Water Treatment Plant may contain trace amounts of aluminum sulfate following the completion of treatment processes (Figure 16). To ensure the safety of treated water for human consumption, aluminum concentrations must adhere to regulatory standards established by health authorities. The World Health Organization (WHO) recommends that aluminum levels in drinking water should not exceed 0.2 mg/L to minimize potential health risks. However, due to ineffective regulation of wastewater discharge, the actual concentration of aluminum in the effluent remains undetermined.

Figure 1629: Wastewater Discharge at Mt. Eriama



76. Residents living near Mt. Eriama have been using discharged water from the treatment plant for washing purposes, including laundry and personal hygiene (Figure 17). This water may contain low levels of aluminum sulfate, potentially exposing individuals to the compound. Although the dilution and typical exposure levels suggest minimal immediate health risks, concerns remain regarding skin irritation or allergic reactions, particularly among sensitive individuals. During the assessment, two residents reported experiencing such symptoms, indicating a need for further investigation.

77. While the use of discharged water containing aluminum sulfate for washing may not pose significant health risks under controlled conditions, continuous monitoring and proactive public education are essential. These measures help ensure community safety and reduce the likelihood of adverse effects on both human health and the surrounding environment.

Figure 1730: Wastewater Discharge - Mt. Eriama

b. Wastewater Discharge

78. The POM wastewater system represents a significant source of environmental pollution. Designed to collect and treat sewage from urban areas, the system frequently struggles with inadequate infrastructure, limited treatment capacity, and overflows during periods of heavy rainfall. These challenges often result in the release of untreated or partially treated wastewater into the environment, contaminating local waterways with pathogens, nutrients (such as nitrogen and phosphorus), and other pollutants. Such discharges degrade water quality, threaten aquatic ecosystems, and pose risks to public health. The limited holding capacity of POM's wastewater transfer and treatment system is exacerbated by various user activities:

(i) Formal residential customers: Improper disposal of sanitary pads and wet wipes, along with the ingress of sand and stormwater due to faulty construction practices.
(ii) Formal non-residential customers: Routine discharge of fats, oils, and grease (FOGs) from restaurants, and hydrocarbons from service stations.

(iii) Informal residential customers: Dumping of solid waste into manholes and direct discharge of fecal waste into stormwater drains.

79. The inland wastewater system comprises sewage networks and waste stabilization ponds located in Waigani, Morata, and Gerehu. These facilities discharge treated effluent into the Tareko Lagoon, which subsequently flows into the Laloki River. Originally designed as passive, gravity-based systems to minimize operational and maintenance costs, these facilities have seen minimal upgrades since their construction in the 1960s and 1970s. As a result, their efficiency has significantly declined, leading to frequent blockages and overflows within the sewerage networks.

80. The Waigani wastewater system currently serves approximately 35% of POM's population and manages the majority of waste from local sanitation systems. The project in this context intends to rehabilitate the Waigani system. This initiative includes decommissioning the Morata waste stabilization ponds and redirecting their output to the Waigani network. This project initiative aims to enhance service delivery, reduce environmental risks, and improve public health outcomes across Port Moresby.

C. Biological Environment

1. Land Use

81. Land use changes were assessed through comparative analysis of current and historical Google Earth imagery. The observations revealed a noticeable reduction in forest cover, particularly along the Rouna Gorges, extending from Rouna 1/3 down to Rouna 4. This decline is primarily attributed to recurring fire regimes that occur during the dry season, contributing to the degradation of forested areas. Bare soil and grassland are predominantly concentrated in the flatter sections of the Laloki River catchment, spanning from Rouna 4 to the Bomana Water Treatment Plant and extending toward the city (Figure 18). This pattern indicates a continuing decline in forested areas, accompanied by a substantial increase in grassland and agricultural land use. These changes suggest a shift in land cover dynamics, likely driven by human activity and environmental pressures.

2. Flora and Fauna

82. A rapid flora and fauna assessment was conducted at four sampling sites using field observations and interviews with local residents (Figure 19). These consultations and observations did not reveal the presence of any critical or endangered species within the area that would be affected by the proposed works.

83. The environment along the road corridor has been significantly altered by human activities, including settlement, agriculture, collection of materials for construction, heating and cooking, and subsistence hunting and gathering. Potentially significant habitats are located far from the project site, and no major impacts on local fauna are anticipated as a result of the proposed development. Common flora and fauna identified at the sampling sites are listed in Table 7. None of the recorded species are listed on the IUCN Red List of endangered or threatened species.

Figure 1831: Forest Cover of Project Site

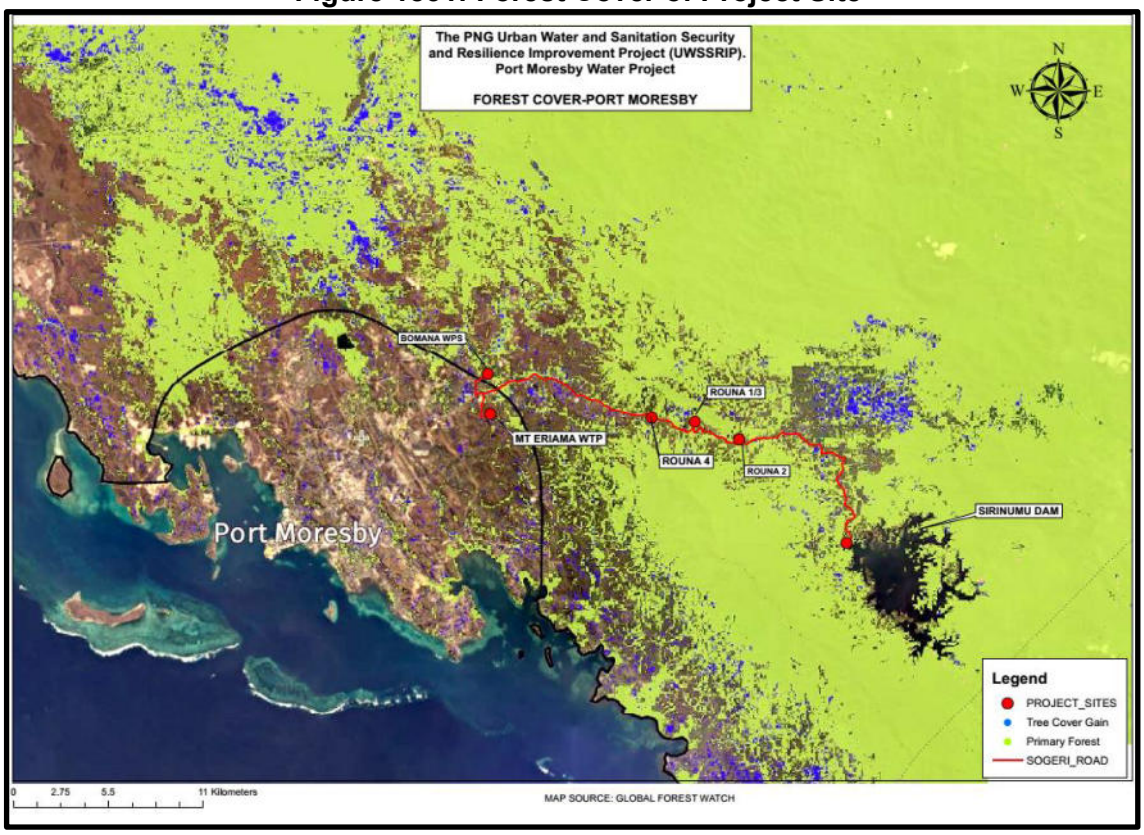


Figure 1932: Flora and Fauna Sampling Sites

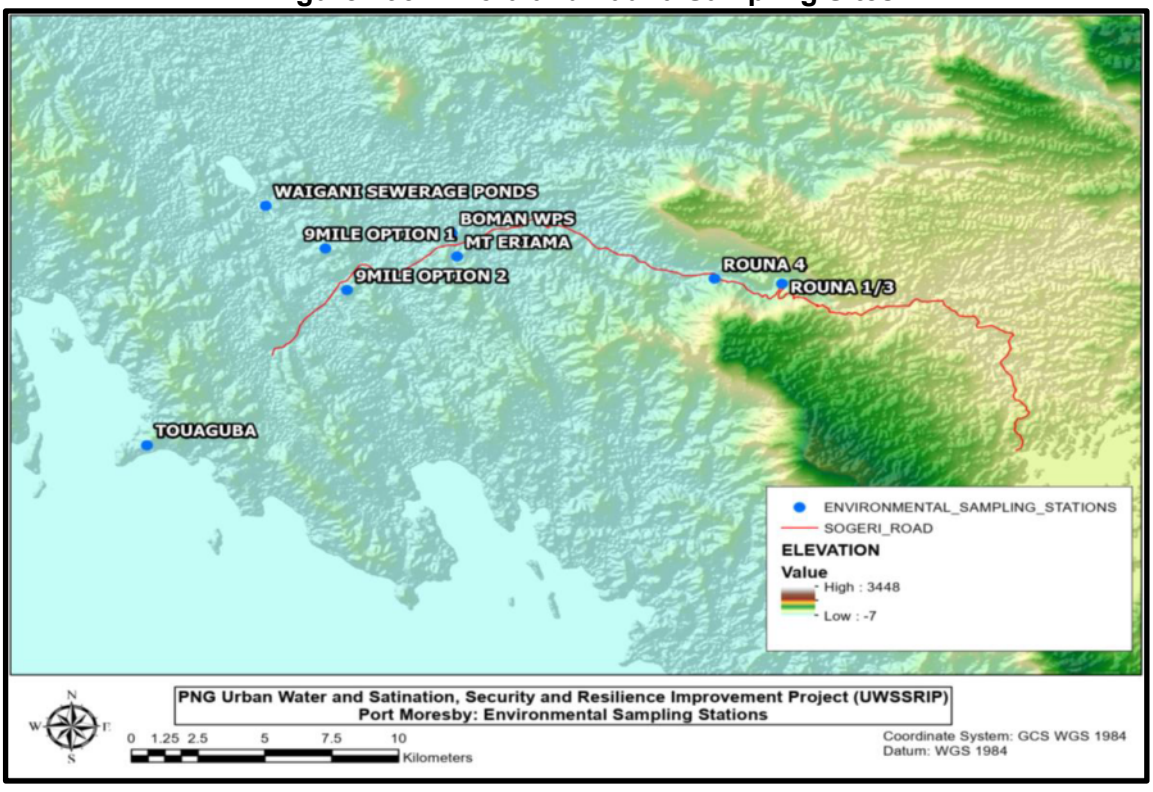
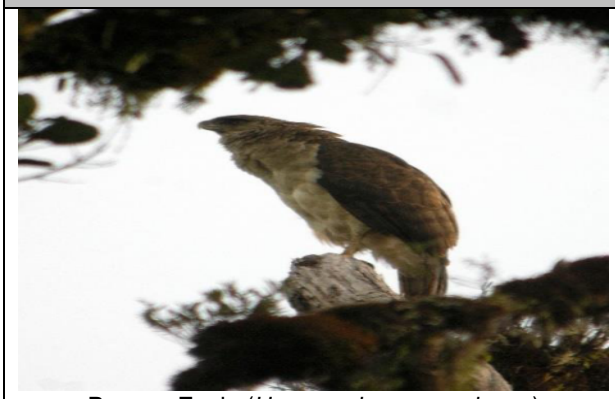
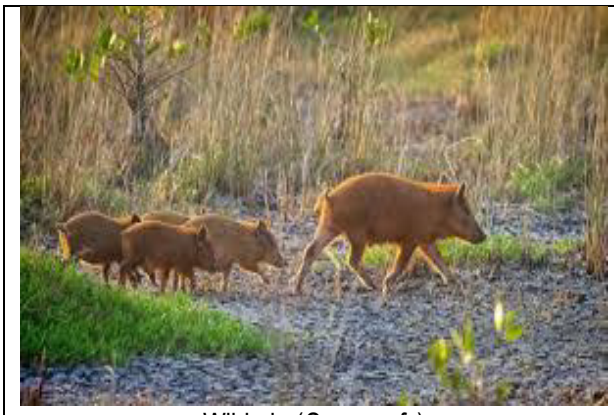


Table 77: Flora and Fauna Species Observed at the Project Sites

<table>
<tr><td colspan="2">Bird species present within the project site</td></tr>
<tr><td> 
Papuan Eagle (Harpyopsis novaeguineae)</td><td> 
Papuan Crow (Corvus orru)</td></tr>
<tr><td> 
Egret (Area alba)</td><td> 
Sclater's Whistler (Pachycephala soror).</td></tr>
<tr><td colspan="2">Mammals Species in the Project Site</td></tr>
<tr><td> 
Eastern white eared giant rat (Hyomys goliath)</td><td> 
New Guinea Slender Rat (Rattus verecundus)</td></tr>
</table>



Wild pig (*Sus scrofa*)

Magani (Wallaby) (*Notamacropus sp.*)

Raffray's Bandicoot *(Peroryctes raffrayana)* It is also a food source for the locals.

Bat

New Guinea Fruit Bat (*Dobsonia magna* or *Dobsonia moluccensis magna*)

Local Fish Species

Common Carp (*Cyprinus carpio*)

Mozambique Tilapia (*Oreochromis mossambicus*)

Mosquito fish (*Gambusia affinis*)

Freshwater Eel (*Anguilla sp.*)

Flora within the site

Red Box (*Eucalyptus polyanthemos*)

River Red Gum (*Eucalyptus camaldulensis*)

Pineapple Zamia (*Lepidozamia peroffskyana Regel*)

Red Grass (*Themeda triandra*)

Japanese Poinsettia (*Euphorbia heterophylla*)

Casia Amarilla (*Senna spectabilis*)

Monarch Fern (*Phymatosorus scolopendria*)

Yellow cheesewood (*Nauclea orientalis*)

Rain Tree (*Samea saman*)

Water Spinach (*Ipomea aquatica*). Common vegetable, grows along the swampy areas along the project site.

Wild daka (*Piper aduncum*)

Banana (*Musa paradisiaca*)

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

(i) Identification-Guide-to-Flora-and-Fauna-of-Hides-Ridge.
(ii) PNG Buzz.
(iii) https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:592777-1/general-information
(iv) Birds of Papua New Guinea, Thane.K Bruce M. Beehler.

3. Protected Areas

84. Designated protected areas are located at a considerable distance from the project site, as shown in Figure 20 and Figure 21. The nearest protected areas include Variarata National Park and the Kokoda Trail and Wildlife Management Area, both situated further inland. Due to the significant distance and the limited scope of construction activities, no adverse impacts on these protected areas are anticipated.

4. Aquatic and Terrestrial Ecology of the Area

85. 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.

5. Information on Vulnerable and Endangered Species

86. Risk screening conducted for the Port Moresby subprojects 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 20: 33 Protected Areas of Papua New Guinea

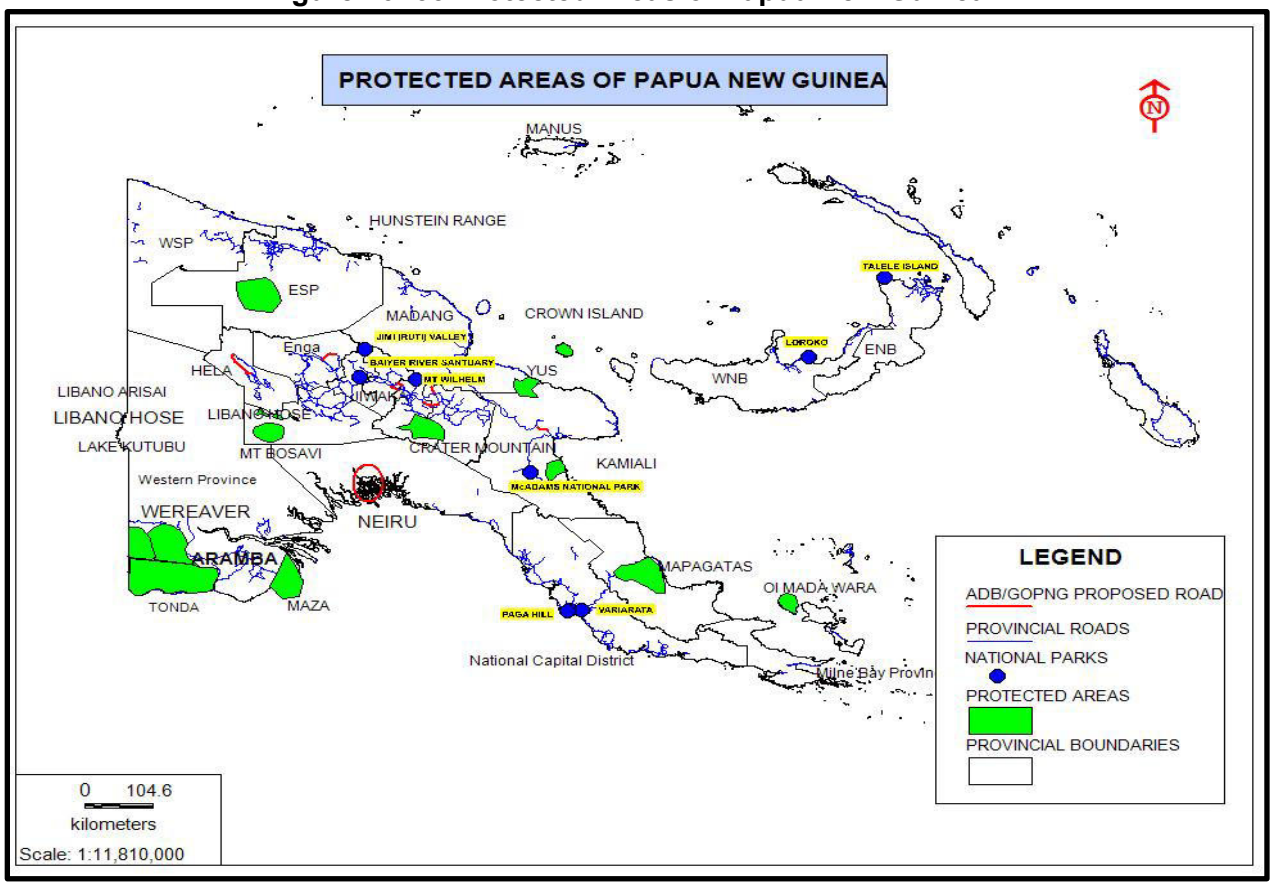
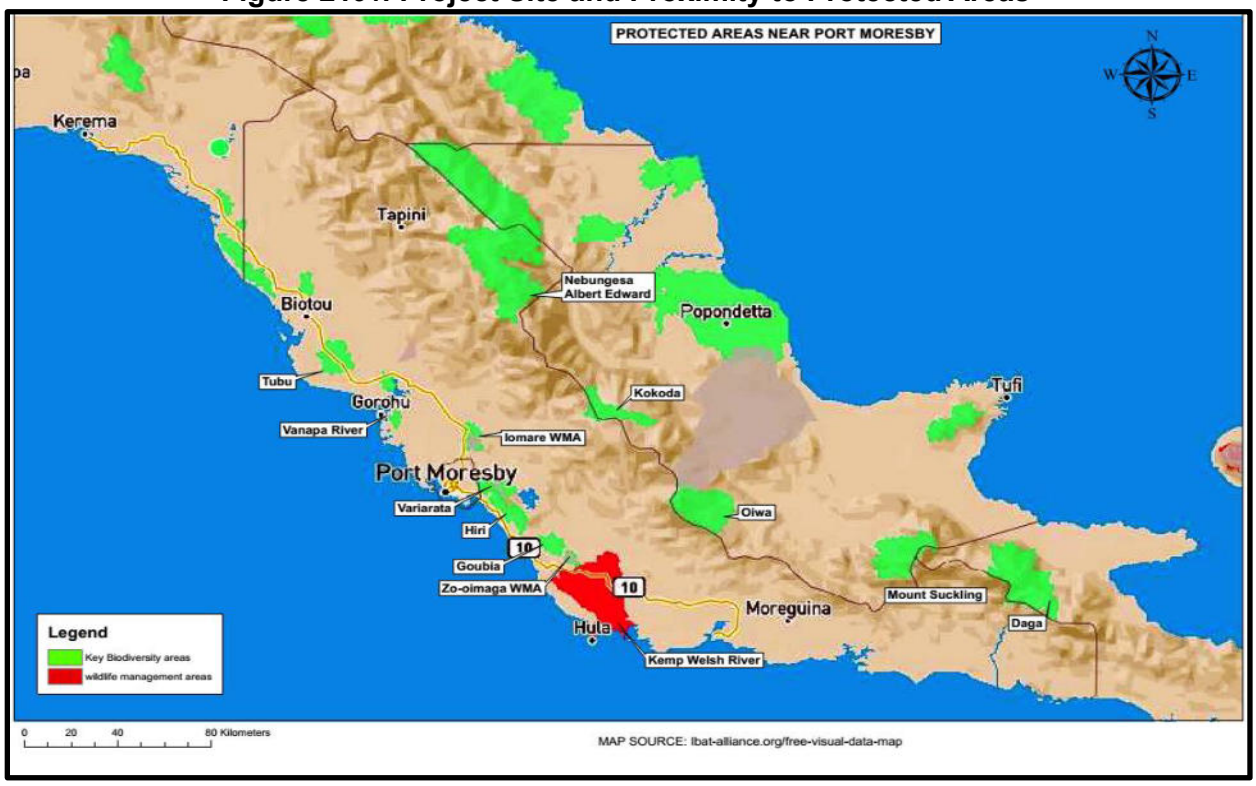


Figure 21*34*: Project Site and Proximity to Protected Areas



D. Socio-Economic Environment

87. **Population and Demography**. POM's estimated population in 2021 was 513,918,[16] up from 364,125[17] recorded in the 2011 Census. Between 2000 and 2011, the city's population grew at an estimated annual rate of 3.3%, exceeding the national average of 3.1% during the same period.[18] This may be attributed to rural to urban immigration, particularly to man cities of people looking for opportunities and access to social services. According to the NCD Urban Development Plan Port Moresby Towards 2030, the city's population is projected to increase by between 210,000 and 480,000 people by 2030.[19] This equates to an average annual growth of approximately 20,000 to 44,000 individuals. This sustained population growth is largely attributed to continued internal migration from rural areas, the expansion of informal settlements, and increased birth rates within the urban environment.[20] Based on the projections, 51% of the population is male and 49% female. The age distribution comprises 20.8% aged 0 to 14 years, 67.9% between 15 and 64 years, and 2.3% aged over 65.[21]

88. **Informal Settlements.** Over the past decade, the area occupied by informal settlements

[16] National Statistical Office (NSO). Census 2011, Port Moresby.
[17] National Population Estimate 2021. National Statistical Office, Australian Government and AusPNG Partnership and (UNFPA), 2021.
[18] National Capital District Commission Urban Development Plan Review 2020, "Port Moresby Towards 2030". November 2020. Port Moresby.
[19] IDEM.
[20] Port Moresby, Papua New Guinea – Climate Change Vulnerability Assessment, United Nations Human Settlements Program (UN-Habitat). 2013.
[21] National Population Estimate 2021. National Statistical Office, Australian Government and AusPNG Partnership and (UNFPA), 2021.

has more than doubled, growing from 18 km² to 40 km². Combined with undeveloped land within the Subdivision zones currently under development, the total urban footprint is expected to reach approximately 80 km².[22] Informal settlements constitute the dominant land use in the city, occupying nearly 15% of the city. Urban expansion has recently focused on consolidating existing developed zones through redevelopment, while informal settlements have proliferated on the city's fringes.[23] Informal settlements continue to expand on both state and customary lands. The informal land system is increasingly perceived as a practical alternative to the formal system, which is often viewed as bureaucratic, slow, and financially inaccessible. This informal market allows land to be sold or leased, largely through kinship-based arrangements.[24]

89. According to the 2000 census, population growth has been concentrated in inner suburbs such as Gerehu, Morata, Gordons, and Tokarara. Residential expansion has moved uphill—initially in areas between the port and Koki, and since the mid-2000s, extending to the elevated areas surrounding Waigani, Hohola, and Garden Hills.[25] These settlement characteristics must be carefully considered in project design and planning—particularly given the city's scattered urban pattern and the need to avoid works that could restrict or temporarily cut off access to water sources during the dry season.

1. Economic Activities

90. The primary economic activities in POM are concentrated in the service industry. However, the city faces significant challenges with a high unemployment rate, which exceeds 50%. Many unemployed individuals reside in informal settlements and urban villages, where they often engage in informal sector activities to make a living. The informal economy plays a vital role in Port Moresby's socioeconomic landscape, sustaining a large share of the urban population—especially more than 75% of those living in informal settlements. Informal activities, typically structured as microenterprises or livelihood ventures, span areas such as marketing, distribution, small-scale manufacturing, and service delivery.[26] This sector is estimated to generate around 2 million kina per day, equating to roughly 750 million kinas annually, and represents the primary income source for nearly half of all urban households. Even among those employed in the formal sector, it is common to engage in informal economic activities to supplement household income.[27]

91. The expansion of the informal economy has been driven by a combination of factors, including rapid population growth, a shortage of formal employment opportunities, low wages, rising living costs, and increasing numbers of children leaving school before completing their education.[28] The economy is thus largely underdeveloped, with most of the population living below the poverty line.

92. **Poverty.** According to the United Nations Development Programme (UNDP), PNG's Multidimensional Poverty Index (MPI) for 2019/2020 was 0.263. This indicates that approximately 37.8% of the population was considered multidimensionally poor, facing deprivation across key

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[22] IDEM.
[23] IDEM.
[24] National Capital District Commission Urban Development Plan Review 2020, "Port Moresby Towards 2030". November 2020. Port Moresby.
[25] IDEM.
[26] National Capital District Commission Urban Development Plan Review 2020, "Port Moresby Towards 2030". November 2020. Port Moresby.
[27] IDEM.
[28] IDEM.

indicators such as health, education, and living standards.[29] Data from the 2009 PNG Household Income and Expenditure Survey (HIES) estimated that around 37% of the national population was living below the income poverty line at that time. However, no more recent disaggregated household income data is available specifically for POM.[30]

93. **The Wantok system**—a traditional network of solidarity and reciprocity that connects individuals sharing the same language, culture, or regional background—remains an integral part of Papua New Guinea's social fabric. While it plays a crucial role in fostering social cohesion and providing informal support in contexts where public services are lacking, it can also reinforce cycles of poverty. In urban settings such as POM, where formal and informal systems intersect, the wantok system serves both as a social safety net and a concealed financial burden, particularly for individuals seeking economic autonomy.[31]

2. Land Tenure

94. Over 50% of the city's population lives in informal settlements, many without legal land titles or compliance with urban planning regulations. Whether located on state or customary land, these areas are typically characterized by inadequate housing, unemployment, limited access to essential services, and heightened social vulnerability. Their growth—primarily driven by rural-to-urban migration—has outpaced formal development, now covering the equivalent of 70% of land occupied by planned urban areas, placing increasing pressure on both formal infrastructure and traditional land systems. In terms of landownership, about 60% of Port Moresby's land is classified as alienated or state land, while 40% falls under customary ownership. Access to basic urban services such as water supply, energy provision, sewerage networks, sanitation, and refuse collection varies significantly between formal areas and informal settlements. While formal areas tend to be well-serviced, residents in informal settlements frequently resort to illegal means to access these essential services.

3. Urban Services

95. POM's water supply depends largely on the Sirinumu Reservoir, with water treated at the Mount Erima plant, which processes around 177 megalitres per day. Despite this capacity, the system faces critical inefficiencies: only 45% of treated water is billed. Losses arise from leaks (27%), illegal connections (11%), and unbilled consumption (17%), particularly within informal settlements and customary villages. The distribution network primarily serves older suburbs, leaving substantial areas—especially in the east, south, and west—without reliable service.

96. The wastewater treatment system consists of several decentralised basins connected mainly to the Waigani Wetlands and Joyce Bay. Although a new treatment plant was recently added near the bay, it operates at only 25% of its capacity and is restricted by legal constraints related to sludge disposal. Currently, sludge is accumulating on vacant land. The Waigani treatment lagoons are severely congested and require the removal of at least 300,000 m³ of sludge. The absence of regulatory frameworks on wastewater and sludge management poses

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[29] UNDP (United Nations Development Programme). Multidimensional Poverty Index (MPI) https://hdr.undp.org/content/2024-global-multidimensional-poverty-index-mpi#/indicies/MPI . Accessed on 27 June 2025.

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

[31] National Research Institute (NRI) Spotlight Volume 16, Issue 11 "Papua New Guinea is facing the development challenges of poverty in urban centers " Philip Kavan. July 2023.

growing public health and environmental risks, particularly as urban development encroaches on treatment infrastructure zones.

97. The city's electricity system is managed by PNG Power Ltd, combining hydroelectric generation (Rouna 1–4) with thermal power (Moitaka), interconnected through substations located at Bomana, Boroko, Waigani, and Konedobu. However, service coverage remains heavily concentrated in formal urban areas, with limited or unreliable access in informal settlements and peripheral zones.

4. Public Transport

98. The infrastructure within Port Moresby requires substantial improvement. The existing road network is poorly maintained, particularly in suburban areas and informal settlements. Public transport systems are inadequate and need enhancement to better serve the population.

5. Health and Education

99. The National Capital Region Provincial Health Authority (NCDPHA) has developed its 2025–2030 Strategic Plan to improve the equity, efficiency, and coverage of services, especially in peri-urban communities and informal settlements, where health gaps are most pronounced. The most recent figures indicate that the infant mortality rate stands at 34.8 deaths per 1,000 live births, while maternal mortality is approximately 171 per 100,000 births. Under-five mortality is 49 per 1,000 live births. Communicable diseases such as tuberculosis and HIV/AIDS remain prevalent, particularly in densely populated settlements. Port Moresby accounts for a significant proportion of the country's HIV cases, and although the national prevalence ranges between 0.8% and 1.0%, testing coverage remains low: only 6.9% of women and 5.9% of men aged 15-49 have recently been tested and received results. Non-communicable diseases such as hypertension and type 2 diabetes are on the rise, driven by urban sedentary lifestyles, food insecurity, and limited access to preventive care. Although Port Moresby has better infrastructure than other regions in the country, less than 55% of births are attended in health facilities, and only 35.3% of children aged 12–23 months receive their full vaccination schedule.

Education faces several challenges in terms of both access and quality. Port Moresby, as the national capital, is home to a significant portion of the country's urban population and presents a dual educational structure: on the one hand, public and private schools with established infrastructure; on the other, a network of community schools and informal centers in urban settlements with limited access to resources, staff, and basic services. The rollout of a new education system is hindered by infrastructure shortfalls, a lack of qualified teachers, insufficient teaching materials, and poor classroom and sanitation conditions. Low public funding exacerbates these issues, affecting education quality across the system. Nationally, over 70% of ten-year-old children in PNG do not demonstrate age-appropriate reading comprehension. There is little to no access to early childhood education, leaving many children at a disadvantage before entering primary school. Teacher absenteeism and weak school management further hinder learning outcomes.

100. Overall, healthcare facilities and educational institutions are available but often suffer from poor resources and maintenance issues. This affects their ability to provide quality services to the community.

6. Gender

101. In PNG, the situation for women is complex, marked by the coexistence of strong traditional roles. Women's participation in PNG's economy is strongly divided between the informal sector and a very small formal sector. Women play a key role in the informal economy, especially in the production and sale of fresh food in local markets. Men are more likely to be formally employed than women. Sixty-four percent of married men worked in the past 12 months, compared to only 36 percent of married women. Forty-six percent of married women with cash income independently decide how their earnings are used. Approximately half of women and men report making joint decisions about their partners' cash income.[32]

102. It is estimated that around 56% of women aged 15 to 49 in Papua New Guinea have experienced physical violence since the age of 15, and 28% have experienced sexual violence. Eighteen percent of women who have ever been pregnant have experienced violence during pregnancy.[33] Around 63% of women who have ever been married have experienced physical, sexual, or emotional spousal violence. The most common type of spousal violence is physical violence (54%), followed by emotional violence (51%). 29% of women have experienced spousal sexual violence. 57% of women who have experienced physical or sexual spousal violence have suffered injuries.[34] Cuts, bruises, or sore spots are the most common types of injuries reported. In Port Moresby's urban settlements, these rates are often even higher, driven by factors such as insecurity, poor lighting, poverty, and social marginalization.[35]

7. Future Prospects

103. As the national capital, POM concentrates a significant proportion of PNG's economically active population, particularly in sectors such as commerce, construction, public administration, and essential services. While the official local unemployment rate is estimated at 1.9%, this figure does not adequately capture the high levels of informality and underemployment prevalent across the city. Despite these challenges, Port Moresby is poised for expansion due to its strategic location and strong trade agreements with neighboring countries in the Asia Pacific region. This potential growth could lead to improved economic conditions if effectively harnessed.

104. Overall, Port Moresby's socio-economic environment reflects a complex interplay of opportunities for growth against a backdrop of significant challenges related to unemployment, infrastructure deficits, and access to essential services.

E. Identification of Environmental Receptors Sites

105. Project receptor sites are illustrated in Figure 22. The identification of these receptor sites is based on the nature of project activities and their potential impacts on surrounding communities, schools, hospitals and other essential infrastructure. The description of each receptor site, its location, and corresponding photographs are detailed in Section V.

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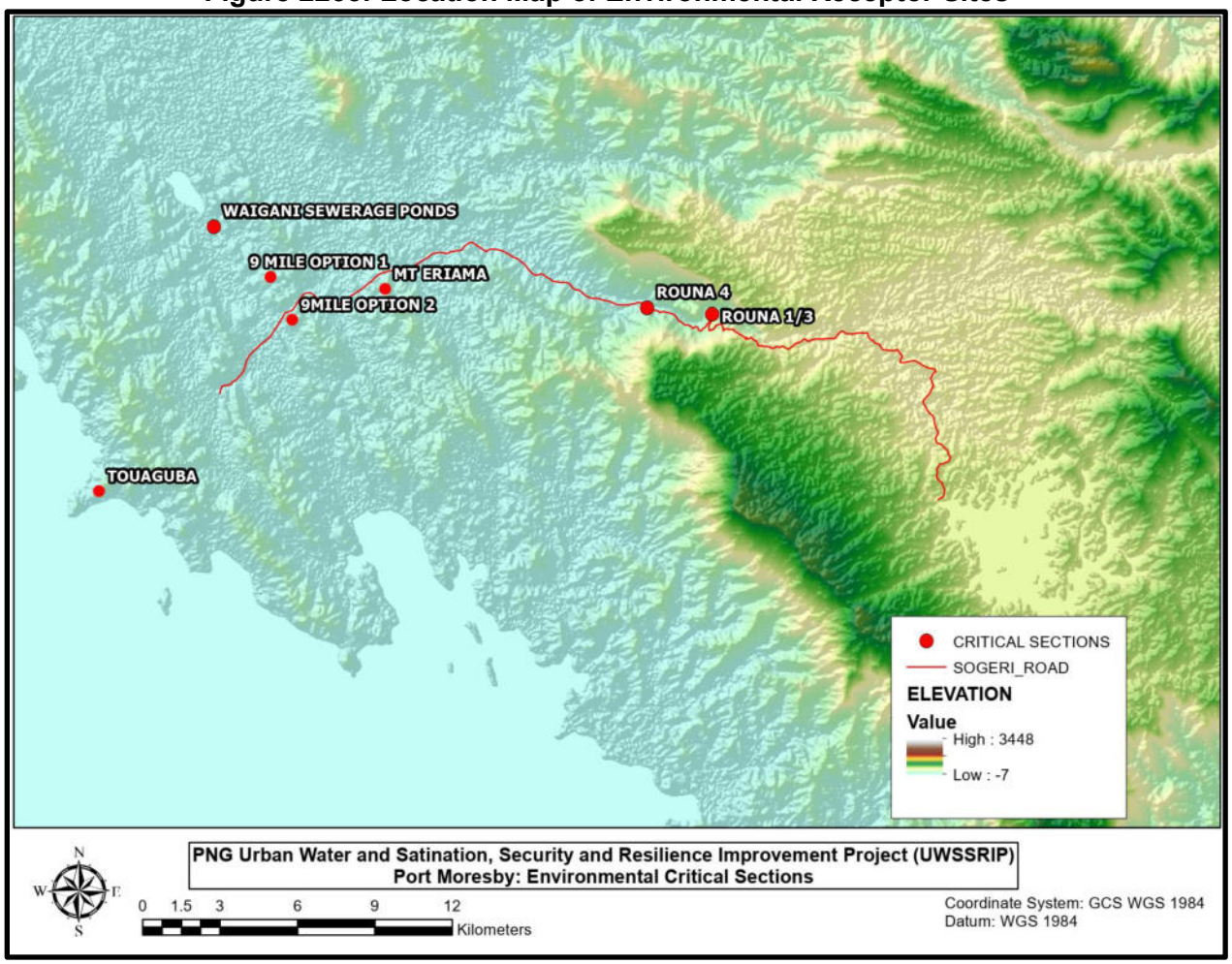
[32] National Statistical Office – PNG Household Income and Expenditure Survey, Key Findings of the 2016-18 DHS. https://www.nso.gov.pg/census-surveys/demographic-and-health-survey/ . Consulted on 27 June 2025.
[33] IDEM.
[34] IDEM.
[35] UN Women PNG. (2023–2025). Country Gender Equality Brief.

Figure 2235: Location Map of Environmental Receptor Sites



V. ANTICIPATED ENVIRONMENTAL IMPACT AND MITIGATION

106. The proposed POM Water Supply and Sanitation Subprojects involve the optimization of water sources and treatment systems, the augmentation and expansion of storage and distribution infrastructure, and the rehabilitation of the Waigani sanitation system. The civil works associated with these activities are expected to result in several environmental impacts. A thorough understanding of these potential effects is essential for designing effective mitigation strategies that promote the sustainability of the local ecosystem while addressing POM's water supply and sanitation needs.

107. The following section provides an assessment of the likely impacts of the proposed infrastructure investments on the physical, biological, socioeconomic, and physical cultural resources in POM. It identifies 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's SPS and national CSS and where PNG has no set standard or guidelines, the standards given in the World Bank Environmental Health and Safety (EHS) General Guidelines are used.

A. Impacts and Mitigation Measures for Design and Pre-Construction

108. 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.

109. **Review and update of the EMP.** Based on the two EMPs in this assessment and following detailed design, the EMPs 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: (a) prior to the tender being called the EMP will be revised and updated as required based on the detailed design; (b) 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; (c) 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 (d) 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.

110. **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.

111. 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 detailing 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.

112. 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.

113. **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.

114. **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.

115. **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 includes 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. The proposed subprojects integrate key climate adaptation measures to enhance system resilience and water security. These include: (i) upgrades and expansion of water treatment facilities to provide safe and climate-resilient water to communities vulnerable to rising temperatures and heat stress; (ii) a program to reduce physical water losses, thereby lowering per capita demand and easing pressure on raw water resources; (iii) improved hydrometeorological monitoring and climate-resilient reservoir operations, supported by capacity development, to optimize reservoir releases for hydropower and water supply; (iv) a geotechnical dam safety assessment to mitigate risks of overtopping due to increased rainfall intensity; and (v) the development of a multi-stakeholder watershed action plan for the upper Laloki River catchment to support sustainable watershed management.

116. **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.

117. **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.

118. 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.

119. **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.

120. **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 Port Moresby to be free from biosecurity risk material, such as soil, seeds, plant, and animal material.

121. **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.

B. Impacts and Mitigation Measures for Construction Phase

122. The construction phase starts when the contractor commences mobilization to the work sites and the establishment activities such as setting up of the 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 the Physical Environment

123. The proposed POM 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.

124. **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.

125. **Air quality and odor**. The implementation of proposed subprojects 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, hospitals, 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. Other environmental concerns specific to the Waigani rehabilitation works include potential impacts on air quality, particularly from odors and construction-related emissions. These issues highlight the need for a comprehensive sludge management plan, which should include odor control measures and be incorporated into the CEMP. Additionally, surrounding stakeholders should be notified of the rehabilitation activities to ensure transparency and minimize disruptions

126. **Noise and vibration**. Construction activities associated with subprojects will 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.

127. **Water quality and water extraction**. Water quality is a critical component of any water supply initiative. For the POM subproject, ensuring that water extracted from sources such as the Laloki River remains uncontaminated is essential for protecting public health and maintaining environmental sustainability. Construction activities pose potential risks to water quality, particularly through runoff that may carry sediments, chemicals, and pollutants into nearby water bodies. Materials like concrete, if not properly managed, can leach harmful substances, while soil disturbance can lead to erosion and increased sedimentation, disrupting aquatic ecosystems. Additionally, wastewater from facilities such as the Mt Eriama WTP can contribute to pollution if not adequately treated or disposed of.

128. To effectively address potential risks to water quality, it is essential to implement Best Management Practices (BMPs) throughout the project lifecycle. These practices are designed to minimize environmental impacts and safeguard water resources. One effective BMP is the installation of silt fencing around construction sites, which helps control erosion by trapping sediments before they enter nearby waterways. This reduces sedimentation and its harmful effects on aquatic habitats. In addition to physical controls like silt fences, regular water quality monitoring is critical. Monitoring should be conducted at key stages—prior to construction, during

active operations, and after project completion. Important parameters to assess include turbidity (indicating sediment levels), pH (reflecting chemical balance), and the presence of harmful contaminants such as heavy metals or pathogens. Systematic tracking of these indicators enables early detection of water quality issues and allows for timely corrective actions.

129. Maintaining high water quality standards, especially when extracting surface water from sources like the Laloki River, requires careful planning and execution. By identifying potential contamination sources—such as construction runoff and wastewater discharge—and applying robust mitigation strategies like BMPs and continuous monitoring, the project can effectively protect public health and preserve environmental integrity. 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.

130. **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.

131. **Waste management**. Effective waste management is vital for minimizing environmental impacts associated with the water supply project in Port Moresby. Construction activities typically generate various types of waste including solid waste (e.g., packaging materials, discarded equipment), hazardous waste (e.g., fuel and lubricants, chemicals and other materials that require special handling), and wastewater (e.g., construction runoff, vehicle washing). 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.

132. **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

133. **Land use**. The implementation of the subprojects in POM is likely to influence land use patterns across the region. While much of the area has already been modified by human settlements, the environmental disturbances associated with the project may be less severe compared to those in untouched or ecologically sensitive zones. Nevertheless, construction

activities, particularly land clearing, can still have notable environmental consequences. Land clearing for infrastructure development can lead to soil erosion, especially when vegetation is removed without proper stabilization measures. This erosion may result in sedimentation in nearby waterways, negatively impacting water quality and aquatic ecosystems. Furthermore, disruptions to natural drainage systems can alter local hydrology, potentially increasing flood risks and affecting groundwater recharge rates. Despite Port Moresby's extensive urban development, further conversion of natural landscapes into built environments can contribute to habitat loss for local wildlife. Encroachment into previously undeveloped areas may threaten species that depend on these habitats for survival, underscoring the need for careful planning, implementing zoning regulations, and promoting sustainable land management to balance development with ecological preservation. Given that the majority of the subproject sites consist of built-up areas, including residential zones and commercial establishments, significant land use changes are not anticipated. These locations are already considered modified and disturbed habitats, reducing the likelihood of substantial environmental impact.

134. **Forest resources**. The subproject aims to improve urban water access and sanitation management, but it may have several environmental impacts, particularly on forest resources in catchment areas. Key concerns include deforestation and habitat loss due to land clearing, which can disrupt ecosystems and threaten local wildlife. Soil erosion and sedimentation from construction activities may degrade water quality and aquatic habitats, while changes in forest cover could alter local microclimates. Additionally, expanding human settlements may increase human-wildlife conflict and affect indigenous communities that rely on forest resources for their livelihoods. To mitigate these risks, the project should implement a range of Best Management Practices (BMPs), including using selective clearing techniques, initiating reforestation programs, establishing buffer zones around sensitive areas, engaging local communities in planning and education, promoting sustainable resource management, and addressing biodiversity and wildlife conservation.

135. **Biodiversity and wildlife management**: The subproject, while primarily located in urban areas, may still impact local biodiversity and wildlife. Construction activities can lead to habitat loss, fragmentation, and disruption of local ecosystems through vegetation removal, sedimentation, and contamination of nearby water bodies. These changes may also facilitate the spread of invasive species and disturb urban wildlife through noise and increased human activity. Despite the reduced presence of natural habitats in POM, wildlife management remains essential. Integrating biodiversity considerations into urban planning will help preserve remaining habitats and corridors.To mitigate potential impacts on biodiversity and wildlife, several measures should be implemented including establishment of buffer zones around sensitive habitats, application of sustainable construction practices to minimize erosion and runoff, restoration of disturbed areas with native vegetation post-construction, and development of long-term monitoring programs to evaluate and adapt mitigation strategies.

136. Site clearance and vegetation removal will be required for the subproject. The augmentation and expansion of the pipeline will involve construction 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 plans to minimize potential impacts on surrounding terrestrial habitats.

137. **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 Socio-economic Environment

138. 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. POM, as the capital city of PNG, faces a range of socio-economic challenges exacerbated by natural hazards, urbanization, and climate change. The impacts are multifaceted, affecting various sectors including health, education, infrastructure, and economic stability.

139. **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.

140. 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.

141. **Potential social issues due to influx of workers**. A small number of workers are expected to work on the POM subprojects. Where capacity is available, laborers will be hired locally from POM. However, for skills not available in the capital and for specialist jobs, workers 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).

142. **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.

143. 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.

144. **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 work on site through community consultation and awareness sessions.

145. **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.

146. **Traffic management.** It is noted that construction activities may affect traffic flow and accessibility, particularly in densely populated or high-traffic areas. To mitigate these impacts, the contractor will be required to develop and implement a comprehensive traffic management plan. This plan should ensure safe and efficient movement for both vehicles and pedestrians, while minimizing inconvenience to residents and businesses. Although the proposed site-specific investments are located near trunk main transmission lines—reducing the likelihood of major disruptions—traffic-related impacts must still be carefully considered and addressed to safeguard public mobility and access.

C. Impacts and Mitigation Measures for Operation Phase

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

1. Operation impacts on Physical Environment

148. **Environmental benefits**. The POM Subproject is expected to deliver substantial environmental benefits. It will lead to improved water quality and significantly reduce reliance on contaminated groundwater sources, such as shallow wells. By enhancing the efficiency of water treatment and distribution systems, the project will minimize water loss and alleviate pressure on existing water resources. The availability of safe and reliable water supply will also discourage informal and unregulated water extraction practices, thereby reduce environmental degradation and promote sustainable resource management.

149. In parallel, the improved wastewater treatment system will reduce pollution levels in local waterways, contributing to cleaner and healthier aquatic environments. This upgrade is crucial for protecting aquatic ecosystems and preserving downstream biodiversity. Moreover, by increasing the capacity and reliability of the sanitation infrastructure, the project will lower the risk of untreated sewage discharges during heavy rainfall or system overloads, safeguarding both environmental and public health.

150. **Operational risks**. While the POM Subproject offers significant benefits, several environmental and operational risks may arise during its operation phase. One key concern is the increased energy consumption required for expanded water treatment and pumping operations, which may contribute to higher greenhouse gas emissions if not managed sustainably. There is also a risk of chemical spills or leaks from treatment facilities, particularly involving substances such as chlorine or aluminum sulfate, which could pose hazards to both the environment and public health. Additionally, the expansion of infrastructure may cause minor disturbances to local ecosystems, especially in areas adjacent to natural habitats. The operation of the expanded Waigani sanitation system may generate odor and noise, potentially affecting the quality of life for nearby residents. Furthermore, accidental discharges or overflows during system failures could lead to environmental contamination. Lastly, sludge management and disposal must be carefully handled to prevent secondary pollution, ensuring that waste byproducts do not compromise soil or water quality.

151. To effectively manage the environmental and operational risks associated with the project, a comprehensive and proactive strategy is essential. Key mitigation measures include:

(i) Increased energy consumption and greenhouse gas emissions can be mitigated by (a) using energy-efficient technologies such as high-efficiency pumps, motors and treatment systems; (b) integration of renewable energy technologies to offset grid electricity use; (c) regularly assessing energy use and optimize operations; and (d) invest in reforestation or other offset initiatives.

(ii) Chemical spills or leaks from the use of chlorine and aluminum sulfate can be mitigated by (a) installing secondary containment and spill trays around chemical storage areas; (b) using sensors and alarms to detect leaks; (c) ensuring operators are trained in safe handling of chemicals and emergency response; and (d) conducting routine checks of storage tanks, pipelines, and dosing systems.

(iii) Odor and noise from Waigani sanitation system can be mitigated by (a) installing odor control systems and noise barriers; (b) limiting noisy activities to daytime hours; and (c) community engagement in planning mitigation measures.

152. **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.

153. **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. Operation Impacts on the Biological Environment

154. **Flora and fauna**. The operation of the POM subproject's is unlikely to encourage poaching or hunting of wildlife, as the project area primarily consists of built-up sites that have been settled since the 1970s. These urbanized zones have limited remaining wildlife. Existing faunas are largely confined to controlled environments, such as the Port Moresby Nature Park—a zoological facility covering approximately 12 hectares located about 20 km from the city. Additionally, Varirata National Park, situated around 42 km from Port Moresby, is home to a rich diversity of bird species. To support wildlife conservation efforts, it is essential that WPNG incorporates regular Information, Education, and Communication (IEC) campaigns as part of its operational activities. These should

be complemented by ongoing monitoring to help protect and preserve the remaining wildlife species in the region.

3. Operation Impacts on the Social Environment

155. **Operational benefits and risks**. The POM subprojects are expected to deliver substantial social benefits while also presenting some potential adverse impacts that must be carefully managed. On the positive side, the project will significantly improve public health by providing access to clean water and better sanitation, thereby reducing the prevalence of waterborne diseases such as cholera and diarrhea. This improvement in hygiene and sanitation will enhance the overall quality of life, particularly for women and children who often bear the burden of collecting water. With more reliable water access, households can save time and redirect their efforts toward education and income-generating activities.

156. The subprojects also bring economic opportunities through job creation. Small businesses, such as laundry services and food vendors, may also benefit from improved water availability. Furthermore, the project promotes gender and social inclusion by ensuring that sanitation facilities in schools and public areas are safe and accessible, especially for women, girls, and persons with disabilities. Hygiene education campaigns associated with the project can also lead to long-term behavioral changes and better health outcomes.

157. However, the subprojects may also result in some adverse social impacts. Affordability could become a concern if water tariffs or connection fees are too high for low-income households, potentially leading to unequal access. Additionally, if the subprojects lack adequate community consultation, it may face resistance or mistrust, especially if cultural sensitivities around sanitation are not respected. To build trust and foster community ownership, the subproject should prioritize inclusive and ongoing stakeholder engagement. This includes conducting consultations with local leaders, women's groups, and marginalized communities during both planning and implementation phases. Communication should be culturally appropriate and delivered in local languages where necessary. Moreover, sanitation solutions should be designed with cultural norms in mind, ensuring that facilities are acceptable and usable by all community members. Establishing community feedback mechanisms—such as hotlines or local liaison officers—can also help address concerns promptly and transparently.

158. **Community Health and Safety.** Upon completion, the POM subproject is expected to significantly enhance public health by providing reliable access to safe drinking water and reducing dependence on potentially contaminated groundwater from shallow wells. The inclusion of improved sanitation systems will further reduce the risk of waterborne diseases and promote hygienic living conditions. Additionally, the project will strengthen community resilience to climate change, particularly during periods of drought, by ensuring a more secure and sustainable water supply.

159. **In-migration**. The operation of the subprojects 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.

160. **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.

D. Risk Assessment of Environmental Receptors Sites

161. 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 assessments for the seven identified receptors include proposed mitigation measures for the anticipated impacts for the site-specific areas. The identified receptors include (i) Mt. Eriama Water Treatment Plant (WTP), (ii) Mt. Eriama Reservoir, (iii) 9-Mile Reservoir, (iv) 8 Mile Reservoir, (v) Touaguba Hill, (vi) Port Moresby Water Distribution Network, and (vii) Waigani Sanitation Ponds.

162. **Risk assessment methodology**. The likelihood and consequence of each identified risk are provided in Table 8 and Table 9 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 10. 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 8*8*: Likelihood of Risks

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 9*9*: 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. (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 result 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.	4
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.	3

Consequence of Risk	Description	Score
	The occurrence of any of the above may result in work being halted and in a fine.	
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 remain 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 10*10*: 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.

163. **Environmental risk assessment**. The initial environmental risk assessment (ERA) affecting the identified receptor sites are presented in the tables. 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.

164. These environmental risks are site-specific, temporary in nature, and can be effectively mitigated 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.

Table 11 11: ERA for Receptor Site 1 – Mt Eriama Water Treatment Plant

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
Mt Eriama Water treatment Plant	Upgrade of Mt Eriama Water treatment Plant. Installation of the 4km main from Eriama to 9mile.	Degrades Natural Habitat	2	2	4	• Less likely to happen as this site has already been occupied by human settlement with less flora and fauna significance.
		Slope Erosion	3	3	9	• Works are in line with careful planning and engineering solutions. • Regular monitoring shall be conducted.
		Surface water pollution due to increased sedimentation during excavation works.	2	3	6	• Less Likely to happen • 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. • Works be in line with careful planning and engineering solutions
		Disturbing the stability of Nearby House /Adjourning structures.	2	3	6	• Pay compensation for the damaged structures if required.
		Pollution of ground water from hydrocarbon leakages	2	3	6	• 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	3	9	• Using new equipment and machinery. • Regularly maintaining and servicing machinery. • Conduct air quality monitoring regularly
		Noise pollution from machineries	2	3	6	• Using new equipment and machinery. • Regularly maintaining and servicing machinery. • Conduct Noise level checks regularly
		Solid waste/ Excavated waste management.	2	2	4	• 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.

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
		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	2	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	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 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.
		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.

Table 1212: ERA for Receptor Site 2 – Mt. Eriama Reservoir

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
Mt Eriama	Construction of New Reservoir Construction of new Water main from Mt Eriama WTP to 9mile' Construction of the access road.	Degrades Natural Habitat	2	2	4	• Less likely to happen as this site has already been occupied by human settlement with less flora and fauna significance.
		Slope Erosion	3	3	9	• Works are in line with careful planning and engineering solutions. • Regular monitoring shall be conducted.
		Surface water pollution due to increased sedimentation during excavation works.	2	3	6	• Less Likely to happen. • There are no water bodies nearby which is likely to be polluted. • 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. • Works be in line with careful planning and engineering solutions
		Disturbing the stability of Nearby House /Adjourning structures.	2	3	6	• Less likely to happen • Pay compensation for the damaged structures if required.
		Pollution of ground water from hydrocarbon leakages	2	3	6	• 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	3	9	• Using new equipment and machinery. • Regularly maintaining and servicing machinery. • Conduct air quality monitoring regularly
		Noise pollution from machineries.	2	3	6	• Using new equipment and machinery. • Regularly maintaining and servicing machinery. • Conduct Noise level checks regularly
		Solid waste/ Excavated waste management.	2	2	4	• 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.

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
		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	2	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	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 onsite with first aid training to selected workers on 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.
		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.

Table 13 13: ERA for Receptor Site 3 – 9-Mile Reservoir

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
9-mile Option 1	Construction of New Reservoir. Site clearance Construction of access road	Degrades Natural Habitat	2	2	4	• Less likely to happen as this site has already been occupied by human settlement with less flora and fauna significance.
		Slope Erosion	3	3	9	• Works are in line with careful planning and engineering solutions. • Regular monitoring shall be conducted.
		Surface water pollution due to increased sedimentation during excavation works.	2	3	6	• Less Likely to happen. • There are no water bodies nearby which is likely to be polluted. • 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. • Works be in line with careful planning and engineering solutions
		Disturbing the stability of Nearby House /Adjourning structures.	2	3	6	• Less likely to happen • Pay compensation for the damaged structures if required.
		Pollution of ground water from hydrocarbon leakages	2	3	6	• 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	3	9	• Using new equipment and machinery. • Regularly maintaining and servicing machinery. • Conduct air quality monitoring regularly
		Noise pollution from machineries.	2	3	6	• Using new equipment and machinery. • Regularly maintaining and servicing machinery. • Conduct Noise level checks regularly
		Solid waste/ Excavated waste management.	2	2	4	• 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.

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
		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	2	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	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 onsite with first aid training to selected workers on 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.
		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.

Table 1414: ERA for Receptor Site 4 – 8-Mile Reservoir

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
9-mile Option 2	Construction of New Reservoir. Construction of access road.	Degrades Natural Habitat	2	2	4	• Less likely to happen as this site has already been occupied by human settlement with less flora and fauna significance.
		Slope Erosion	3	3	9	• Works are in line with careful planning and engineering solutions. • Regular monitoring shall be conducted.
		Surface water pollution due to increased sedimentation during excavation works.	2	3	6	• Less Likely to happen. • There are no water bodies nearby which are likely to be polluted. • 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. • Works be in line with careful planning and engineering solutions
		Disturbing the stability of Nearby House /Adjourning structures.	2	3	6	• Less likely to happen • Pay compensation for the damaged structures if required.
		Pollution of ground water from hydrocarbon leakages	2	3	6	• 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	3	9	• Using new equipment and machinery. • Regularly maintaining and servicing machinery. • Conduct air quality monitoring regularly
		Noise pollution from machineries.	2	3	6	• Using new equipment and machinery. • Regularly maintaining and servicing machinery. • Conduct Noise level checks regularly
		Solid waste/ Excavated waste management.	2	2	4	• 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.

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
		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	2	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	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 kits onsite with first aid training to selected workers on 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.
		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.

Table 15 15:ERA for Receptor Site 5 – Tougoba Reservoir Rehabilitation

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
Toaguba	Upgrade of existing reservoir	Degrades Natural Habitat	2	2	4	• Less likely to happen as this site has already been occupied by human settlement with less flora and fauna significance.
		Slope Erosion	2	2	4	• Less likely to happen • Works are in line with careful planning and engineering solutions. • Regular monitoring shall be conducted.
		Surface water pollution due to increased sedimentation during excavation works.	2	2	4	• Less Likely to happen. • There are no water bodies nearby which are likely to be polluted. • 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. • Works be in line with careful planning and engineering solutions
		Disturbing the stability of Nearby House /Adjourning structures.	2	3	6	• Less likely to happen • Works are in line with careful planning and engineering solutions. • Pay compensation for the damaged structures if required.
		Pollution of ground water from hydrocarbon leakages	2	3	6	• 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	3	9	• Using new equipment and machinery. • Regularly maintaining and servicing machinery. • Conduct air quality monitoring regularly
		Noise pollution from machineries.	2	3	6	• Using new equipment and machinery. • Regularly 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.	2	2	4	• 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	2	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	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 kits 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.
		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.

Table 16: ERA for Receptor 7 – POM Water Distribution Network

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
POM water distribution network and NRW	Upgrade of water distribution network.	Degrades Natural Habitat	2	2	4	• Less likely to happen as this site has already been occupied by human settlement with less flora and fauna significance.
		Slope Erosion	2	2	4	• Less likely to happen • Works are in line with careful planning and engineering solutions. • Regular monitoring shall be conducted.
		Surface water pollution due to increased sedimentation during excavation works.	2	2	4	• Less Likely to happen. • There are no water bodies nearby which is likely to be polluted. • Regular monitoring shall be conducted.
		Slope Collapse from Excavation	2	2	4	• Gently batter the slope face to stabilize the slopes • Regular Monitoring to be conducted. • Works be in line with careful planning and engineering solutions
		Disturbing the stability of Nearby House /Adjourning structures.	2	2	4	• Less likely to happen • Works are in line with careful planning and engineering solutions. • Pay compensation for the damaged structures if required.
		Pollution of ground water from hydrocarbon leakages	2	3	6	• 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	3	9	• Using new equipment and machinery. • Regularly maintaining and servicing machinery. • Conduct air quality monitoring regularly
		Noise pollution from machineries.	2	3	6	• Using new equipment and machinery. • Regularly 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.	2	2	4	• Identify stable sites for spoils disposal. • All solid waste shall be disposed at authorized sites. • Burning of solid waste on site shall be prohibited.
		Accidental spills	3	3	9	• All fuel and oil change shall be conducted at the designated workshops. • Immediately clean up accidental spills of oil and fuel
		Protected /Endangered Species	1	3	3	• 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 for all workers. • -Provide emergency contact details for all local health clinics in the area. • -Provide first aid kits onsite with first aid training to selected workers in those worksites to apply first aid to any injuries onsite.
		Worksite threats	2	2	4	• 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.
		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.

Table 1717: ERA for Receptor Site 6 – Waigani Sanitation Ponds

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
Waigani Sanitation Ponds	Upgrade of existing reservoir	Degrades Natural Habitat	2	2	4	• Less likely to happen as this site has already been occupied by human settlement with less flora and fauna significance.
		Slope Erosion	2	2	4	• Less likely to happen • Works are in line with careful planning and engineering solutions. • Regular monitoring shall be conducted.
		Surface water pollution due to increased sedimentation during excavation works.	2	2	4	• Less Likely to happen. • There are no water bodies nearby which is likely to be polluted. • 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. • Works be in line with careful planning and engineering solutions
		Disturbing the stability of Nearby House /Adjourning structures.	2	3	6	• Less likely to happen • Works are in line with careful planning and engineering solutions. • Pay compensation for the damaged structures if required.
		Pollution of ground water from hydrocarbon leakages	2	3	6	• 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	3	9	• Using new equipment and machinery. • Regularly maintaining and servicing machinery. • Conduct air quality monitoring regularly
		Noise pollution from machineries.	2	3	6	• Using new equipment and machinery. • Regularly 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.	2	2	4	• 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	2	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	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 kits 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.
		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. INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

A. Legislative Framework for Public Consultation

165. 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

166. Stakeholder consultation and participation for the POM subprojects included meetings with local communities and relevant authorities to inform them about the project's objectives and to address questions or concerns related to water supply and sanitation improvements. To ensure that affected individuals, government entities, and private landholders are adequately informed, the Project Team is committed to conducting meaningful consultations with relevant community groups, including marginalized populations such as women, the elderly, and persons with disabilities. These consultations aim to gather insights and incorporate community perspectives into project planning and implementation. During the early stages of project preparation, the Project Team engaged with the Department of Lands and Physical Planning (DLPP), the National Capital District Commission (NCDC), other relevant stakeholders, and local communities residing near the proposed project sites.

167. As the project progresses, further consultations will be conducted in accordance with the Stakeholder Consultation Plan. These will include dissemination of information on the scope of works, detailed design, construction schedules, anticipated impacts, and proposed mitigation measures to stakeholders and communities directly or indirectly affected by the Port Moresby Water Supply Project. Continuous engagement throughout the implementation phase will promote transparency, build trust, and ensure that community feedback is actively integrated into project design and execution. Targeted consultations and interviews with affected individuals and communities will be carried out during the implementation phase. Special attention will be given to understanding and addressing the challenges faced by women, particularly in their roles as administrators of household water use and sanitation responsibilities, to ensure their needs and perspectives are reflected in project activities.

168. 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), National Broadcasting Commission (NBC), and Department of Treasury (DOT);
(ii) Local Government: National Capital District Commission (NCDC);
(iii) Non-Government Organizations (NGOs): churches and vulnerable groups (e.g., people living with disabilities); and
(iv) Other stakeholders: Informal settlements, shops and businesses in 8-Mile and 9-Mile areas, and local communities.

1. Consultation with Affected Communities

169. Between early 2024 and mid-2025, several high-level stakeholder meetings were held in POM involving representatives from the ADB team and various departments and agencies of the PNG. During this period, WPNG and the project consultants faced challenges in maintaining consistent stakeholder engagement related to the planned subprojects. To ensure alignment with land tenure requirements, WPNG prioritized engagement with DLPP to confirm cadastral survey maps and identify settlement zones along the periphery of state land, where the proposed water reticulation systems are expected to be constructed. Due to uncertainties surrounding the final project scope and avoiding raising premature expectations, the project team limited engagement with informal settlement communities located within and adjacent to state land areas at 8-Mile and 9-Mile. However, stakeholder engagement with these communities will resume during the early stages of project implementation. Community views and concerns will be carefully considered and integrated into subsequent planning and implementation phases.

170. Throughout project implementation, the contractor and the IA will ensure ongoing communication and consultation with affected communities and key stakeholders. These efforts aim to provide timely, transparent, and accurate information about project activities and foster inclusive participation. Engagement measures will include the installation of project signage, distribution of newsletters, regular informational briefings, and formal consultation meetings. The contractor will appoint a dedicated Community Liaison Officer (CLO), responsible for leading community engagement, coordinating stakeholder consultations, and managing all project-related communication initiatives.

2. Stakeholder Consultation and Engagement Plan during Project Implementation

171. WPNG and the NCDC will jointly coordinate the disclosure of project information to local communities and relevant stakeholders across POM. This process will be carried out during the construction and installation of transfer pump stations, reservoirs, treatment plants, and water reticulation pipelines, as outlined in the project design scope for the city's suburbs.

172. The WPNG PMU, in coordination with DLPP, will also engage affected stakeholders to plan and implement the land acquisition process. This includes consultations on compensation arrangements and the formal transfer of state leases to WPNG for the development of water reservoirs and treatment facilities. Additional consultations will target informal settlement areas, commercial establishments, businesses, and private landholders during the first year of project implementation. Engagement with these groups will continue throughout the project lifecycle to ensure transparent communication and responsiveness to stakeholder concerns. Furthermore, WPNG and DLPP will coordinate with WR Carpenters regarding the proposed reservoir sites. This will involve consultations with leaseholders to explore options for land purchase, subdivision, and the eventual transfer of lease ownership to WPNG to facilitate the construction of reservoir infrastructure.

Table 1818: Stakeholder Consultation Activities

Date	Reference	Participants	Brief Description	Notes & Outcomes
May 2024	Land Acquisition	Social Safeguards Specialist and DLPP	Numerous meetings with DLPP on land acquisition for Port Moresby	Formal Letter requesting DLPP assistance in the acquisition process. DLPP Secretary responded by WPNG financial constraint

Date	Reference	Participants	Brief Description	Notes & Outcomes
				led to delay in assistance being sought
April 08, 2025	Land Acquisition	Social Safeguards Specialist and DLPP	Interviewed Land Officials and Conduct searches on land earmarked for reservoirs in Port Moresby	Project Internal Land Status Report compiled and submitted to Urban Development Specialist and WPNG PMU
June 2025	Land Acquisition	WPNG, Social Safeguards Specialist, DLPP	Various meetings with DLPP, second formal request to DLPP Secretary from WPNG CEO requesting officers to assist in land acquisition work for Port Moresby (and Vanimo)	Final Field Surveys Completed in Vanimo in mid-June 2025

Table 1919: Interviews and Surveys

Type of Meeting	Date	Participants	Key Points & Findings	Follow-up Actions
Consultation	September 2024	Vendors at Mt Eriama Water Treatment Facility Entrance and Social Safeguards Specialist	Enquiries on “who” owns land next door to the treatment plant – previous candidate site for Mt Eriama Reservoir. Site owned by Behori Clan of Koiari, Central Province	Verified information to be correct
Consultation	April 2025	WPNG, Social Safeguards Specialist and WR Carpenters Consultant; Murale Nair	WR Carpenters planned to develop 8-mile proposed site for reservoir into housing estate for their staff	Data to inform infrastructure, gender-sensitive planning, and community education initiatives

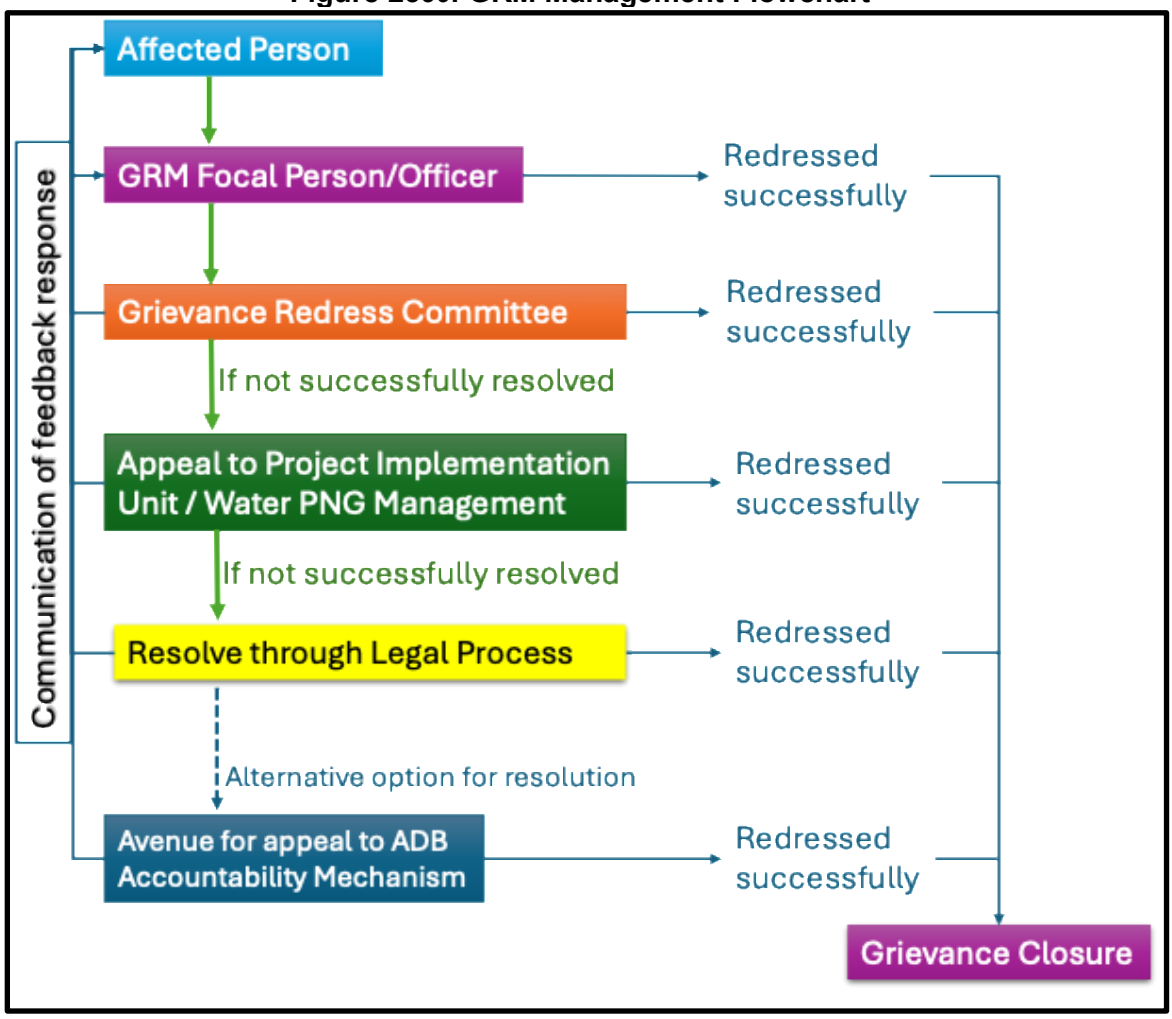
C. Information Disclosure

173. 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 (iii) corrective action plans, if any, prepared during project implementation, upon receipt by ADB. A copy of the IEE and EMPs 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. This IEE will be updated based on detailed design, and results of the geological surveys. 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.

VII. GRIEVANCE REDRESS MECHANISM

174. 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 affected person (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 Figure 23 will be followed. The process begins with an attempt to resolve the issue directly at subproject level.

Figure 23*36*: GRM Management Flowchart



A. Roles and Responsibilities

175. **GRM focal point in Port Moresby**. WPNG PMU will designate a GRM focal person for the POM subprojects. 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 APs, 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 GRC 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.

176. **Subproject grievance redress committee.** A gender inclusive GRC will be established by the Project in POM, 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 including representatives from planning, environment, community development, and lands & survey divisions. 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 Port Moresby and collaboratively identify mitigation measures.

177. **WPNG/Project Management Unit**. WPNG PMU is responsible for providing project related information and coordinate with the focal on daily basis in planning and coordination of activities in Port Moresby 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.

178. **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

179. 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.

180. **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 PMU and issue an acknowledgment to the complainant within the day of receiving the grievance.

Step 2 – The focal point assesses the grievance and determines its 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 WPNG Administration to resolve. If still unresolved, the GRC chairperson will call a meeting with the GRC members and organize a hearing session within 5-7 days for resolution process. The verdict 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.

181. **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.

182. 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).

183. **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

184. ADB's Accountability Mechanism also applies to the project. However, while the project level GRM is the responsibility of the WPNG 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

185. 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.

VIII. ENVIRONMENTAL MANAGEMENT PLAN

A. Objectives

186. 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 two EMPs serve 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 EMPs 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.

187. In line with the best international practices, the outlined EMPs will be revised based on detailed design, and subsequently, the contractors will develop the construction environmental management plans (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 EMPs provided aim 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

188. KCH will have 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 Design Supervision Consultant (DSC) will support project implementation and conduct training and capacity building for KCH and WPNG and will be responsible for implementing the IEE and EMPs. Table 20 summarizes the organizational responsibilities for the POM Subprojects.

Table 2020: 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 • 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

Project Implementation Organization	Management Roles and Responsibilities
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 the 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 consultants 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 contractors, 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 • 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 of contractor's monthly reports

Project Implementation Organization	Management Roles and Responsibilities
	• 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 and social safeguard monitoring report (SMR) 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. Specific 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 bidding 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 a 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' environmental health and safety officers (EHSO) to ensure that environmental awareness training for workers is done.
Contractor(s) / Subcontractor(s)	The principal contractor for each subproject 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

Project Implementation Organization	Management Roles and Responsibilities
	• 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

189. 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 EMPs conditions into the bid and contract documents and the evaluation and selection of the contractors. 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 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.

190. Implementation of the EMPs and mitigation measures will ensure compliance with obligations under the CSS on environmental and social safeguards. The EMPs will also ensure ADB's safeguard standards are met. To ensure mitigation measures contained in the EMPs are successfully implemented:

(i) The EMPs will be updated after detailed design and after the geological survey and hydrological studies are completed, where required;
(ii) The EMPs will be included in tender documentation;

(iii) The contractor(s) shall prepare CEMPs describing the project and site-specific measures that will be implemented to comply with the EMPs;
(iv) The contractor(s) will submit its CEMPs 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 EMPs at the project site.

D. Monitoring and Reporting

191. 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).

192. 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 CEMPs 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 CEMPs 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.

193. The EMPs, including monitoring requirements, are presented in Table 21 and Table 22, corresponding to the POM water source and treatment system optimization and the Waigani sanitation system rehabilitation, respectively. The EMPs are prepared in a matrix form and describe the potential impacts, proposed mitigation measures, roles and responsibilities. This subproject, and all project activities to be financed by ADB and government, will be subject to ADB's SPS and PNG's CSS. The EMPs are essential for ensuring that environmental considerations are integrated into the planning and execution of the water supply and sanitation subprojects. These plans outline measures to mitigate adverse environmental impacts, enhance positive effects, and monitor compliance with environmental regulations.

Table 2121: Environmental Management and Monitoring Plan Matrix: POM Water Source and Treatment System Optimization and Expansion of Storage and Distribution System

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 Part 1 of 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,	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

Project Activity		Mitigation Measures			Monitoring	
Project Activity	**Environment Impact**	**Proposed Mitigation Measures**	**Implementing Responsibility**	**Mitigation Cost**	**Frequency and Means of Monitoring**	**Monitoring Responsibility**
		noise, and dust management etc.).				
Environment and Other Permits	Compliance with CSS	• Obtain Environmental Compliance Certificate (ECC) or Environment Permit (EP) from CEPA	Contractor	Part of the contractors' bid cost	Relevant Environmental Permits (EP) secured before commencement of civil works and as required	WPNG PMU / DSC / CEPA
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 / NCDC / DLPP	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 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	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

Project Activity		Mitigation Measures			Monitoring	
Project Activity	**Environment Impact**	**Proposed Mitigation Measures**	**Implementing Responsibility**	**Mitigation Cost**	**Frequency and Means of Monitoring**	**Monitoring Responsibility**
		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 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 with 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	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**
		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.				
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.	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

Project Activity		Mitigation Measures			Monitoring	
Project Activity	**Environment Impact**	**Proposed Mitigation Measures**	**Implementing Responsibility**	**Mitigation Cost**	**Frequency and Means of Monitoring**	**Monitoring Responsibility**
		• 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;				
GRM establishment	Community complaints due to project related impacts	• 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. • Ensure that the contact details are visible on noticeboards and/or website.	Contractor	Included in project cost	• Number of both verbal and written GRM complaints registered. • Once in early project implementation and ongoing throughout project implementation with verification of the number of valid complaints registered	WPNG PMU / DSC
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	Contractor	Part of contractor's bid cost	Periodic visual inspection of sources and verification of Government permits	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**
		should be licensed and covered by required government permits.				
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 earthworks activities	WPNG PMU / DSC
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	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**
					from communities.	
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. • Surplus spoil will be used where practicable for local repair works to fill eroded	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**
		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 contamination 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	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**
		within the sub-project site footprint). • Recyclables shall be recovered and sold to recyclers. • 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	Contractor	Included in contract cost	• Records of accidental releases • Training records of	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**
		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. • 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.			personnel for hazardous materials • Visual inspection of storage area • Daily and as necessary	
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	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**
		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. • The contractor will be responsible for providing information to workers with respect of 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	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**
		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. • 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.	Contractor	Included in contract cost and as per any agreements	• Monitoring of services relocated as per agreed plans • Monitor repair of damaged and	Contractor /- WPNG PMU / DSC Utility providers GRM

Project Activity		Mitigation Measures			Monitoring	
Project Activity	**Environment Impact**	**Proposed Mitigation Measures**	**Implementing Responsibility**	**Mitigation Cost**	**Frequency and Means of Monitoring**	**Monitoring Responsibility**
		• 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 to provide prior notification to affected households and establishments			rehabilitated utilities • Notification of affected households and establishments • Verification of coordination meetings and notifications • After completion of meetings and notifications	
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. • Provide cover in storage area of construction materials, stockpiles, and spoils to prevent fine materials from being blown.	Contractor	Included in contract cost	Periodic monitoring of the implementation of relevant dust and emission measures as per the 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**
		• Prohibit the 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.				
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
Public Safety	Community health and safety risks	Implement measures for community health and safety: • Engage local communities, government agencies, and other stakeholders in planning	Contractor	Included in contract cost	• Inspection of safety control such as signages,	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**
		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 lights 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.			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	
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	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**
		equipment, fire extinguishers, etc. • 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 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
Operation of new and rehabilitated reservoirs	Increased energy consumption, increased greenhouse gas emissions, and potential seepage	• Implement energy-efficient technologies such as high-efficiency pumps, motors, and treatment systems • Integrate renewable energy sources to reduce reliance on grid electricity • Conduct regular energy audits and optimize operational efficiency	WPNG operations department	WPNG operational cost	• Periodic review of energy consumption • Performance tracking of energy-saving technologies	WPNG
Water treatment	Chemical leak or spill from the use of chlorine and aluminum sulfate	• Install sensors or alarms to detect leaks • Provide secondary containment and spill trays around chemical storage areas • Train operators in safe chemical handling and implement emergency response procedures for leaks or spills • Conduct routine inspections of storage tanks, pipelines and dosing systems	WPNG operations department	WPNG operational cost	• Periodic inspection and maintenance of chemical storage and dosing facilities	WPNG

Project Activity		Mitigation Measures			Monitoring	
Project Activity	**Environment Impact**	**Proposed Mitigation Measures**	**Implementing Responsibility**	**Mitigation Cost**	**Frequency and Means of Monitoring**	**Monitoring Responsibility**
Operation of distribution network augmentation	Pipeline leakage, pressure surges, and water loss	• Install pressure regulating valves • Monitor flow • Repair leaks	WPNG operations department	WPNG operational cost	• Regular pipe monitoring	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

Table 2222: Environmental Management and Monitoring Plan Matrix: Waigani Sanitation System Rehabilitation

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 of 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 commencement of civil works and as required	WPNG PMU / DSC / CEPA
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 / NCDC / DLPP	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	• 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.	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**
	catchment area, ground water recharge rates and saline intrusion into water lens.	• 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 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 with 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 related impacts	• 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. • Ensure that the contact details are visible on noticeboards and/or website.	Contractor	Included in project cost	• Number of both verbal and written GRM complaints registered. • Once in early project implementation and ongoing throughout project implementation with verification of the number of valid complaints registered	WPNG PMU / DSC
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	Contractor	Part of contractor's bid cost	Periodic visual inspection of sources and verification of Government permits	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**
		be licensed and covered by required government permits.				
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 earthworks activities	WPNG PMU / DSC
Construction Phase						
Rehabilitation works	Sludge handling risks	The contractor is required to prepare a sludge management plan to avoid contamination of water in the surrounding environment. The sludge management plan should include the following: • Analyze the sludge to determine it chemical and biological composition ensuring appropriate handling and disposal methods • Use mechanical or natural methods (e.g., drying beds, centrifuge) to reduce moisture content and stabilize before transport • Transport of sludge to approved disposal areas that are engineered to prevent leachate and groundwater contamination • Use sealed and leak-proof containers and vehicles to prevent spills during transport • Follow national standard for sludge disposal, including guidelines from PNG's CEPA	Contractor	Included in contract cost	• Verification of sludge disposal methodology • Immediate verification of complaints received from communities, if any	WPNG PMU / DSC
Rehabilitation works	Odor emission during sludge removal	The following odor control measures should be implemented: • Use covers or enclosures for sludge handling areas and treatment units to contain odor	Contractor	Included in contract cost	• Verification of sludge disposal methodology • Immediate verification of complaints	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**
		• Apply aeration to reduce anaerobic conditions and use odor-neutralizing agents • Schedule odor-intensive activities during times of low public exposures (e.g., early morning or late evening) • Inform nearby residents of planned activities and provide a feedback mechanism for odor complaints			received from communities, if any	
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	The contractor will be required to prepare an erosion and sediment control plan as part of their CEMP. 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	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. • 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.	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**
		• 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 contamination 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. • 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.	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
Use of Oil and hazardous materials and	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.	Contractor	Included in contract cost	• Records of accidental releases	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**
hazardous waste disposal		• 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. • 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.			• Training records of personnel for hazardous materials • Visual inspection of storage area • Daily and as necessary	
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. • 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.	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**
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. • Provision of safe access across the works site to people whose villages and access are temporarily affected.	Contractor	Included in contract cost	Assess the implementation of TMP provisions on a weekly or as required	WPNG PMU / DSC
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.	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

Project Activity		Mitigation Measures			Monitoring	
Project Activity	**Environment Impact**	**Proposed Mitigation Measures**	**Implementing Responsibility**	**Mitigation Cost**	**Frequency and Means of Monitoring**	**Monitoring Responsibility**
		• Village-based community awareness to provide prior notification to affected households and establishments				
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. • Provide cover in storage area of construction materials, stockpiles, and spoils to prevent fine materials from being blown. • Prohibit the 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.	Contractor	Included in contract cost	Periodic monitoring of the implementation of relevant dust and emission measures as per the CEMP	WPNG PMU / DSC
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
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.	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	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 security personnel in hazardous areas to restrict public access. • Where nighttime works is required, operate construction night lights 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.			policy and health and safety records • Daily visual site inspection	
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. • 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	Contractor	Included in contract price	• Inspect first aid station, PPE, emergency response equipment • Verification of health and safety plan sanitation facilities • Review of health and safety records (near miss, first aide, lost time accident) • Daily visual site inspection	WPNG PMU / DSC
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	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**
					• Once when all site work is complete	
Operational Phase						
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
Waigani ponds operation	Effluent discharge, odor, and flood risk	The following strategies to maintain levees should be implemented to prevent flooding, overflow, and structural failure of pods during heavy rainfall or high inflow events: • Strengthen levees using compacted earth, geotextiles, or riprap • Remove deep-rooted plants that can compromise levee integrity • Ensure proper drainage systems are in place to divert excess rainwater and reduce pressure on levees • Develop contingency plans for levee breeches	WPNG sanitation operations department	WPNG operational cost	• Verification of management procedures, SOPs, and records • Routine maintenance records. • Visual inspections	WPNG
Waigani ponds operation	Effluent discharge	To ensure that treated wastewater discharged does not harm the public or environment, the following should be implemented: • Conduct regular laboratory analysis of effluent to comply with national standards on effluent / wastewater discharge standards • Adjust treatment processes or flow routing based on monitoring results to maintain compliance • Where feasible, install sensors and data loggers to continuously track water quality indicators	WPNG sanitation operations department	WPNG operational cost	• Maintain records of effluent quality and share findings with regulatory bodies and stakeholders	WPNG

IX. MONITORING AND REPORTING

194. 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).

195. **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.

196. **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.

197. **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.

X. CONCLUSIONS

198. The proposed POM Subprojects are expected to significantly enhance the resilience of the city's water supply and sanitation systems. The rehabilitation and expansion of the water supply infrastructure will involve a combination of physical and non-physical investments designed to meet projected demand through 2040. These infrastructure interventions will strengthen the capacity of WPNG and serve POM as the primary water supply scheme. Importantly, the increased capacity will enable the extension of water services to informal settlements that are currently unserved by WPNG. In parallel, the proposed sanitation improvements aim to enhance the quality of effluent discharge into the Tereko Lagoon, thereby supporting broader wastewater quality improvements across the Waigani catchment.

199. The IEE concludes that the proposed works are not expected to result in significant adverse environmental impacts, provided that appropriate mitigation measures are implemented. These measures are detailed in the two EMPs, which will serve as the basis for the contractor's CEMPs during the construction phase, once detailed designs are finalized. The CEMPs will include provisions for erosion and sediment control, waste management, and traffic management. For the Waigani sanitation system rehabilitation, specific attention must be given to sludge handling and potential odor emissions; therefore, a dedicated sludge management plan will be incorporated into the CEMP. Oversight of EMP implementation will be carried out by the PMU and the DSC safeguard specialists, reporting to WPNG on behalf of the Government. Regular reporting to ADB will be maintained.

200. The environmental assessment and associated EMPs are considered sufficient to meet the requirements of ADB's SPS and PNG's CSS. The proposed POM Subproject's environmental categorization of "Category B" is confirmed and no further environmental assessment is warranted. The IEE will be publicly disclosed in project areas and made available through the ADB and WPNG websites. Stakeholder engagement will continue throughout project implementation to ensure inclusive participation and transparency and the project's GRM contains measures for resolving any complaints or issues raised throughout subproject implementation. Where required, the IEE and the EMPs will be updated following the completion of detailed design.

COMMUNITY CONSULTATIONS

Table 2323: 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 2424: 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 2525: 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 (FGD)	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 (KII)	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

GRIEVANCE INTAKE/REPORTING FORM

Project: PNG Urban Water Supply and Sanitation Security and Resilience Improvement Project (UWSSSRIP) – Port Moresby Subproject

The UWSSSRIP Subproject in Port Moresby, 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 comments/ complaint	
Position of staff:	
Type of grievance:	
Remarks	
Signature of staff	

Update on the case:

Date:	Update

OUTLINE OF SAFEGUARD MONITORING REPORT (SMR)

Heading/Section	Contents
Abbreviations	List of abbreviations used in the SMR
Executive Summary	Concise overview of the entire document
1. Introduction	• 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
2. Project Status	• Project progress and status • Safeguards implementation arrangements • Status of approvals and clearances etc. under the country system (summarize in table)
3. Environmental Safeguard Monitoring	• 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)
4. Social Safeguard Monitoring	• 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

<table>
<tr><th>Heading/Section</th><th>Contents</th></tr>
<tr><td></td><td>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>
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</table>

• Whether works and measures comply with the approved EMP/CEMP

• It should follow the sequence of items identified in EMP/CEMP and 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>
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<u>SOCIAL</u>

• Status of actions and measures to ensure compliance with the approved RP.</td></tr>
</table>

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<tr><th>Heading/Section</th><th>Contents</th></tr>
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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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It should 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>
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</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>
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Heading/Section	Contents
8. Summary and Conclusions	• 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
9. Recommendations for Implementation and 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